Feasibility Study on Evaluating Driver Education Curriculum

NHTSA

www.nhtsa.gov

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT HS 811 108		

4. Title and Subtitle	5. Report Date
Feasibility Study on Evaluating Driver Education Curriculum	April 2009
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
Allan F. Williams, David F. Preusser and Katherine A. Ledingham	

9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
Preusser Research Group, Inc. 7100 Main Street Trumbull, CT 06611	
	11. Contract or Grant No. DTNH22-05-D-25043

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
U.S. Department of Transportation National Highway Traffic Safety Administration 1200 New Jersey Avenue SE., NTI-130 Washington, DC 20590	Final Report
	14. Sponsoring Agency Code

15. Supplementary Notes

Dr. Patty Ellison-Potter served as the NHTSA Contracting Officer's Technical Representative for the study.

16. Abstract

One way to attempt to reduce the problem of teen driving crashes is professional driver education. However, despite the seemingly universal appeal of driver education, scientific evaluations have indicated that such programs generally do not produce safer drivers. Perhaps most noteworthy is the DeKalb study where driving tasks were established, ranked, and used to create a state-of-the-art program, the Safe Performance Curriculum (SPC), which overall did not reduce crashes. There have been many additional studies since DeKalb, nearly all showing similar results. In evaluating the new American Driver and Traffic Safety Education Association (ADTSEA) program, there are basically two design alternatives: the random assignment study, as in DeKalb, and some variation of a quasi-experimental design. No study can be done presently as the program has been introduced only in limited ways. As nearly all prior driver education program evaluations have found either zero or adverse effects on crashes, in undertaking an evaluation, the possibility of similar outcomes needs to be considered.

17. Key Words	18. Distribution Statement
Driver education Driver licensing ADTSEA Teen driving Teen crash Young driver	This report is available from the National Technical Services (NTIS), Springfield, VA 22161 (703) 605-6000. It is also available, free of charge, on the NHTSA Web site at www.nhtsa.dot.gov.

19. Security Classification .(of this report)	20. Security Classification .(of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	36	

Form DOT F 1700.7 (8-72) **Reproduction of completed page authorized**

DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

TECHNICAL SUMMARY

CONTRACTOR	CONTRACT NUMBER
Preusser Research Group, Inc.	DTNH22-05-D-25043
REPORT TITLE	REPORT DATE
Feasibility Study on Evaluating Driver Education Curriculum	April 2009
REPORT AUTHOR(S)	
Allan F. Williams, David F. Preusser, & Katherine A. Ledingham	

Objectives

The objectives of this project are to identify and examine previous evaluations of driver education programs, focusing on research design issues, and to determine the feasibility of conducting a comprehensive evaluation of the new driver education curriculum developed by the American Driver and Traffic Safety Education Association (ADTSEA).

Introduction

Driver education has long been in the forefront of ways to deal with the young driver problem. It enjoys wide popular support and it is generally assumed that driver education graduates are superior drivers. However, scientific evaluations do not support driver education as a mechanism for reducing crashes.

Driver Education History

The first known driver education programs were developed between 1910 and 1920, but it was not until the 1930s that formal courses were actually offered. The early growth and popularity of driver education were fueled by studies reporting it to be effective in reducing crashes. Many of these studies failed to control for differences between students who received the training and those who did not. Later studies that took these differences into account did not yield positive findings. This led to a period of uncertainty about driver education effects.

The DeKalb Study

In an attempt to reduce this uncertainty, the National Highway Traffic Safety Administration (NHTSA) embarked on a major long-term program to develop and evaluate a state-of-the-art driver education program. This resulted in the "Safe Performance Curriculum" (SPC), which involved over 70 hours of instruction allocated between classroom, simulator, closed course behind-the wheel training, and on-road training (some at night). The total hours and behind-the-wheel experience far exceeded the typical driver education course. A second driver education program was also developed and evaluated, the "pre-driver licensing curriculum" (PDL), which provided minimal training in skills required to pass the licensing test.

The study design was based on random assignment of students in DeKalb County, Georgia, to the SPC and PDL groups, as well as a control group receiving no formal education. This was an expensive project, costing more than 4 million dollars. A large sample size was used to provide a narrow confidence interval, permitting the detection of about a 15% difference in crash rates between groups. The assignment procedure resulted in 5,464 students in the SPC group, 5,430 in the PDL group, and 5,444 controls, for a total of 16,338 students.

