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Workshop To Identify Training Requirements Designed to Reduce Young Driver Risk Taking and Improve Decision Making Skills

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16. Abstract

On April 27 and 28, 1993, the National Highway Traffic Safety Administration (NHTSA), U.S. Department of Transportation (DOT), assembled a panel of 11 national and international experts in traffic safety at the Belmont Conference Center, Elkridge, Md. The group was convened to identify research and development requirements for training designed to reduce young driver risk taking and improve decision making skills. The workshop was chaired by Michael Smith, Office of Program Development and Evaluation, NHTSA.

This report summarizes the discussions that took place during the workshop. The discussions of the group covered several major areas: issues and definitions involved in analyzing young driver risk taking, training as a means of reducing risk taking, ways to restructure current driver training efforts, and the research and development requirements needed to improve driver training.

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Executive Summary

On April 27 and 28, 1993, the National Highway Traffic Safety Administration (NHTSA), U.S. Department of Transportation (DOT), assembled a panel of 11 national and international experts in traffic safety at the Belmont Conference Center, Elkridge, Md. The group was convened to identify research and development requirements for training designed to reduce young driver risk taking and improve decision making skills. The workshop was chaired by Michael Smith, Office of Program Development and Evaluation, NHTSA.

This report summarizes the discussions that took place during the workshop. The discussions of the group covered several major areas: issues and definitions involved in analyzing young driver risk taking, training as a means of reducing risk taking, ways to restructure current driver training efforts, and the research and development requirements needed to improve driver training.

One of the major themes of the workshop was the need for better understanding of the driving process: the skills involved, when they are acquired, and how they can be modified. Participants agreed that improved driver training will occur when better understanding of the driving process is coupled with improved knowledge of how drivers interact with the driving environment. Better understanding of human development processes, social forces, and the psychology of learning will also improve driver training efforts. Group members strongly endorsed suggestions to lengthen the driver education process and to supplement classroom instruction with extensive on-road practice. Adoption of provisional licensing structures and selective imposition of curfews were also recommended as ways to improve driver training and reduce risk taking.

Workshop participants identified a number of specific recommendations for improved research on and training of young drivers; this report includes a list of those recommendations. Other recommendations were not explicitly stated, but can be deduced from the discussions that took place during the workshop.

Appendixes to the report include Dr. James McKnight's "Youthful Driver at Risk," a background issue paper commissioned for the workshop, the agenda, and a list of participants.

Introduction

On April 27 and 28, 1993, the National Highway Traffic Safety Administration (NHTSA), U.S. Department of Transportation (DOT), assembled a panel of 11 national and international experts in traffic safety at the Belmont Conference Center, Elkridge, Md. The group was convened to identify research and development requirements for training designed to reduce young driver risk taking and improve decision making skills. Appendices A and B contain the agenda and a list of participants, respectively. Appendix C contains "Youthful Driver at Risk," a background issue paper, which was commissioned for the workshop.

The workshop was chaired by Michael Smith, Office of Program Development and Evaluation, NHTSA. Participants included Alan Block, NHTSA; John L. Harvey, State of Washington; Dr. Francis Kenel, American Automobile Association (retired); Dr. Neil Lerner, COMSIS Corporation; Dan Mayhew, Traffic Injury Research Foundation of Canada; Dr. James A. McKnight, National Public Service Research Institute; Dr. Richard Pain, Transportation Research Board; Dr. John W. Palmer, St. Cloud State University; Beth Poris, NHTSA (morning of April 27 only); and Dr. David Preusser, Preusser Research Group.

This report presents an overview of the significant points made by workshop participants during their discussions. The opinions expressed by the participants are their own and do not represent the views of the National Highway Traffic Safety Administration. No attempt has been made to verify the accuracy of the information provided by the participants.

Issues and Topics

The workshop began with several presentations that outlined current issues and research trends among those who study young driver risk taking behavior.

Alberta Motor Association Symposium

Mr. Harvey and Dr. Palmer summarized the proceedings of a recent Alberta Motor Association symposium that examined various research from educational, sociological, and technological perspectives. Some 25 researchers from a number of different nations addressed issues relative to young driver risk taking behavior. Speakers advocated skills training for improved risk management; suggested that driving behavior occurs in a social context and that influencing the social phenomena associated with driving can affect driving practices; suggested using cultural and age-specific approaches to communicate with young drivers; appealed to parents and policymakers to regulate driving behavior among young drivers (including wider use of curfews and graduated licensing); urged parents to become more involved in driver training; advocated a higher degree of professionalism among driving instructors; advocated creating learning environments that lead students along a desired path; and suggested a revamped driver training approach tied to the very early stages of human development and learning (ages 3 to 5).

In discussing the presentations in Alberta, Dr. Palmer noted that lack of driving experience means a lack of knowledge about what is acceptable risk taking; the challenge for those who train drivers is to increase the knowledge base about acceptable risk. He also observed that young drivers exhibit egocentric behavior; being in control appeals to them. This fact presents educators with a good opportunity to influence how young people think about driving. Finally, as a side, he pointed out that the advanced multimedia technology currently being promoted at conferences similar to the Alberta symposium is only as good as the instructional material on which it is based.

American Automobile Association Meeting

Dr. Kenel and Dr. Palmer spoke briefly about a recent meeting of the American Automobile Association (AAA) that brought together representatives of AAA member clubs, Federal agencies, professional associations, and other groups interested in driver education. The purpose of the meeting (the second in an ongoing series) was to review current issues and to identify perceived needs in driver education. Dr. Kenel stated his belief that driver education is a lifelong process that must proceed in steps. The task for educators and policymakers is to determine what those steps are, what kinds of information and experiences are necessary during each step, and whether risk management can be taught.

Meeting participants also discussed the implications of Senate Bill 738 (also known as the "Danforth bill"), which creates incentives for states to address issues affecting young drivers. Most of those at the meeting plan to support the Danforth bill, which is still evolving in Congress.

Federal Highway Administration Driver Perception of Risk Research

Dr. Neil Lerner described a study currently being conducted for the Federal Highway Administration (FHWA). The project, "Understanding Driver Performance Variability and Perception of Risk," is a methodological examination of driver performance and risk perception. The project's research emphasis is on highways, rather than on vehicles or licensing/training. Researchers are looking for risk perception, rather than risk taking. While young drivers will be part of the study, they are not its sole focus. Among the driver performance variability factors being considered during the project are basic perception and motor abilities (vision, audition, attention/cognition/higher order perception, body senses, and motor skills). Other driver characteristics being examined include transient states (e.g., drug effects), experience, personality/social, anthropometrics, health status/pathologies, and demographics. The project outcome will be a final report and a 5-year program for future research.

Dr. Lerner also described "Risk Perception in Highway Driving," a report produced for FHWA in 1988 but never published by the Agency. That report examined driver risk taking. Participants registered their perceptions of risk on a handheld meter as they were driven along selected sections of road. Among the research findings was that during the day older drivers consistently rated risks higher than did younger drivers; at night, when the visual advantages of youth become more constricted, the risk ratings given by the two groups tended to converge.

Group members noted that perceived risk is very different from actual, or objective, risk. Dr. Kenel argued that the challenge for road designers—and driving instructors—is to anticipate actual driver behavior and plan accordingly. Dr. Pain suggested that there may be levels of risk at which the driver is unable to compensate and that road design is an integral component of driver safety. Dr. Palmer cautioned that when an attempt is made to change the driving environment, careful attention must be given to cultural, gender, and experiential variables. Such variables can influence how individuals view the driving environment.

Background Issue Paper

Dr. James McKnight presented a background paper entitled "Youthful Driver at Risk" (for the full text of this paper, see Appendix C). The paper began with a review of the 1981 Hodgdon, Bragg, and Finn literature review of young driver risk taking. The report covered driving practices, exposure, experience, vehicle characteristics, personality characteristics, and risk taking hypotheses. In the report, Hodgdon et al. also define risk; establish several risk models; and present measurement techniques for perceived risk, risk utility, and risk choice.

Since the 1981 review, researchers have made a number of strides in understanding young driver risk taking. Dr. McKnight's paper reviews recent developments in the field and relates them to the methodological framework devised by Hodgdon, Bragg, and Finn. For example, recent research that addresses variables such as speed; passing, merging, and lane changing; headways; safety belt usage; distractions; and driving under the influence of alcohol or drugs has shown that accidents are related to certain unsafe driving practices by

youthful drivers. Additional research in the areas of exposure, experience, vehicle characteristics, personality characteristics, risk perception, risk utility, and risk choice also has helped researchers paint a clearer picture of youthful driver risk taking.