The DeKalb data have been analyzed by several sets of researchers. Studies based on those assigned to the groups report minimal effects or negative effects. When crashes and violations were analyzed per licensed driver, the results did favor driver education in the first months after the courses were taken, but not after that. At 6 months, the mean crash rates for both the SPC and the PDL groups were virtually the same, and both were lower than the controls. However, these comparisons do not provide a valid test of driver education, because students were self-selected into the analysis by their decisions about when to obtain licenses.

Post-DeKalb Studies

Many studies have been undertaken since the seminal DeKalb experiment, using a variety of research designs that can be considered for evaluating the new ADTSEA curriculum. These include four additional random assignment studies; studies in which one type of driver education program is compared with another; studies involving statistical matching of non-random groups; studies of laws changing driver education requirements; and studies of newly introduced driver education programs. With rare exceptions, these studies have not found positive effects.

Driver Education Issues

Although it may be "common sense" to think that driver education is the preferred way to learn how to drive, it also makes sense that the notion of a traditional driver education course by itself producing safer drivers is optimistic. Generally, the courses are taught over short periods of time and most of the course is spent teaching basic vehicle handling skills. This leaves minimal time to try and teach *safe* driving skills, and safety messages can be overwhelmed by attitudes, motivations, peer influences, and other lifestyle factors that shape driving styles. Additionally, the audience for driver education may be relatively unmotivated regarding safety, the primary motivation being to learn enough to get a driver's license.

Studies have failed to show that driver education courses produce safer drivers. If driver education fosters earlier licensing, it could lead to additional crashes and injuries through greater exposure. It is well-established that when driver education is available at an early age, it fosters earlier licensing, which can lead to additional crashes and injuries.

Trends in Driver Education

The standard driver education package in the United States has long been based on the 30 (classroom hours) +6 (hours behind the wheel) formula for learner drivers. The 30+6 formula fit the high school curriculum format, and for many years, driver education was primarily taken in

high schools, or in commercial courses, which in most cases mirrored the high school format. Commercial programs are more varied, and developments in computer technology have led to changes in the way driver education is delivered. These changes feature simulator technology and computer-assisted learning, and often involve interactive programs. Other countries such as Sweden, Finland, and Australia are also trying out new forms of driver education.

The new ADTSEA program recommends 45 hours of classroom and 8 hours of behind-the-wheel driving instruction. It represents the latest thinking on what should be taught in a driver education course and how it should be taught. Its short-term nature and the inherent difficulty of achieving lasting change put it at a disadvantage in doing more than imparting the basic skills of driving. However, there are two important factors that may make for more favorable outcomes. One, the ADTSEA program is being introduced in States that now have graduated licensing systems, which may provide some motivation for safe driving practices since crashes can halt or reverse progress through the system; and two, the new ADTSEA program has a parent component, encouraging parent involvement in the licensing process in providing supervised driving practice and enforcing graduated licensing rules.

Experimental Design Alternatives

When designing the ADTSEA program evaluation, it is important that it be based not only on crash and violation records, but on some intermediate measures of interest: passing the driving test, knowledge about driving rules and safety issues, safe driving attitudes, on-road skills performance, and learner and parent satisfaction with the education. Time to licensure also needs to be measured. Ideally the ADTSEA program would be introduced in a setting in which driver education does not stimulate early licensure.

There are basically two design alternatives: the random assignment study, as in DeKalb, which is preferable, and some variation of a quasi-experimental design that has been used in other evaluations of driver education. The most likely quasi-experimental design candidates involve comparing non-random groups across ADTSEA and non-ADTSEA schools or communities; a before-after study of ADTSEA schools or communities; or a combination of the two: a before-after study involving both ADTSEA and non-ADTSEA programs.

Presently the ADTSEA program cannot be evaluated because it has been utilized only in piecemeal fashion. Thus it would be necessary to introduce the program systematically in schools or communities in a way that facilitates scientific evaluation. This would likely be a difficult task. The other major issues involve the large sample sizes required and resultant costs, and the administrative burden that would be involved in conducting a proper study.

Conclusions

This report chronicles the history of driver education in the United States and provides a review of studies on the effects of driver education programs around the world. Design alternatives and guidelines for evaluating the new ADTSEA program will be presented and discussed. An evaluation of the ADTSEA program is contingent on it being introduced in schools and communities so that it can be evaluated properly. This is not presently the case. Convincing

schools or communities to introduce the ADTSEA program in a way that facilitates a proper research design will be a challenge, and it should be noted that evaluating the program will be a high-cost venture requiring large sample sizes. Since prior driver education program evaluations have found zero effects, or even negative effects due to accelerated licensure, the possibility of these types of outcomes need to be considered before moving forward, and steps to reduce the earlier licensing effect would need to be introduced.

(Continued on additional pages)

"PREPARED FOR THE DEPARTMENT OF TRANSPORTATION, NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION UNDER CONTRACT NO.: DTNH22-05-D-25043. THE OPINIONS, FINDINGS, AND CONCLUSIONS EXPRESSED IN THIS PUBLICATION ARE THOSE OF THE AUTHORS AND NOT NECESSARILY THOSE OF THE NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION."

TABLE OF CONTENTS

I. INTRODUCTION

This is the final report of a study entitled *Feasibility Study on Evaluating Driver Education Curriculum.* Work covered in this report was carried out under Contract Number DTNH22-05-D-25043.

II. OBJECTIVE

The objectives of this project are to identify and examine previous evaluations of driver education programs, focusing on research design issues, and to determine the feasibility of conducting a comprehensive evaluation of the new driver education curriculum developed by the American Driver and Traffic Safety Education Association (ADTSEA).

III. BACKGROUND

The Young Driver Problem

The young driver problem in the United States is substantial, as it is in every motorized society. The United States is an early licensing country, most States allowing licensure at age 16, so the problem is greater than in countries that license at 17 or 18. Sixteen-year-olds have the highest crash risk per mile driven of any age group, and the highest fatal crash rate per licensed driver, even though the problem has been reduced somewhat with the introduction of graduated licensing systems (Williams, Ferguson, & Wells, 2005).

Given the high crash risk for beginning drivers, attention has been focused on ways to reduce their crashes. The reasons for their extra risk are well established. By definition, beginning drivers lack experience, and lack of experience is a known crash risk factor, whatever the age of driving onset (McCartt et al., 2005). Immaturity is another major crash risk factor, which on the roads is displayed as a more risky driving style compared with older drivers (Arnett, 1992). Youthful drivers are more likely than adults to speed, tailgate, choose smaller gaps, and display a variety of other risky driving practices (Romanowicz & Gebers, 1990; Jonah, 1986, 1987). Combining this driving style with lack of experience, which is manifested in lesser abilities to recognize and respond to hazards, elevates their crash rate. Countermeasures have to be able to deal with these twin contributors.

Driver Education as a Countermeasure

Driver education has long been in the forefront of ways to deal with the young driver problem. Beginners have to learn how to drive and it makes sense to most people that professional instruction should be superior to learning from family or friends. Driver education enjoys wide popular support among the general public (National Highway Traffic Safety Administration, 1996). It is widely assumed that driver education graduates are superior drivers, and in many States they are granted special privileges in accord with this belief. In many States, driver education graduates can be licensed at 16, whereas without driver education 18 is the minimum age. In other States, graduates are sometimes granted special privileges (e.g., fewer hours of supervised practice required in the learner period, or earlier termination of night driving restrictions) (Insurance Institute for Highway Safety, 2006).

Despite the widespread appeal of driver education, scientific evaluations have indicated that it does not produce safer drivers, that is, drivers less likely to be in crashes than comparable drivers without formal training. This conclusion is based on studies of a wide variety of driver education programs around the world, to be reviewed later. Since driver education is embedded in our culture and relied upon by families as a way to prepare their sons and daughters for licensed driving, this is a disappointing situation.

The next sections will recount the history of driver education in the United States, types of programs that have been tried, evaluations of driver education programs, research design issues,

and an assessment of what driver education can and cannot accomplish. Following this, the new ADTSEA program will be described and design alternatives discussed.

Driver Education History

Several historical reviews of driver education have been published (Stack, 1966; Nichols, 1970; Warner, 1972; Butler, 1982; Public Technology, 1986). The first known programs were developed between 1910 and 1920, but it was not until the 1930s that formal courses began to be offered. Beginning in 1949 and continuing in 1953, 1958, and 1963, a series of national conferences were held, sponsored by the National Commission on Safety Education within the National Education Association. These conferences represented a formal attempt to organize the movement and to bring standardization, consistency, and professionalism to programs that were developing across the United States. It was at the 1949 conference that the standard formula for high school driver education was put forward: 30 hours of classroom instruction and 6 hours of behind-the-wheel instruction. (Note that the term "driver education" as used in this report includes both didactic efforts to transmit knowledge and instill safe driving attitudes through classroom instruction, and on-road training skills needed to operate a vehicle on the roads and to illustrate safe and unsafe driving practices.) ADTSEA was formed in 1956 to represent the interests of the driver education community.