In discussing Dr. McKnight's paper, group members addressed several issues related to the research methodology currently being used to study young driver risk taking. Dr. McKnight suggested that the concept of risk utility as defined by Hodgdon, Bragg, and Finn should be amended to include the notion of getting from one place to another, a suggestion that was endorsed by other members of the group. In the area of risk assessment, Dr. Kenel pointed out that research based on surveys (which involve self-assessment by individuals who may not adequately perceive risk) will offer strikingly different results from research based on assessments (which are made by trained observers).

A major issue raised in the discussion was the use of curfews, other graduated licensing procedures, and other methods to control the behavior of young drivers. Group members offered differing perspectives on the use of restrictions and controls. Dr. Palmer urged that any proposed constraints be consistent and easily understood. He suggested that any use of limitations should enable positive decision making by the driver (as in graduated licensing), not punish everyone. Mr. Mayhew argued that in the absence of knowing which young people are likely to crash, countermeasures such as graduated licensing need to be universally applied to all young drivers to reduce the incidence of crashes. Thus, the benefits of restricting the entire group of young drivers outweigh the costs of such an approach to individuals. Group members discussed the various types of curfews currently in force in Maryland, New Jersey, and New York, as well as attempts to introduce curfews in other jurisdictions; it was noted that for elected officials, the political costs of supporting curfews could be high.

Group members agreed that the best way to introduce new drivers to the driving task is gradually and over a long period of time. Dr. Preusser recommended the development of a model graduated licensing program and integration of that program with a driver education training plan. There was general feeling in the group that a "carrot" approach toward

graduated licensing and curfews would be more effective than a "stick" approach. It was noted that the primary enforcement mechanism for such an approach might well be parents; there was some debate among group members about the desire of parents, as well as local police forces, to play an enforcement role.

Definitions

In preparation for detailed discussions, group members reviewed a set of working definitions for risk-related terms:

- **Risk.** Potential of a negative outcome resulting from an action or inaction.
- **Risk Perception.** An individual's recognition of the potential of a negative outcome resulting from an action or inaction.
- **Risk Taking.** An individual's acceptance of potential negative outcome and initiation of action or inaction.
- **Objective Risk.** Specification of actual risk.
- **Subjective Risk.** Specification of individual's perceived risk.

During the discussion of definitions, several participants stressed the need to consider that risk has both positive and negative aspects (for example, the choice of a risky behavior to accomplish a desired outcome). Mr. Smith commented that "risk" is usually defined by society, but the perception of risk is an individual one. He pointed out that risk taking is a natural component of human development. There was some sentiment among group members that objective risk should be used to mean measurable risk, with the assumption that quantification of risk would be made by the safety community. No consensus was reached on a set of final definitions.

Group members did decide to define a "young driver" in terms of youthful behavior, rather than in terms of a specific age range.

Can Training Reduce Risk Taking?

Group members discussed a number of questions related to the impact of training on risk taking behavior. Improved risk perception, improved decision making, and improved behavioral skills were among the areas addressed by group members.

Improve Risk Perception?

Dr. Preusser began the discussion of improved risk perception by pointing out that people who perceive risk often overestimate that risk. From the perspective of the safety community, this is probably a beneficial situation; improving risk perception in this regard may not be a good idea. Dr. Palmer suggested as a corollary that the safety community be very careful in making choices about when to emphasize and when to de-emphasize risk during the training process.

Dr. Pain pointed out that the safety community needs to do more work to identify scenarios in which drivers do not perceive risk and to develop an effective method of training responses to those scenarios. The important issue is for the driver to be engaged at a conscious level. Everyday driving situations, such as wet pavement conditions, stopping the vehicle, and making lateral movements, are rarely perceived as risky. Experience driving in hazardous conditions may eventually reduce risk taking, but the costs of acquiring such experience may be high, even fatal. Group members discussed the general failure of driving simulators to help drivers perceive and respond to risk, particularly for unexpected driving events. There was some concern that simulators and other "benign" teaching methods (e.g., experience with lawn tractors) may actually work to desensitize young drivers to real risk by making them overconfident about their abilities.

The discussion then turned specifically to driver training. Mr. Harvey commented that there is no common core of information about driving that can be used to teach concepts like acceptable following distances and safe interaction with other vehicles. Furthermore, risk perception is an individual skill that is difficult to address in group training situations.

Seemingly simple information that can help responsible drivers more accurately assess risk (e.g., the precise interaction between blood alcohol content and driver impairment, or the fact that high speed is not always unsafe) can encourage irresponsible drivers to take even greater risks. Even technological developments in the safety field, such as antilock brakes, can give young drivers a false sense of security in their interactions with other drivers.

Improve Decision Making?

For purposes of discussion, the group decided that driver decision making includes both conscious deliberation and habitual motor response (steering, braking, swerving). In the case of habitual motor response, those tasks are taught first in the driver training process; thus, decision making skills involving motor response are the first to become automatic. "Performance shaping factors," such as driver emotion, responses to surrounding drivers, and interaction with passengers, also influence driver decision making.

Dr. Pain commented that young drivers may have already formed their attitudes and decision making skills when they reach a driver training course; thus, driver education should be a lifelong process that begins early in the developmental cycle. Dr. Lerner suggested that researchers examine the factors (including driver maturation) that cause risk taking behaviors to decline after a certain amount of driving experience and modify training programs accordingly.

Group members agreed that the basic motor skills involved in driver decision making are relatively easy to teach. The safety community is far less knowledgeable about the development and maturation process in young people and equally uncertain about how the process of driving becomes habitual. Nor is there a good understanding of how people respond to the actual geometrics of the road environment. It is clear that few drivers understand the physics of the relationship of the vehicle with the road; the whys and hows of the ways experienced drivers use visual and other clues to identify risks also are less clear to educators.

Group members agreed that current driver training efforts are inadequate in terms of form, content, and ultimate goals. Dr. Palmer suggested that educators examine success stories in the teaching of young people to use complicated, visually oriented equipment and learn from those examples. The U.S. military has had success with this type of training; however, military training conditions differ radically from those in which driver education is or could be conducted.

Assuming that risk taking is an unavoidable component of youthful behavior, group members stressed the need for extending the period of driver training and practice before a license is granted. They discussed a hypothetical model for an integrated system of training and licensure. The model includes spreading driver training over a longer period of time (up to 2 years, ending as late as age 18), with monthly assessments and supervised driving practice on a long-term learner's permit. Plateaus of accomplishment could be built into the system that would allow young drivers to "graduate" to unsupervised driving during the day and then at night. This kind of model incorporates multiple decision points, allowing intervention at each stage of the process. Group members criticized much of the current novice driver education system, as many of these programs only enable students to pass the license test and do not provide a sound basis of safe driving behaviors. Dr. Palmer urged that education and training be made a prerequisite for moving on to the next level of a graduated licensing system, not a means to accelerate the process.

Improve Behavioral Skills?

For purposes of discussion, group members defined "behavioral skills" as vehicle handling skills (swerving, braking, etc.) that would aid in collision avoidance.

Group members reviewed a number of studies of driver behavior (Peggy Jones, police training data, Swedish skid school). There is some evidence that teaching young drivers, especially young males, accident avoidance skills might encourage them to seek out dangerous conditions to test those skills. Evidence derived during the training of young police officers supports the theory that improvement in driving skill levels is a long-term process, rather than an immediate outcome of skills training. Still other studies have

examined controlled failure as a teaching method. Unfortunately, many of these studies have been flawed by factors ranging from poor design to inadequate numbers of participants to variations in assessment procedures. Mr. Mayhew suggested that U.S. researchers build upon research currently under way in the United Kingdom that links accident involvement to methods of driver learning and licensing for 30,000 participants. Several group members suggested that researchers revisit the Essex accident-avoidance skill training study (which addressed vehicle handling and decision making as part of driver mental rehearsal processes), including looking at whether any of this training could be taught in a classroom. Dr. Palmer commented that simulated environments, whether electronic or ostensibly "real world," are only one medium in which driver skill can be evaluated; another environment is that which a student enters after driver training. Both types of environments should be investigated by researchers and educators.

Group members offered anecdotal evidence about the importance of teaching accident avoidance skills other than braking; they stressed the need to provide repetitive practice, both on- and off-road, in real world driving conditions. The problem for educators is to provide feedback and reinforce correct behavior but not encourage overconfidence. Mr. Mayhew pointed out that the requirements of multitasking have been researched relatively little, despite the fact that driving is made up of multiple tasks performed simultaneously; driver training methods must include strategies for training a range of skills.

Group members expressed concern that funding is inadequate to support the kinds of in-depth research required to improve driver education programs. Nor is it clear how best to distribute the limited resources available for driver training.