Between 1947 and 1967, enrollment in high school driver education courses increased from approximately 200,000 students in 3,000 public high schools to about 1,300,000 students in nearly 12,000 schools. In 1966 the U.S. Congress enacted the Highway Safety Act and identified driver education as a major crash countermeasure. With this Federal law, driver education became a designated priority program, and matching funds were made available to the States to support growth, quality improvement, and standardization of driver education programs.

The early growth and popularity of driver education were fueled by studies reporting it to be effective in reducing crashes. The first studies were done in the early 1940s and they began to accumulate. Allgaier (1964) reviewed 30 studies in the early 1960s and reported that the studies indicated that driver education was associated with reduced crashes and violations. However, many of these studies were of inferior quality, failing to control adequately for potential differences between students who received the training and those who did not. These studies came under increasing scrutiny by the research community. In the late 1960s, McGuire and Kersh (1969) noted that each of the 30 studies reviewed by Allgaier "included gross errors in experimental design." The most serious limitation of the early studies is that typically they did not control for differences between students who received training and those who did not. Many of the studies simply compared those who chose to take driver education with those who chose not to. These studies ran afoul of "volunteer bias," a well-known phenomenon in social science and medical research. Volunteer bias refers to volunteers typically having characteristics that make them noncomparable to those who do not volunteer. In the case of driver education, volunteers are typically individuals with lower crash risk than those not volunteering; in some cases, these volunteers may be more safety-conscious than individuals choosing not to take driver education. This is the actuarial basis for some insurance companies offering lower premiums for teenage drivers who have taken driver education courses, Allstate in 1952 being

the first to do so. However, the lower crash rate is not necessarily reflective of the effects of the courses themselves, since course participants would have a lower crash rate without taking the course.

Another class of studies tried to deal with the noncomparability issue through statistical analyses controlling for some of the differences between participants and non-participants. These studies tended to find reduced effects of driver education or no effects. For example, Conger et al. (1966) reported that when factors such as intelligence and social class were controlled, the differences in collision rates between teenagers with and without training were eliminated. However, it is not possible to control for all possible influential factors through after-the-fact statistical adjustments. This can be done for variables such as gender, academic achievement, and various demographic factors, but not for other likely influential factors such as safety-consciousness and motivation.

Uncertainty About Effects

The challenges to driver education resulted in a period of uncertainty about its effects, reflected in reviews done in the late 1960s and early 1970s. It became increasingly clear that there was little reliable evidence to support earlier claims of its effectiveness. Two reviews aptly summarized the state of knowledge. One review, by New York University (1968), stated that "no clear proof has yet been produced showing that driver education, as presently constituted, has a significant favorable effect on driver performance." By the same token, the review also concluded that "no clear proof has as yet been produced showing that driver education, as presently constituted, does not have a significant effect on driver performance." Similarly, a review by Page-Valin et al. (1977) concluded that "no definitive information exists regarding the effectiveness of driver instruction in achieving many of its objectives;" and that "the effectiveness of formal instruction as a preventive countermeasure to the involvement of young drivers in traffic crashes and violations has yet to be investigated definitively."

Resolving the Uncertainties: the DeKalb Study

Because of the Federal law supporting driver education, NHTSA had keen interest in determining its effectiveness, and embarked on a major long-term program to develop a state-of-the-art driver education program and evaluate it in a way that would be definitive. NHTSA was urged to develop this program by the U.S. Congress as well as by both proponents and critics of driver education. This long-term research and development program took place in the late 1970s and early 1980s. It involved, among other exercises, a thorough analysis of the driving task, with identification of more than 1,700 driving behaviors that were then rated by safety experts in terms of their criticality to safety. The tasks rated as having high or moderate importance were used as the basis for a new driver education program called the "Safe Performance Curriculum" (SPC). These included basic vehicle control skills, environmental factors that affect driving, complex perceptual skills to avoid risky driving situations, driver impairments, emergency situations, and personal readiness. The SPC was the most advanced driver education program ever developed, and involved over 70 hours of instruction allocated between classroom, simulator, closed-course behind-the wheel training, and on-road training, including some at

night. The total hours and behind-the-wheel experience far exceeded the typical driver education course.

A second driver education program was also developed and evaluated, the "pre-driver licensing curriculum" (PDL). The PDL program provided minimal training in skills required to pass a license test, including about 20 hours of classroom, driving range, and simulation instruction. PDL students received only one hour of on-road instruction. The total hours of instruction and on-road experience were thus substantially less than in the standard high school driver education course.

There were also special teachers hired specifically for the driver education courses. Instructors were recruited from around the country. They were highly trained, motivated, and closely supervised. They taught both the SPC and the PDL courses to minimize instructor influence on the evaluation outcome. The two courses were taught at four training centers, designed and built specifically for the project.

The study design was based on random assignment of students in DeKalb County, Georgia, to the SPC and PDL groups and a control group receiving no formal education. Random assignment is the experimental paradigm for outcome studies of this type, ensuring that the students being compared come from the same population. Student participants were limited to those who said they wanted to obtain their license as soon as possible.

Assignment was done on a stratified random sampling basis. Each student volunteer was classified by gender, grade point average, and socioeconomic status (SES). These are factors expected to be related to crash likelihood. Then, for each participating school, students of the same gender, grade point average, and SES were grouped together, and then randomly assigned to one of the three groups, SPC, PDL, or control. This procedure ensured that the three groups would be matched on these factors.

This was an expensive project, costing more than 4 million dollars. A large sample size was used to provide a narrow confidence interval, permitting the detection of about a 15% difference in crash rates between groups. The assignment procedure resulted in 5,464 students in the SPC group, 5,430 in the PDL group, and 5,444 controls, for a total of 16,338 students.

Findings of Five Studies

The DeKalb data have been analyzed by several sets of researchers (Stock et al., 1983; Smith & Blatt, 1987; DeWolf & Smith, 1988; Lund et al., 1986; Davis, 1990). As Mayhew and Simpson (1996) noted, "…it is likely that such an intense level of scientific assessment concentrated on a single project is unparalleled in the field of road safety." They go on to add that, "Unfortunately, despite these concerted efforts to resolve the issue regarding the effectiveness of an improved driver education program, the value of driver education remains controversial."

However, the results of the studies and the design and evaluation issues involved in the DeKalb study are actually quite clear cut. Study findings range from negative effects to no effects to positive effects of the SPC program, the differences mainly depending on what groups or

subgroups are compared. There is agreement in all studies that driver education resulted in earlier licensure, although the early licensing effect was lessened by inclusion in the study population of only those students who said they planned to obtain their licenses as soon as possible. These students may be expected to become licensed rapidly even without the added stimulus of driver education. It is unknown how many students were excluded on this basis, but such students should be more susceptible to any licensure effects of driver education and the study's effect is biased downward by their exclusion.

The studies based on those assigned to the groups reported no effects or negative effects, while studies using the most sophisticated statistical analyses reported negative effects (Lund et al., 1986; Davis, 1990). The Lund et al. (1986) study concluded that, "Despite the presence of factors that would constrain the licensure effect of driver education, students assigned to SPC were at significantly greater hazard of crashing and of receiving traffic violations than were comparable control students. There was no evidence that SPC (or PDL for that matter) reduced the per capita likelihood of crashes or violations, even during the first six months of eligibility for licensure."

When crashes and violations were analyzed per licensed driver, the results did favor driver education in the first months after the courses were taken, although not after that. It is plausible that if there is a positive effect of driver education, it should be evident shortly after the course and fade over time. At 6 months, the mean crash rates for both the SPC and the PDL groups were virtually the same, and both were lower than the controls. However, these comparisons do not provide a valid test of driver education, because students were self-selected into the analysis by their decisions about when to obtain licenses. That is, the random assignment procedure ensuring comparability among groups was violated. Therefore, using the reduction in crash risk per licensed driver to infer a protective effect of driver education assumes either that licensing decisions were independent of the course assignments, or that, once licensed, students with and without driver education were similar in factors related to crash risk. Both assumptions are contradicted by the results. The original report on the DeKalb study indicated that students receiving driver education were licensed sooner than students not taking driver education; moreover, the control students reported more driving exposure per licensed driver (Stock et al., 1983). Thus, the reduced crash experience per licensed driver among those assigned to driver education reflects lower average driving exposure, which is probably due to different reasons for licensing. In any event, because of subject self-selection, the crash rate per licensed driver is not a valid measure of the effects of driver education.

Even if the comparisons based on licensed drivers constituted a valid test of the effect of driver education, the finding that the PDL group (bare bones driver education) did as well as the SPC group (greatly enhanced driver education) is curious and renders the evidence for the effectiveness of driver education highly ambiguous. In all the analyses of the DeKalb data the PDL group did as well or, in some analyses, better than the SPC group (Smith & Blatt, 1987; Lund et al., 1986). This finding has no satisfactory explanation, but it does not provide an argument for the effectiveness of driver education.