Mr. Mayhew observed that crash data could be one source that should be used to indicate the hierarchy of driving skills that need to be taught to young drivers. More research should be directed at identifying the relative contribution of experience-related factors to collisions of novice drivers. Those factors that are found to be the most critical should be given the greatest emphasis in training programs. Some areas that require additional research include

basic differences between younger and older drivers, including visual search and scan abilities, and other factors in hazard detection.

Is Training a Reasonable Approach to Reducing Risk Taking?

There was some debate about whether improved driver training in physics, vehicle operation skills, and crash avoidance really addresses the problem of young driver risk taking.
Dr. Preusser and Dr. Pain commented that the main difference between young drivers and more mature drivers lies not in skills such as collision avoidance, but in the decision making ability and situational awareness that would help them avoid collision situations.
Mr. Mayhew remarked that despite the unchanging developmental factors that contribute to young driver risk taking, training can have a positive effect on increasing young driver experience (and thus reducing risk caused by inexperience). He reiterated the importance of tying driver education training to graduated licensing approaches.

Mr. Harvey suggested developing a feedback system that would enable young drivers to categorize and assess variables such as line of sight, path of travel, lane position, and speed control while driving (Dr. Palmer called these "vigilance skills"). Building on Mr. Harvey's comments, Dr. Palmer suggested addressing the learner at several levels by determining: (1) what the learner is most interested in learning; (2) areas of criticality for young drivers according to collision data (inattention, inappropriate speed, inability to maintain control of the vehicle prior to a crash, etc.); and (3) if there is a process by which these behaviors are transferred to a host of students.

Several participants commented that the critical factor is raising driver consciousness of the driving task so that driver decision making occurs as a conditioned response, not as a panic reaction to impending crisis. Dr. Lerner suggested the adaptation of divided attention procedures used in research to train young drivers to attend to multiple tasks. Dr. Palmer commented that young drivers soon learn that they do not have to be at high alert at all times while driving, thus reducing the chance they will habitually respond to an emergency.

Group members commented that the current sources of data about youthful risk taking are limited. A question was raised about the crash study in Virginia. It was felt that the data collection activities in Charlottesville, Va., do not focus on risk taking, but on crash outcomes. Police accident reports, driver statements, coroner information, and other data are being collected, but all are somewhat subjective and not much help in studying risk taking. Accident-based data do not allow investigation of experience versus inexperience in young drivers because accident forms lack information on the level or the amount of driving experience. In addition, accident data do not tell researchers anything about inexperienced drivers who are not involved in crashes. Collecting real time crash data broad enough to be significant is time consuming and expensive. Nevertheless, accident data and other existing data sets provide researchers with a starting point. Recent developments in video technology, for example, may make certain types of data collection easier.

Dr. Lerner reminded group members that sex differences should also be examined in existing and future data sets and training approaches. Mr. Mayhew urged that young drivers not be treated as a homogenous group during the development of more realistic training materials; some degree of tailoring should be included in any training plan.

Dr. Palmer commented that driver education has traditionally been approached as an intellectual task, which is not the way that the general public thinks of driving. Dr. Pain commented that training should not stand alone; real change in young driver risk taking needs to be approached from a broad systems perspective, as risk itself is multidimensional.

Group members debated the effectiveness of the antismoking campaign undertaken in the 1960s among young children; there was some sentiment that saying "don't" to young smokers was not effective (and by extension would not be effective with young drivers). While some group members suggested that a campaign to inculcate good decision making skills in children might be beneficial in reducing young driver risk taking, other group members pointed out that resources, not to mention experience with child development, are scarce in the traffic safety community. Dr. Preusser suggested that driver education piggyback onto ongoing self-worth programs designed to discourage drug use among

schoolchildren. Group members agreed that, while general information and education about driving are important at an early age, the major focus of driver training should be nearer to the age at which young people attain their licenses.

How Much Training Is Needed? When? Where?

The general consensus was the more training that can be provided, the better. Operationally, this translates into the high school years, covering the 2-year period from ages 16 to 18 (it was considered impractical to extend training past age 18, which is the threshold of adulthood in many jurisdictions). Training would also be provided for other age groups when needed and extended downward in those jurisdictions that provide learner's permits at age 15. The general preference among group members seemed to be a high school setting for training. Mr. Harvey suggested that training should be relative to performance, rather than provided on a time basis; Dr. Palmer pointed out that one of the problems of the current system of training is that it is crudely based on performance. The key is to base the training on the most appropriate performances.

Who Should Pay for Training?

Dr. Palmer pointed out that people clearly undervalue the cost of safety training. It is imperative, therefore, to retain public and private investment in training. Mr. Mayhew suggested that upgrading testing standards will encourage greater investment in the driver training system (which may be a difficult political issue in many jurisdictions). Mr. Smith suggested that increased costs be charged only to those who successfully navigate the system of licensure. He also suggested letting the outside system determine the costs associated with improved training efforts. Dr. Palmer recommended that the group concentrate on how best to use the revenues that are already generated, rather than on changing the way the system is financed.

Dr. Palmer remarked that the group was moving toward a clinician's model that involves meetings with the clinician, laboratory settings (simulation), and support group settings that spread the learning activity over a longer period of time. Schools do not normally operate in that fashion. Such a model will have to be tested in the marketplace; it is important that a

model not be too frightening for students. Mr. Mayhew pointed out that if the model is based on sound concepts demonstrated by crash data and proven crash reduction, resource constraints may become less onerous as agencies might be more willing to provide the necessary resources to support the program. It may also be possible to generate savings through reduced insurance costs to participants in such a model, particularly by building in tiers, such as daylight driving. Mr. Smith remarked that approximately one-third of the vehicles on the road are uninsured; while insurance savings may be attractive to individuals who hold insurance, others simply opt out of the system.

Group members discussed the difficulties in redirecting licensing fees to pay for training and the fact that it is difficult in most states to raise licensing fees even slightly.

What Are the Research and Development Needs for Such a Program?

Dr. Pain suggested finding out where the world of simulation is and how it might apply to driver training, particularly in the area of virtual reality. Mr. Smith warned that young people often turn simulation into gaming. Dr. Palmer remarked that gaming is not an inappropriate teaching tool as long as there is an interaction with the results of the game. In terms of utility, gaming may be the only way to bring certain safety concepts into a classroom setting. Mr. Mayhew suggested that simulation technology be used to develop realistic simulations that young drivers would complete before entering a car, thus shortening expensive in-car training. Dr. Palmer commented that there may be "low-tech" driving tasks that can be created that would not be as expensive or complex as virtual reality. Television and video technology may also have applications in this context. The optimal driver training model may include a combination of high- and low-technology simulation.

Dr. Lerner added that the first task confronting those who would like to see more use of simulators is to determine exactly what part of driver education is best suited to simulation. Dr. Kenel noted that "low-tech" methods that teach response to lateral position might have a good success rate. Several group members remarked on the high costs of "high-tech" simulation and the incentives for manufacturers to sell the most sophisticated models.

Dr. Pain asked whether the influence of television does not lead young people to believe that failure is not really failure (e.g., car crashes have minimal negative consequences) and whether that fact might affect young drivers' perceptions of driving.

Dr. Pain also suggested development of diagnostic testing for different stages of a training/graduate licensing package. He asked whether training packages should be identical for each student, or whether students should receive different training based on individual skill. The general consensus of the group seemed to be that such a test would be standardized, but that training could be individualized to mesh with a given student's abilities. Mr. Mayhew commented that if motor skills are not the main factor in crashes, the current concept of skills-based diagnostic tests and training may be addressing the wrong goals.

Group members briefly discussed the political issues surrounding the adoption of a new training model, including the fact that a number of states currently waive minimum age requirements for licensing upon completion of a driver education course. Participants expressed some hope that the Danforth bill currently being discussed in Congress may tighten licensing requirements across the states.

Dr. Lerner pointed out that researchers still do not fully understand how people perceive and misperceive risk. Building on that point, Dr. Preusser recommended that researchers undertake a synthesis of all the research completed over the past few years to determine which elements of a crash are caused by learned behavior (as opposed to elements caused by maturation, changing values, etc.). He urged that the findings be run through risk homeostasis analysis, keeping the focus on safety rather than mobility or utility concerns. (See Appendix C for additional information on risk homeostasis.)