Overall, providing driver education in DeKalb County resulted in no benefits, or negative effects, depending on the study. If driver education provided any additional crash-avoidance skills, they

were inadequate to compensate for the early licensure effect. Early licensure provides extra mobility to teens, which has benefits, but this comes at the expense of safety.

The DeKalb study was an important milestone, albeit with results that were disappointing. However, as one of the authors of the original report points out, the study did have some ancillary benefits in generating new thinking about the role of driver education in young driver licensing, and providing early support to the value of implementing graduated licensing programs (Weaver, 2006).

Decline in High School Driver Education

Although driver education remains popular, there has been a decline in high school driver education since the DeKalb study. Unfortunately there is no longer any good way to keep track of how many schools offer driver education, how many students take driver education, and what types of courses they take. However, it is known that many high schools dropped driver education for financial and other reasons, including the unfavorable results of the DeKalb study. In addition, driver education was dropped from NHTSA's list of priority programs, and as a result Federal funding for driver education was significantly reduced.

DeKalb was not the end of research on driver education effectiveness, however, as many studies have been undertaken post-DeKalb. Almost all the studies have not found positive effects of driver education, but they are reviewed here because they illustrate some design alternatives that have been used in evaluation studies, and that can be considered in evaluating the new ADTSEA program.

Post-DeKalb Studies

Random Assignment

Some additional random assignment studies have been conducted, one in Australia (Strang et al., 1982), one in New Zealand (Wynne-Jones & Hurst, 1985), and one in Sweden (Gregersen, 1994). In Australia, the effectiveness of combinations of on-road and off-road training versus informal training was studied. About 800 males ages 17-19 who volunteered for the program were randomly assigned to one of four groups involving three different combinations of theoretical, on-road and off-road behind-the-wheel training, and a fourth group with no formal training. The trained groups scored higher on tests regarding knowledge of the law and safety factors, but there were no differences among the four groups in subsequent collision involvement.

In New Zealand, an evaluation was conducted of the New Zealand Automobile Association's secondary school driver training program for students ages 15-18. Students were provided with 12 hours of classroom instruction on traffic law, attitudes, and motor mechanics, and 16 hours of in-car instruction – 8 hours behind the wheel and 8 hours as an observer. A total of 788 students were randomly assigned to this training or a control group, and matched on age, gender, and exposure. There were no significant differences between the two groups on violations or crash involvement.

In Sweden, 17-year-olds were randomly assigned to a parent training group or a group that received parent training in conjunction with professional driving instruction. The group with professional training also was exposed to an educational component and driving lessons to be completed at home. They also were asked to provide verbal commentary on actions, observations, and potential risks while driving, and they were exposed to various situations to demonstrate their skill limitations. The results showed a significantly greater collision rate for the professional instruction group in the first year following training, and a significantly lower risk the second year, and no effects overall, based on both years combined.

One Program Compared With Another

Studies in Virginia (Ohlson & Stoke, 1986) and Ohio (Barner, 1987) compared students who completed high school driver education courses with students who completed commercial driving courses. These studies addressed the relative effectiveness of two types of driver education, not the absolute effectiveness of formal driver training. In these two States, driver education is required as a condition of licensure prior to age 18, so no control group was available. Both studies found that students who completed the commercial courses had higher crash rates than the high school course graduates. No conclusions can be drawn, however, because students chose which course to take, and there is no way to determine if students in the different courses were similar on variables related to crash involvement. Efforts to equate the groups or control for differences between groups statistically were not employed.

Statistical Matching of Non-Random Groups

Some studies have attempted to equate non-randomly assigned groups, usually through statistical manipulations. As indicated earlier, this can be done only imperfectly, because typically not all variables of interest are available, and it is impossible to control for potential differences in attitudes and motivations, which may be key factors. One interesting approach to this problem was used in a study of high school driver education in Oregon (Jones & McCormac, 1989). In an attempt to lessen the potential confounding effects of self-selection, the study compared students who took driver education with a group of students who said they would have taken it had it been available to them. However, the groups were not matched on potentially confounding variables such as grade point average, which may have affected the results. In any case, there were no statistically significant differences between the groups on subsequent crash involvement.

A study in Pennsylvania was conducted to evaluate the effectiveness of driver education programs in that State (McKenna et al., 2000). Comparisons were made among those who had taken a high school driver education course, those who had driving school instruction, and those who reported no formal education or training. Statistical analyses were used to control for extraneous variables. There was no evidence of lower crash likelihood for the education groups.