Group members debated the ethics of assuming that there is an acceptable level of loss to society that is traded for increased mobility. They returned to the question of high-performance driver skills training. While some participants felt strongly that high-performance driving skills would increase young driver risk taking, others felt that such skills

would protect young drivers from collisions. Mr. Mayhew noted that Canadian researchers are currently reviewing the literature of the past several decades to determine how experienced drivers differ from inexperienced drivers from a collision perspective. The Canadian effort is not attempting to discover how those differences are learned.
Dr. Preusser suggested that, after determining what those differences are, the findings should be run through the risk homeostasis model. After that, educators can decide which elements among the list they want to affect.

Dr. McKnight pointed out that some people are determined to emphasize utility over safety. The challenge for educators is to teach those parts of driving that increase utility (such as early hazard recognition) without teaching elements that adversely affect driver safety.
Dr. Palmer commented that drivers often fail to approach driving actions and decisions rationally. Furthermore, young drivers receive all kinds of conflicting messages about vehicle capabilities (from advertising and movies) and the safety of road conditions.
Mr. Mayhew added that given the same set of circumstances, a young driver might not make the same decisions about his or her vehicle's capabilities as would an older, more experienced driver.

Participants discussed evidence that some young drivers do not perceive accidents as costly or dangerous. Dr. Preusser advised that if the group adopts a risk utility model, there is a need to research the perceptual, downside costs of crashes for this age group and raise perceptions of those costs. Dr. Palmer recommended that educators develop a broad vision of what it means to drive and deliver coordinated messages about driving at all educational levels. Group members recognized that educators are largely unable to affect the maturation process or the lifestyle decisions of young drivers; nevertheless, it is important for educators to determine how these processes work and adapt training to the realities of young drivers.
Dr. Lerner suggested that the traffic safety community seek collaborators (and funding) among the National Institutes of Health and other Federal agencies for research into these areas. Some participants expressed concern that using a medical model (e.g., dealing with symptoms) may not be the best model for preventing the crashes of young drivers.

Mr. Smith noted the importance of developing and assessing support structures and quality control for any new training model.

Returning to the issue of a new training and licensing model, group members discussed a recent trend toward license suspension rather than revocation as a means of maintaining some control over violators. Mr. Smith stressed the need for a reasonable, progressive system of punishment as part of any new licensing and training system.

Research Suggestions

Workshop participants developed a number of specific and related suggestions and recommendations for future research during their two days of discussions. Recommendations are listed here in the order in which they were made during the workshop and are cross-referenced to the speaker and discussion topic under which they were offered.

- Develop better definitions of objective risk (Palmer, Understanding Driver Performance).

- Develop tools and measures that drivers can use while driving to register risk perception (Lerner, Understanding Driver Performance).

- Measure the costs of lost mobility (including mobility for recreational and other purposes) along with the benefits of increased safety in any utility model assessment of young driver curfews (McKnight, Youthful Driver at Risk).

- Develop a model graduated licensing program (including a provisional component) and integrate that program with a driver education training plan (Preusser, Youthful Driver at Risk; see also related discussion during Improved Decision Making).

- Examine the terms used to describe risk and risk taking, both as a methodological issue and in terms of effective communication with young drivers (Smith, Definitions).

- Identify scenarios in which drivers do not perceive risk and develop an effective method of training responses to those scenarios (Pain, Improved Risk Perception).

- Develop guidelines about when to emphasize and when to de-emphasize risk in the driver training process (Palmer, Improved Risk Perception).

- Determine when attitudes and decision making patterns are formed in young drivers and when those patterns can be influenced by educators (Pain, Improved Decision Making).

- Determine why accident curves and other data show a decline in risky behavior after a certain amount of driving experience. Is it simply driver maturation, or are other factors at work? Use that understanding to modify driver training techniques (Lerner, Improved Decision Making).

- Develop a system in which driver training is spread out over more time and in more types of environments (Preusser, Improved Decision Making).

- Identify success stories in the teaching of young people to use complicated, visually oriented equipment, and determine what can be learned from those examples (Palmer, Improved Decision Making).

- Define the mixture of confidence building strategies and controlled failure experiences that is most appropriate for the skill level and maturity of young drivers and incorporate that knowledge into driver training (Palmer, Mayhew, Improved Behavioral Skills).

- Building upon the Essex accident avoidance study, revisit the issue of mental rehearsal during driving. Correlate the activities of study participants with their subsequent driving records (Smith, Mayhew, Improved Behavioral Skills).

- Build upon research currently under way in the United Kingdom that links accident involvement to methods of driver learning and licensing (Mayhew, Improved Behavioral Skills).

- Review and/or conduct collision studies to identify the important driving skills that need to be taught to young drivers (Mayhew, Improved Behavioral Skills).

- Investigate basic differences between younger and older drivers, including visual search and scan abilities and other factors in hazard detection (Mayhew, Improved Behavioral Skills).

- Develop a model parent involvement program that will upgrade the driving knowledge and performance of both parents and young teenage drivers in their decision making skills (Harvey, Improved Behavioral Skills).

- Develop a feedback system based on line of sight, path of travel, lane position, speed control and other variables to enable young drivers to process information (Harvey, Is Training a Reasonable Approach?).

- Address the learner at several levels by determining: (1) what the learner is most interested in learning; (2) areas of criticality in young drivers according to collision data (inattention, inappropriate speed, inability to maintain control of the vehicle prior to a crash, etc.); and (3) a process by which these behaviors are transferred to a host of students (Palmer, Is Training a Reasonable Approach?).

- Adapt divided attention procedures to train young drivers to attend to multiple tasks (Lerner, Is Training a Reasonable Approach?).

- Examine sex differences in existing and future data sets (Lerner, Is Training a Reasonable Approach?).

- Young drivers should not be treated as a homogenous group during the development of training materials; some degree of tailoring should be included in any training plan (Mayhew, Is Training a Reasonable Approach?).

- Piggyback traffic safety education onto self-worth programs designed to discourage drug use among schoolchildren (Preusser, Is Training a Reasonable Approach?).

- Find out where the world of simulation is and how it might apply to driver training, particularly in the area of virtual reality (Pain, What Are the Research Needs?).

- Develop realistic simulations that young drivers must complete before getting into a car. Such simulations can shorten in-car training time (Mayhew, What Are the Research Needs?).

- Determine exactly which parts of driver education are best suited to simulation and how best to convey those concepts in a simulated environment (Lerner, What Are the Research Needs?).

- Determine the influence of television on young drivers' perceptions. How much of their perception of driving is influenced by a television, or "gaming," mentality (i.e., failure is not real)? (Pain, What Are the Research Needs?).

- Assess the strengths and weaknesses of the current efforts to establish adequate teacher preparation standards (Harvey, What Are the Research Needs?).

- Develop a standardized road test which can be correlated with collision experience (Harvey, What Are the Research Needs?).

- Develop diagnostic testing for different stages of a model training/graduate licensing package (Pain, What Are the Research Needs?).

- Synthesize all the research completed over the past few years to determine which elements of crashes are learned behavior (as opposed to elements caused by

maturation, changing values, etc.). Run those findings through risk homeostasis analysis, keeping the focus on safety rather than mobility or utility concerns (Preusser, What Are the Research Needs?).

- Develop and assess support structures and quality control measures for any new training model (Smith, What Are the Research Needs?).

- Develop a broad vision of what it means to drive and deliver coordinated messages about driving at all educational levels (Palmer, What Are the Research Needs?).

- Seek collaborators (and funding) among the National Institutes of Health and other Federal agencies for research into human development and maturation (Lerner, What Are the Research Needs?).

- Include a reasonable, progressive system of punishment as part of any new licensing and training system (Smith, What Are The Research Needs?).

Appendix A

Agenda

National Highway Traffic Safety Administration's "Workshop To Identify Training Requirements Designed To Reduce Young Driver Risk Taking and Improve Decision Making Skills"

April 27–28, 1993
Belmont Conference Center
Elkridge, Md.

Tuesday, April 27

9:00 – 9:30	Welcome & Introduction	*Mike Smith/Rob Gilliland*
9:30 –10:00	Overview of the Alberta Conference	*John Harvey/John Palmer*
10:00 –10:30	FHWA Presentation	*Neil Lerner*
10:30 –11:00	Break	
11:00 –12:30	Presentation of Background Paper	*Jim McKnight*
12:30 – 1:30	Lunch	
1:30 – 2:00	Introduction II	*Mike Smith*

2:00 – 3:30	**Discussion Topic I** *Can training reduce risk taking?*
3:30 – 4:00	**Break**
4:00 – 5:30	**Discussion Topic I** (cont.)
5:30 – 6:00	**Free Time**
6:00 – 7:30	**Reception, Howard County Chamber of Commerce**
7:30	**Dinner**

National Highway Traffic Safety Administration's "Workshop To Identify Training Requirements Designed To Reduce Young Driver Risk Taking and Improve Decision Making Skills"

April 27–28, 1993

Belmont Conference Center

Elkridge, Md.

Wednesday, April 28

9:00 – 9:30	Summary of Discussion Topic I	*Mike Smith*
9:30 –10:30	Discussion Topic II *Is training a reasonable approach?*	
10:30 –11:00	Break	
11:00 –12:00	Discussion Topic II (cont.)	
12:00 –12:30	Summary of Discussion Topic II	*Mike Smith*
12:30 – 1:30	Lunch	

1:30 – 3:00	**Discussion Topic III** ***What are the R&D needs requirements?***	
3:00 – 3:30	**Break**	
3:30 – 4:00	**Summary of Discussion Topic III**	*Mike Smith*
4:00 – 4:30	**Overall Summary/Closing**	*Mike Smith*

Appendix B

Participant List

National Highway Traffic Safety Administration's "Workshop To Identify Training Requirements Designed To Reduce Young Driver Risk Taking and Improve Decision Making Skills"

April 27–28, 1993

Belmont Conference Center

Elkridge, Md.

Participant List

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Appendix C

Youthful Driver at Risk Workshop Background Issue Paper

YOUTHFUL DRIVER AT RISK WORKSHOP
BACKGROUND ISSUE PAPER

A. James McKnight & Jennifer Resnick
National Public Services Research Institute
April 27, 1993

This paper was prepared for participants in the Youthful Driver At Risk Workshop held in Belmont, Maryland, April 27th - 28th, 1993. It provides an update of the report "Young Driver Risk-Taking Research: State of the Art" by Jonathan D. Hodgdon, Barry E. Bragg, and Peter Finn of Abt Associates, Inc. The update is preceded by a review of the original report itself.

REVIEW OF "YOUNG DRIVER RISK-TAKING RESEARCH: THE STATE OF THE ART"

The first section of this report summarizes young driver risk taking as reported by Hodgdon, Bragg, and Finn in their interim report on the State of the Art, published in 1981. That report identifies five hypothesized contributors to risk of young drivers: driving practices, exposure, inexperience, vehicle characteristics, and personality characteristics. The authors also examined a sixth "hypothesis," which actually involves a set of theoretical formulations attempting to explain the elevated risk of young drivers. This review will follow the same structure as employed by Hodgdon, Bragg and Finn (1981).

Driving Practices

The authors summarize the relationship of driving practices to accident risk as follows:

"To date, there is no evidence that youth engage in any driving practices that can account for their overinvolvement in traffic collisions."

Practices taken from violation and accident-related violation data include: speeding, sign non-observance, equipment defects, turning unlawfully, passing unsafely, right-of-way violations, major infractions, and alcohol. The authors cite a 1970 study of California drivers that showed youth under the age of 26 to have the highest violations rates for all seven categories. Also, males have a much higher representation than females. Youth under the age of 25 had nearly twice as many drinking-related accident violations as the next closest age group. These statistics involve three findings: the BACs of younger drivers involved in collisions are lower than those of older crash-involved drivers; accident rates are highest within the first 2 years after it is legal for a young person to purchase alcohol; and drinking inexperience may be a more salient factor than driving inexperience in the higher DWI accident rate. Other drug use and driving violations have not been extensively studied and the studies conducted did not control for driver age and other relevant factors.

Do youth in fact engage in these hazardous driving practices more often than experienced drivers?

Speed — Observational studies showed that young male drivers speed more than young female drivers and experienced drivers of both sexes. However, no studies related increased speed directly to accidents.

Passing — Young males were significantly more likely to be involved in front-end collisions while passing, but no study addressed the question of whether young men accept shorter gaps in passing.

Headways (Tailgating) — Although young male drivers are involved in more rear-end crashes, no study determined whether this is due to shorter headways or higher speeds.

Turning — Young drivers did not commit significantly more turning violations per mile of travel than older drivers. Experienced drivers were found to prefer larger temporal gaps in turning. However, differences in gap acceptance have not been directly related to accidents.

Safety Belt Usage — Belt usage rates increase with age. Relative lack of safety belt use would be expected to affect injury and survival rates in crashes. However, the authors cited no studies dealing with this relationship.

Driving in Adverse Weather Conditions — One Canadian study showed that the number of young drivers on the road declined in adverse weather conditions, a finding the authors explain may be attributable to more discretionary travel.

Alcohol — Although the proportion of young drivers found to be impaired or to have been drinking was lower than the overall proportion of drivers, their risk of accident involvement when they are impaired is dramatically higher than that of older drivers.

Of several hazardous driving practices thought to be engaged in by young drivers, the authors believe that only speeding can be said to occur more often among youthful than among experienced drivers, and there is little evidence to demonstrate that speed itself is a direct cause of the higher accident rate among young drivers.

Exposure

While males log twice as much mileage as females, young male drivers (under the age of 24) drive fewer miles annually than older males. Within the younger age population, mileage is correlated with accident rate. Since mileage is correlated with accidents and youthful drivers drive fewer miles, the overrepresentation of youth in accidents cannot be attributed to mileage exposure. The authors identify other elements of exposure that may help account for the high accident rate, including driving at night, on weekends, and at high speeds. The authors conclude that "at least 90% of the variation in accident rates remains to be explained by other age-related factors."

Experience

Research relating accidents to experience defined the latter in terms of either familiarity with driving or psychomotor skills. The studies in the former category showed that teen drivers

are twice as likely to be involved in an accident due to lack of experience than were adults. Studies on psychomotor skills were not conclusive. The authors conclude that, overall, inexperience appears to contribute less to the overrepresentation of young drivers in accidents than does exposure. The authors do not attempt to differentiate the relative effects of age and experience upon accidents, confining their examination of experience to the youthful population.

Vehicle Characteristics

The authors conclude that, while defective equipment accounts for higher violation rates among youth, it has only limited potential for explaining variation in accident rates. Although vehicles under 110 Hp are twice as likely to be involved in accidents, no relationship between age and vehicle power was found. And, while youth with high accident rates are more likely to own their cars than youth with lower accident rates, there is no evidence that ownership is a factor in the relatively high accident involvement of young drivers as a group. No correlation was found between vehicle type or body style and driver age/accident involvement rate, except that over half of all motorcycle accidents involved operators between the ages of 16 and 24.

Personality Characteristics

Studies examining personality characteristics of drivers with high accident rates are fraught with difficulties. Comparing the personality characteristics of drivers with high accident rates against those of accident-free drivers smacks of "accident proneness," a concept that has been thoroughly investigated and rejected. Additionally, how does one study causal relationships without an assessment of personality characteristics before the accidents occur? The authors conclude that there is currently no evidence linking personality and driving practices which will explain the high accident rate among young drivers.

Risk-Taking Hypotheses

Approximately half of the 1981 report is devoted to theoretical formulations attempting to explain the observed youthful propensity to risky behavior. Their treatise on risk taking encompasses *definitions* of risks, *models* of risk-taking behavior, and the *measurement* of the three model components: risk perception, risk utility, and risk choice.

<u>Definition of Risk</u>

The authors point out that definitions of risk include risk as (1) the probability of a negative outcome; (2) the probability of a negative outcome coupled with the amount of loss — infrequently used in traffic safety because of the difficulty in quantifying cost; (3) the probability of loss multiplied by the net difference between cost and benefit. The authors used "risk" to mean the product of probability of a negative outcome and the cost (severity) of that outcome.

The authors distinguish between *objective risk*, the actual probability of a negative outcome for a class of individuals, and *subjective risk*, which is the expected probability of a

negative outcome by an individual in a class. The latter may differ from the former if individuals perceive risk incorrectly or uniquely. Thus, in assessing subjective risks, individuals should be asked to estimate the risk for the group and for themselves, as well as the reasons for the discrepancy.

Risk Models

The authors entertain several hypothetical models to explain behavior that exposes people to risk. They settle upon the *utility model* as being most appropriate to acceptance of risk in motor vehicle operation. The utility model posits that, when individuals decide to engage in a risky driving behavior, they have consciously or subconsciously weighed their expected utility of engaging in the behavior against their perceived risk of doing so. It is postulated that drivers will take the risk whenever their expected utility exceeds their perceived risk. There are, however, examples of an alternative selected out of habit or impulsively with only a fraction of factors considered. Alternately, some individuals will avoid risk unless the perceived utility considerably outweighs the perceived risk. These two potential functional relationships are designated equal payoff and risk aversion.

High risk-taking tendencies among young drivers have three possible explanations: (1) young drivers have a lower *perception* of risk than older drivers; (2) young drivers may assign a higher *utility* to a hazardous behavior than older drivers; and (3) young and older drivers may weight utility and risk equally, but older drivers *choose* lower risk levels. These are described as risk perception, risk utility and risk choice.