Two Tasmanian studies compared those who had taken driver education with a statistically matched group that did not. There were two education groups, a 12-hour course taught by road safety officials and a group completing the same course plus another 12-hour course taught by secondary school teachers. In the first study, there were no differences between the education groups, but both had slightly lower crash rates than the no-education group (Langford, 1997). In the second study, based on a large sample (about 34,000), retrospective matching of the groups

was improved, and nonsignificant differences were found between the education and no-education groups (Langford, 1998).

Introduction of a Law

When a new law pertaining to driver education is enacted, this provides a study opportunity. This happened in Quebec in the 1980s when a mandatory driver training requirement was introduced. An evaluation was undertaken that examined the crash rates of newly licensed 18- to 25-year-olds before and after the legislation was introduced (Potvin, Champagne, & Laberge-Nadeau, 1988). The authors estimated that prior to the legislation, 30-40% of newly licensed drivers had not taken driver education, whereas in the post-law period all were trained. To control for other factors that may have influenced crash rates in Quebec over the time period studied, 16- and 17-year-olds were used as a control. Throughout the study period, 16- and 17-year-olds had been required to take driver education.

Study results suggested that driver education may have yielded marginal safety benefits, which were offset by the earlier licensure of new drivers. There were increases in crash rates among both 16- to 17-year-olds and 18- to 25-year-olds in the post-law period, but the mandatory training appeared to dampen the increase in property damage crashes among males and injury crashes among females.

In 1993 the State of Louisiana enacted a law that required 15-year-olds to complete a 26-hour driver education requirement. Licensing was available at age 15, but this requirement made it more difficult and more costly to be licensed early, the courses costing several hundred dollars. Alternatively, at age 16, only a 6-hour course was required. The new driver education requirement for 15-year-olds reduced the per capita crash rate for 15-year-olds by 11-20%, the result of a reduction in 15-year-old licensure by about one-third. Crashes per licensed 15-year-olds actually increased (Ulmer et al., 1999). This is a case where a driver education program put in place reduced rather than increased early licensure, with positive effects on crashes.

Introduction of a New Driver Education Program

The introduction of a new driver education program also provides study opportunities. In Denmark, a new system of mandatory driver education was implemented in 1986. The new system emphasized defensive driving, basic skill training on a closed course, progressively more difficult training on the road and at night, classroom instruction in conjunction with practical training, and a written test. The annual number of crashes was examined for a total of 11 years before and after the program. The crash records of 25- to 54-year-old drivers, who were unaffected by the implementation of the new driver education program, were examined for comparison. Results indicated that the group affected by the law experienced a 35% decrease after the law went into effect, compared with a 17% decrease among the comparison group (Carstensen, 1994). Thus the new program appeared to have a positive effect.

Summary of Driver Education Evaluation Results

The Danish study is one of the few evaluations of driver education to show positive effects. There have been five recent comprehensive international reviews of the best scientific evaluations of driver education programs for young beginners (Mayhew et al., 1996; Vernick et al., 1999; Wooley, 2000; Christie, 2001; Roberts & Kwan, 2002). All come to the same conclusion that overall, based on a wide variety of driver education programs, there is little evidence that the crash records of driver education graduates differ from those of students without formal training. The most current review, from Australia (Christie, 2001) states, "There is little evidence that pre-license training reduces crash rates among novice drivers in the short or longer term." The review continues, "The research literature suggests that, beyond imparting basic car control and road law knowledge skills, pre-license driver training/education contributes little to post-license reductions in casualty crashes or traffic violations among novice drivers. In addition, mandatory pre-license training or even formal pre-license training/education, such as high school driver education programs in the USA, may contribute to increased exposure-to-risk for young drivers, particularly females, by encouraging early solo licensing. There is also considerable evidence that driver training that attempts to impart advanced skills such as skid control to learner drivers may contribute to increased crash risk, particularly among young males. This pattern of results has been confirmed and replicated across numerous studies conducted in Australia, New Zealand, North America, Europe, and Scandinavia during the last 30 years."

Why Driver Education Does Not Produce Safer Drivers

Although it may be common sense to think that driver education is the preferred way to learn how to drive, realistically it also makes sense to think that the notion that a driver education course can produce safer drivers is an overreach. The courses generally are of short duration, and most time has to be spent teaching basic vehicle handling skills. This leaves less time to try to teach safe driving skills. The audience for driver education may also be relatively unmotivated regarding safety, the primary motivation being to learn enough to get a driver's license. Probably the biggest impediment to driver education effectiveness involves the inherent difficulties in affecting lifestyle and developmental factors: the attitudes, motivations, peer influences, and cognitive and decision-making skills that are so influential in shaping driving styles and crash involvement. Safety messages can readily be overwhelmed by these ongoing influences. In this context, Pat Waller (1997) long ago pointed out the unrealistic expectations for the driver instructor compared with the way other teachers are judged. She asked, "Should the driver education teacher be responsible only for whether the student can drive adequately, or whether he actually does drive in this manner," and went on to note the many outside influences that shape subsequent driving performance.