1. *Risk Perception.* Do younger drivers see themselves as taking more risks, or are they unaware of the hazardous nature of their driving? The one study that looked at age and risk perception found no correlation between the two, but suffered from a small sample size and problems in research design. A telephone survey showed young drivers more accurately perceiving accident risks. Studies using galvanic skin response as a measure of risk perception show that drivers are able to differentiate the relative hazardousness of road situations, but tend to overestimate the risk of accident or arrest. The authors describe the ideal study as measuring and comparing the subjective and objective risks associated with a driving situation for both young drivers and at least one group of experienced drivers.

2. *Risk Utility.* Some researchers have suggested that risky behavior arises from "extra motives" beyond the utility of driving itself. Because utility is difficult to measure, it has received little study in relation to young drivers. Most of the research that has occurred consists of within-age group comparisons of young "dangerous" and "safe" drivers. Youth whose driving records indicate unsafe driving have been found to take driving risks for such motives as personal pleasure, competitiveness, frustration, and aggression. They are more likely to own their own cars, to desire to be a race car driver, to drive when worried or frustrated, to race other cars, to drive 10 or more hours per week for fun, to be affected by the passengers, and to feel pressure from adults.

Other studies suggest motives such as expediency (oriented toward self-benefit at the expense of others), aggression and exhibitionism (desire to be the center of attention) are closely linked to greater risk taking. Investigators tend to assume that young drivers possess more of these risk-taking utilities than experienced drivers, and in fact some studies have found a lessening of such motives with age. The authors conclude that "what evidence does exist suggests the presence in young drivers of 'extra motives' leading to increased risk taking, such as frustration, expediency, competitiveness, aggression, exhibitionism, and thrill seeking."

3. *Risk Choice.* Studies on risk choice have measured the maximum risk the driver would be willing to accept, but not in a true driving situation. All of the studies of choice have dealt with driving simulation, gambling situations not related to driving, or observed driving behavior. One study that did involve true risk, while not testing for effects due to age, supported the utility model by showing that subjects regulated their risk according to rewards and penalties.

   While youth tend to take more risks on impulse than do experienced drivers, no studies were found which related age and impulsiveness to risk choice. Although inexperienced drivers perceive driving as a more hazardous task than do experienced drivers, they clearly drive in a more hazardous manner, including driving faster, accepting smaller temporal gaps when turning, and driving proportionately more at night. It was this paradox that the authors explore.

In their efforts to review techniques assessing risk taking, the authors differentiate between risk perception and risk choice. Most studies that review risk choice, do not look at whether young drivers perceive driving situations as more or less hazardous than experienced drivers. If young drivers are unaware of the increased risk of hazardous driving practices, an educational countermeasure approach might be indicated. On the other hand, if young drivers are aware of the increased risks but consciously accept them for perceived benefits, an experimental program increasing the perceived risk of accident involvement might be called for.

Many of the studies took place in simulators and did not determine whether judgments made under simulated driving situations were comparable to judgments made under real driving conditions. One that did involved attempting a left-hand turn across the path of an oncoming "car". The researchers found differences in the simulated situation, including a willingness to take greater risks: 9% of trials resulted in "accidents" where there were none in the real world situations. The authors recommend more studies validating the use of simulators.

Measurement of Perceived Risk

Two disciplines have developed techniques for studying perception: classical psychophysics and gaming decision-making models. The techniques are:

1. *Rank Ordering* — Problematic in that it assumes the intervals between ranks to be equal.

2. *Paired Comparisons* — A time-consuming technique, especially if the number of elements is large.

3. *Categorical Methods* — Likert scaling employs attitude assessment through agreement or disagreement with a particular statement. The Q sort technique has subjects sorting statements into gross categories, then into more discrete categories. Neither show interval width.

4. *Direct Estimation*. Subjects estimate on a scale of probability. This method has the potential advantage of yielding equal intervals -- if the estimates have true validity.

5. *Gamble Methods*. Subjects choose between two options with varying probabilities. This method requires a well-trained respondent. Preliminary studies are first needed to determine whether young and experienced drivers perceive risks differently.

In assessing the advantages and disadvantages of various techniques, the authors examined whether young drivers perceive driving as less dangerous than experienced drivers. The direct estimation technique was chosen because it allows for a quick evaluation of a large number of driving situations, permitting assessment of differences in risk, ordering of situations by risk, and relative position within ordering.

Measurement of Risk Utility

Risk utility is very hard to study because it is the least tangible and most value laden. The authors note the following list of driver risk-taking utilities:

- Outlet for anxiety, stress
- Outlet for aggression, competitiveness
- Outlet for expressing independence
- Means of increasing attentiveness
- Means of increasing arousal or pleasure
- Means of impressing others, exhibitionism
- Means of need achievement, accomplishment — expediency

Curiously, the authors, like those whose work they review, do not include among the utility factors, the most utilitarian feature of driving — namely getting to one's destination quickly. Most of the forms of risky driving behavior reported upon — speeding, running red lights and stop signs, illegal passing, illegal turns — facilitate achievement of this driving objective. One might expect a parsimonious investigator to consider this rather obvious utility before entertaining such questionable motives as seeking outlets for anxiety, aggression, independence, need for arousal, and so on. The authors review a number of studies involving both experimental and survey approaches to assessment of various personality

factors in the acceptance of risk. Although it is hard to find definitive connections between experimental nonsurvey techniques and the utility attributes they intend to measure, the authors are partial to the survey approach. Their review focuses upon the issue of age-related differences in risk perception vs risk choice. The authors planned to adopt a two-stage "top-down" approach. First, they would test for age differences in the overall utility of a risky behavior based on measurement of perception and choice. They would use a combination of experimental and survey measures of selected utility attributes to interpret any age differences. They could test three hypotheses accounting for age differences: differences in perceived risk, differences in expected utility, or differences in method of weighing the expected utility and perceived risk. The authors note that, where studies use only money or points as incentive, failure to show age differences could be due to the limited utility of the incentives provided.

Measurement of Risk Choice

The authors explain that previous experiments concerning risk taking in adulthood (risks that are unrelated to driving) have used a 12-choice dilemma questionnaire or some modification of that questionnaire. They rejected the 12-item choice dilemma questionnaire and common gambling experience in favor of experiments conducted in the context of motor vehicle operation. A "classic" study examined the effect of alcohol on risk choice. Alcohol did not increase risk taking but did increase confidence in success. The limitation of this study is that it posed no physical danger, and the particular hazard they employed does not completely resemble the complex type of moving road hazard.

Risk choice studies often involve simulations with no threat of physical injury. One dart-throwing study increased the level of reward as darts neared an "accident zone." The greater the reward for throwing near the accident zone, more attempts in that direction were noted. However, after hitting in the accident zone, fewer attempts were made on the next few trials to score high points. While two studies involving automobile simulators failed to find relationships between risk taking and pay-off, the pay-off schemes were not proportional to risk. The authors described additional studies employing simulation but not concerned with measurement of risk choice.

UPDATE ON YOUNG DRIVER RISK-TAKING RESEARCH

The review of young driver risk taking research carried out by Hodgdon, Bragg, and Finn (1981) encompassed work undertaken up to and including 1980. This section of the report will survey risk-taking research published since completion of the earlier review. Since it is an update rather than an independent review, it follows the same structure as the earlier report, devoting separate sections to driving practices, exposure, experience, vehicle characteristics, personality characteristics, and risk-taking theory.

Risky Practices of Young Drivers

One obstacle to the identification of risky driving practices by youth, noted by Hodgdon et al., was the lack of research combining measures of age, risk, and driving practice into one study. Epidemiological studies associated youth with accidents while a

different set of observational studies associated youth with various practices believed to be unsafe. While one might suppose that showing overinvolvement of youth in practices known to be unsafe might be sufficient to account for overrepresentation in accidents, the authors were reluctant to make the connection. More recent research includes studies in which accident causation is directly related to certain unsafe driving practices by youth.

Speed

A study by Huston (1986) based on accident data provided by the California Highway Patrol on drivers at fault in accidents in 1983 found that speeding was a primary collision factor for youth in fatal automobile accidents and was a factor in 33% of nonfatal injury accidents. Evans (1991) analyzed fatal accident data by age and direction of impact, and found that young drivers were more likely than older drivers to die in roll-over crashes, a type of accident that is likely to involve high speed.

Barjonet and Gossiaux (1989), Bergeron (1991), Jessor (1987), Jonah (1986), and Michiels and Schneider (1984) identified speed as a risky driving practice for youth. Barjonet made use of three sets of data: (1) interviews with young drivers associated with direct observations of behavior, (2) data on injury accidents, which included information as to who was responsible, and (3) results of in-depth accident investigation that included a non-judicial inquiry to identify behavioral circumstances underlying fatal road accidents. While speeding was identified as the major cause of accidents, the authors emphasized that speed in these instances was not related to thrill seeking or bravado, which they point out "take place on other types of vehicles, scooters, and motorcycles."

Clement and Jonah (1984) also report finding no association between number of crashes and sensation seeking. However, French, West, Elander and Wilding (in press), as well as Parker, Manstead, Stradling, Reason, and Baxter (in press) reported finding young male drivers manifest fast and deviant driving styles. Perry (1986) found crashes and violations among high school students to be related to high scores on a measure of type A behavior and a questionnaire assessing driver impatience.

Passing, Merging, and Lane Changing

Bergeron (1991) found that youth often do not allow enough time to merge into traffic, cross traffic lanes, and pass other vehicles.

A survey by Jonah and Dawson (1987) found that young drivers were more likely than older drivers to report passing in intersections and changing lanes abruptly.

Michiels and Schneider (1984) collected data on traffic offenses and found that an offense frequently committed by young drivers is reckless passing of vehicles.

Headways

Bergeron (1991), Evans and Wasielewski (1983), and Jonah (1986) found that youth are more likely than older drivers to follow too closely. Evans and Wasielewski (1983)

collected data on headways and driver characteristics at freeway sites in Michigan and Ontario. Information on driver and vehicle characteristics were obtained from a photograph of each vehicle. Youth were found to leave shorter headways.

Jonah and Dawson (1987) found that young drivers were more likely than older drivers to report tailgating other drivers.

Safety Belt Usage

American Association of Motor Vehicle Administrators (1989), Beirness and Simpson (1989), and Bierness and Simpson (1988) identified failure to use safety belts as a risk factor. Jonah (1990) found that 20- to 24-year-olds had the lowest seat belt usage rate. The level of seat belt usage was even lower than that of the 16- to 19-year-old age group. Seat belt use was significantly correlated with accident and violation involvement. Malfetti, Rose, DeKorp and Basch (1989) developed an attitude scale to measure young drivers' attitudes on risk-taking behaviors, including failure to wear seat belts.

Distractions

Farrow (1987) found that internal distractions and driving with peers were related to the accident involvement of youth. Frith and Perkins (1991) similarly found that driving with passengers increased the risk of accident involvement. Johnston (1986) found that absence of passengers or only one passenger is associated with a lower risk of automobile crashes.

Driving Under the Influence of Alcohol or Drugs

The vulnerability of youth to alcohol was established through the comparisons of alcohol content in the bloodstreams of accident-involved and non-accident-involved drivers, controlled for age, location, time-of-day, and other related factors. While an abundance of recent research has addressed the alcohol levels of the two categories of drivers separately, few studies have combined the two in a way that would allow alcohol risk to be compared across age levels. Pernager and Smith (1991) examined two-car fatal crashes, using passively involved drivers as controls for those initiating the crash, and computing odds ratios for different age groups. While youth were overrepresented in alcohol-related crashes, they were also represented in crashes not involving alcohol, to just about the same extent. It was the 20- to 35-year age group that showed relatively greater involvement in alcohol-related crashes. Mayhew, Donnelson, Beirness, and Simpson (1986) found that at low BACs, drivers under age 20 had a higher risk of fatal crashes than older drivers.

Barjonet (1989) and Frith and Perkins (1991) identified driving under the influence as a risk factor for youth. Barjonet used interviews and observations, and a listing of traffic injury accidents for 1985 that contained information on responsibility and behavioral data gathered on fatal accidents. Huston (1986) found that driving under the influence was a primary collision factor for youth after reviewing data supplied by the California Highway Patrol. Farrow (1987) interviewed young drivers to collect information about the dangerous driving situations they had been involved in and found that alcohol or drug use was common before these incidents.

Peck (1985) regressed accident frequencies against 10 variables and found that drinking and driving was a significant factor in accidents. Fell (1982) also identified drinking and driving as a risk factor. Williams, Peat, Crouch, Wells and Finkle (1985) collected data on blood samples from young, fatally-injured male drivers and found that alcohol was associated with increased crash responsibility. Marijuana was detected in 37% and alcohol was detected in 63% of fatally-injured 15- to 19-year-old drivers. Marijuana was detected in 39% and alcohol in 67% of drivers 20 to 24 years old.

Highson, Heeren, Mangione, Morelock and Mucatel (1982) gathered data using anonymous telephone surveys in Massachusetts and upstate New York to assess the importance of driving after drinking or drug use as risk factors. They found that, as the frequency of these behaviors increased, accident involvement increased. Teens who drove after using marijuana more than 6 times a month were 2.4 times more likely to have been involved in a traffic accident than those who didn't use marijuana. Further, those who drove after using marijuana more than 15 times in a month were 2.9 times more likely to have been

involved in an accident. When teens who drove after using marijuana were excluded from regression analysis, it was found that teens who drove after consuming alcohol on more than six occasions per month were 2.0 times more likely to have had an accident.

Jonah (1990) conducted a telephone survey of persons aged 16 - 69 within Canada. He found that drivers age 20 - 24 were more likely to drive after drinking than were drivers age 16 to 19. He also found that young drivers, aged 16 - 24, underestimated the number of drinks that would cause impairment more than did older drivers and believed that their chances of being charged with impaired driving were lower than did older drivers. Jonah concluded that driving after drinking or cannabis use indicates that a person is more likely to perform other risky behaviors.

There seems to be little doubt that youth who drink a lot or who use marijuana are indeed more likely to engage in risky behavior than those who do not. The question is whether the use of these substances contributes to risky behavior or is simply a concomitant of it. Jessor's (1988) discussion of adolescent problem behavior stresses the interrelationship among various problem behaviors. He points out that "adolescent problem drinking is not an isolated behavior but, on the contrary, covaries positively with other problem behaviors and negatively with conventional behavior." He concludes that "risky driving behavior emerges from these analyses as an aspect of a larger adolescent lifestyle and has embedded in it the same set of personality, perceived environment, and behavior variables as other adolescent problems behaviors such as delinquency, problem drinking, and illicit drug use."

Exposure

The Hodgdon et al. (1981) paper concluded that the overinvolvement of youth could not be attributed to their driving exposure since young drivers compiled lower annual mileage than their older counterparts. However, some portion of the elevated risk levels of youth arose from exposure to risky driving situations, particularly night driving. The American Association of Motor Vehicle Administrators (1989), Barjonet (1989), and Williams (1985) identified driving at high risk hours, especially at night, as an explanation for the high accident involvement of young drivers. Frith and Perkins (1991) reviewed hospital and accident statistics from the New Zealand Ministry of Transport and found that driving at night was a high risk for young drivers. Farrow (1987) asked subjects in interviews to describe all dangerous driving situations they had been involved in as a passenger and determined that late night driving was common to dangerous situations.

One test of night driving's effect upon the accidents of youth is what happens to the accident rate when nighttime driving restrictions are imposed. Preusser, Williams, Zador, and Blomberg (1984) found fewer nighttime accidents in three states having curfews (New York, Pennsylvania, and Louisiana) relative to neighboring states without curfews. Preusser, Williams, Lund and Zador (1990) compared Detroit, Cleveland and Columbus, all of which have curfew ordinances, with Cincinnati which does not and found that motor vehicle injury decreases with curfews. However, McKnight, Hyle, and Albrecht (1983) looked for changes in nighttime accidents before and after introduction of a curfew in the same state, and found no change when the effects of long-term trends were partialed out. It is apparent even from the data favoring curfews, that the effects upon accidents are quite small.

Experience

Evans (1987) studied accident data from FARS and examined various antecedents as a function of age. He concluded that age and lack of experience contributed to accidents. Frith and Perkins (1991) in their review of New Zealand Ministry of Transportation data also identified age and experience as factors. Summala (1987) in Finland concluded that "declines occur in collision rate ... with increases in driving experience, particularly during the first 3 - 5 years."

Groeger and Brown (1989) and Brown and Groeger (1988) identified inexperience and lack of ability to identify hazards as problems for young drivers. They found that experienced subjects were able to identify risk situations sooner and respond more quickly than inexperienced drivers. However, it should be noted that the youngest age group in the study had a mean age of 24.5. Peck (1985) identified lack of skill and difficulties in judging hazards, both functions that improve with age, as contributors to accidents.

Several studies assessed the relative contributions of experience and age to accidents. Mahew and Simpson (1990) found that collision involvement decreased as age and experience increased. Accident rates among males declined by 15% during the first 4 years of driving. They found similar results for females except that the decrease in crash involvement with age and experience was greater. Comparing age and experience, they concluded that "increases in experience are more likely to be associated with decreases in collision rates among older drivers than among younger drivers, especially with males."

One relationship that has gone unmentioned is the high correlation between age and experience ($r=.9$) among automobile drivers in the United States.[1] The overwhelming majority of drivers obtain their licenses at age 16 or 17. Young drivers obviously are limited in experience, while very few older drivers lack experience. Unfortunately, in many studies, newly licensed drivers are considered to be inexperienced, even though they may have previously held a license in the same or another state. In the study by Mayhew and Simpson (1990), experience was limited to a range of 4 years in order to be able to make comparisons over the entire age range. To compare variation in accidents over a 50-year age span against a 4-year age of experience would appear to bias the comparison in favor of age.

To assess relative contributions of age and experience, McKnight and Robinson (1990) compared accidents occurring on motorcycles, where the correlation of age and experience is low ($r=.3$). They found that accident variance associated with age slightly exceeded variance associated with experience in the case of single vehicle accidents, which are most likely to result from youthful exuberance and impulsiveness. In the case of collisions between vehicles, where the lessons of experience might be expected to have relatively greater influence, the contribution of the two variables to accident variance was about equal.

The relationship between age and experience within the *youthful age group itself* has been studied by Mercer (1986) and O'Connor (1986) among others. They found significant

[1] Based upon an analysis of survey data previously obtained by the authors of the report.

declines in accidents with age within experience group and with experience within age group, despite the small ranges involved. They point out that, while the age difference may clearly reflect the effect of maturity, it might also be a selective factor; those who seek licenses earlier may have a need to drive, and their higher accident rate may be due to greater mileage. In any case, the results of these studies suggest that delaying the age of licensing is likely to reduce the number of accidents during the first year of driving.

Vehicle Characteristics

Farrow's (1987) study found that driving the family car rather than one's own may result in riskier driving. Sixty-eight percent of dangerous drivers in the study reported driving the family car. White (1988) used data from the New Zealand Driver Exposure Survey and data from the Ministry of Transport to calculate standardized risks. He found that a large percentage of driving by youth involved older cars and that older cars had greater accident involvement for all ages. He attributes this to the possibility of component failure in older cars, or to the possibility that drivers with older cars worry less about the consequences of their actions. White also found that teenagers do relatively more motorcycle riding than older drivers.

Williams, Preusser, Lund, and Rasmussen (1987) administered a survey dealing with transportation needs, driving behavior, attitudes and lifestyle to students in 75 high schools in seven different parts of the country. The students who reported greater driving, speeding, drinking and driving had the most traffic violations and accidents. Students who owned cars tended to drive smaller and older vehicles than those driven by non-owners.

Personality Characteristics

Arnett (1990) found that thrill and adventure seeking, disinhibition, and boredom susceptibility are significantly related to drunk driving. Beirness and Simpson (1988) and Beirness and Simpson (1989) also found that accident involvement is related to thrill and adventure seeking, experience seeking, tolerance of deviant behavior, immaturity towards alcohol or liberal attitudes towards alcohol, smoking, getting fewer hours of sleep each night, drug use, excessive drinking, problems with parents, problems with police, problems with friends and problems with teachers. According to Farrow (1987) viewing driving as a social event is common in drivers who engage in risky driving.

Jessor (1987) found risky driving was related to low value on achievement, tolerance for deviance and high frequency of deviant behavior, low parent-friend compatibility, looking to peers for health behavior models rather than parents, drinking, smoking and marijuana use. Jessor also found that risky driving was related to high value on independence and sexual experience for males.

Donovan (1991) and Beirness (1991) found that a tendency towards risk taking, tendency towards thrill seeking, high levels of health-compromising behaviors such as smoking or becoming overtired, use of alcohol and drugs, encounters with the legal system, low grades, tolerance for deviant behavior, vulnerability to peer pressure and alienation were related to accident involvement.

Mercer (1990) and Beirness and Simpson (1989) point out that differences in personality and driving characteristics of individuals within the same age and experience level far exceed differences across these levels. As Mercer points out, "there are more psychological and personality differences within an age group than between age groups, and personality has also been shown to predict collision involvement." The relationship between accidents and violations in one period and those occurring in a later period is one of the first observations ever offered in traffic safety.

Risk Perception

Matthews and Moran (1986) measured perceived risk and perceived driving ability in males, using a questionnaire and videotaped sequences. Young males gave lower ratings of accident risk than older males, felt that they were at less risk than peers, and overestimated their driving ability.

Jonah and Dawson (1987) reported that young drivers rated themselves as less cautious than older drivers did, yet perceived less danger than older drivers in specific driving situations.

Bragg and Finn (1982) found that youth underestimated the risk of certain driving maneuvers and overestimated their ability to avoid accidents. Finn and Bragg (1986), measured perceived risk through interviews, still photograph ratings, videotape ratings and road tests and found that youth often failed to perceive risky situations. McKnight and McKnight (1992) found younger drivers less likely to respond to a set of simulated highway traffic hazards than were older drivers.

Trankle, Gelau and Metker (1990) showed subjects slides of 100 traffic situations and asked them to assess each situation on a scale ranging from "minimum risk" to "high likelihood of accident" and found that young males rated situations as less risky than older males. Trankle et al. proposed that young males may have a higher tolerance for risk, meaning they are more accepting of risk taking.

Dejoy (1992) administered a 3-part questionnaire to males and females aged 18-24 and found that males and females differ on their ratings of the seriousness and accident likelihood of various driving behaviors. Males rated "driving without a seat belt, driving with a BAC slightly over the legal limit, and not making a full stop at a stop sign" as less serious than females did. Males also rated various behaviors as less likely to result in an accident. According to Dejoy, "young males appear to possess an exaggerated sense of their own driving skill and this may lead them to underestimate the degree of risk associated with various dangerous driving acts."

Lerner, Williams, and Sedney (1988) found that old and young drivers tended to rate the risks associated with various road traffic conditions similarly, although older drivers generally rated the conditions as more hazardous than did the younger drivers. In addition to obtaining general ratings of risk, the authors had subjects rate risk continuously throughout a test route. Curves for the two age groups parallelled one another closely. Absolute differences between the two age groups were greater in daytime than at night, an interaction

due primarily to a decline in perceived risk at night for older drivers. This paradoxical finding was attributed to a reduction in the complexity of visual cues available to older drivers at night. Younger drivers were also somewhat slower in responding to various roadway-traffic conditions than were older drivers.

The low risk perception of young drivers has often been attributed to a sense of "invulnerability." A very recent review of youth risks across a broad array of activities is presented by Fischhoff (1993). He cites a number of studies in which adolescents tended to see themselves as being more vulnerable to risk than their parents. He points out that "adolescents may not be intending to take more risks, but, instead, haven't figured out what is a risk and what isn't."

Risk Utility

The notion of risk utility does not seem to have appeared in the literature as much since the Hodgdon et al. (1981) report as it did before. While some youth may find "utility" in the "thrill" that comes with some risky behavior, current research has not been inclined to give it much weight in explaining the risky behavior of youth. However, this does not mean there is no utility in risky behavior. On the contrary, almost all behavior has utility, otherwise, *why would it take place*? As we noted previously, there is utility in most of the behavior that leads to risk, among youth or any other portion of the age spectrum — namely getting to where one is going. The majority of risky behaviors accelerate the process of reaching one's destination, e.g., speeding, running red lights, illegal left turns, and so on. If drivers believe the risk attendant in such activity is very low, then they see no barrier to realizing the utility. There is certainly some question as to how much utility really lies in much of the unsafe behavior in which youthful drivers engage. However in a risk-utility model, it is the *perceived* utility, along with the perceived risk that determines behavior.

Risk Choice

If the perceived utility of risky behavior lies primarily in securing individual transportation objectives, then it is likely to be similar across age groups. If such is true, then the difference between young and old drivers with respect to risk choice could be attributed primarily to established differences in the perception of risk. In any case, age differences need not be attributed to thrill seeking or otherwise finding greater utility in the experience of risk itself.

While a risk-utility model may explain a great deal of youthful risk taking, it doesn't explain everything. In order to perceive risk in a situation, people have to perceive the situation to begin with. All bets are off when drivers are inattentive or too preoccupied even to perceive when a situation exists, when they are impulsive, or when they lack the ability to respond in a way that will gain utility. In summary, while the risk-utility model may help account for much of youthful risk taking, its applicability is limited, and the way it functions even when it does apply is not well known.

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