The situation for driver education is really no different than that of short-term school-based courses attempting to influence the use of alcohol, other drugs, or tobacco. These health education programs have also largely failed, for many of the same reasons driver education courses have (Dielman et al., 1989; Ellickson, Bell, & McGuigan, 1993; Hansen, Malotte, & Fielding, 1988; Baer, MacLean, & Marlatt, 1998; Ellickson & Bell, 1990).

Driver Education Can Make Things Worse

Studies have failed to show that driver education courses produce safer drivers. The quote from Christie (2001) indicates the mechanisms for this outcome: early licensure that provides more opportunities to crash, and courses that unintentionally encourage risk- taking.

It is well established that when driver education is available at an early age, it fosters earlier licensing, which leads to additional crashes and injuries. The requirement in many States that driver education be taken in order to be licensed prior to age 18 is one way driver education leads to earlier licensure. However, independent of driver education requirements, the easy availability of driver education has been found to lead to earlier licensure both in States where it is optional and States where it is required (Lund, Preusser, & Williams, 1987). The strength of this relationship was demonstrated when some Connecticut high schools dropped driver education, which led to a 73% decline in licensure among 16- to 17-year-olds and a substantial decline in crashes (Robertson, 1980). Note, however, that there are cases where driver education can pose a barrier to early licensure, as in Louisiana, when the introduction of a tough and costly driver education requirement reduced licensure and crashes (Ulmer et al., 1999).

The early licensure phenomenon was a critical factor in the DeKalb study, and other studies have confirmed the commonality of this finding in the United States (Robertson & Zador, 1978; Seaver et al., 1979; Levy, 1998, 1990). The relationship between driver education and early licensure is not restricted to the United States. It also has been reported in studies in Australia, Canada, England, and New Zealand (Shaoul, 1975; Potvin, 1991; Wynne-Jones & Hurst, 1985; Langford, 1997).

Some have argued that attributing increased crashes to driver education because it leads to earlier licensure is inappropriate, pointing out that by agreeing to license teens at a specific age, driver education is simply a means of achieving a socially accepted goal, and that any group of people who drive will have crashes. In commenting on this position, Mayhew and Simpson (1996) have noted that "It is not evident that the decision to support driver education as a means of achieving an acceptable goal (licensing) is made through a consideration of the various mobility and safety tradeoffs. Indeed, society agrees to license learners who have successfully completed driver education because of the perceived safety benefits of such programs—driver education is expected to minimize the risk. Legislatures do not mandate driver education to provide youth with an easy access to driving. The critical issue then would be whether society is willing to accept the mobility benefits of driver education/training given the potential safety disbenefits." Without any valid evidence that driver education itself lessens crash risk, this would seem to be a dubious proposition.

This debate is highlighted because it is prominent in discussions about the most appropriate way to evaluate driver education programs, specifically whether the analysis should be based on all those assigned to the program (which captures the early licensing effect, plus any effects of driver education) or only on those who become licensed (which supposedly captures the effects of driver education alone). In the DeKalb study, where this issue was critical, students self-selected into the licensed driver subgroup in a way that invalidated analyses based on licensure as reflecting the effects of driver education.

Another way driver education can worsen the problem is through courses that unintentionally encourage risky driving. Specifically, courses that teach advanced driving maneuvers can produce adverse outcomes. These courses are currently very popular in the United States as a way to supplement basic driver education. The courses are generally taught by police or in advanced driving schools using test track facilities. Several studies, however, have shown that young people, particularly males, who take these courses are more likely than comparable drivers without such training to be in crashes (Jones, 1993; Glad, 1988; Katila et al., 1995). It is not entirely clear why this occurs, but it is clear that superior skills do not necessarily translate to superior driving records and in fact may result in more crashes. Highly trained and experienced racecar drivers, for example, have been found to have worse crash records than run-of-the-mill drivers, adjusting for age, gender, and mileage (Williams & O'Neill, 1982). Advanced skills can translate to overconfidence and risk-taking. For young drivers, the immaturity factor, involving decision-making and peer influences, may also contribute. Young people may create extra opportunities to try out the advanced maneuvers, showing off for their friends. This is an example of how skills learned through driver education can interact with developmental and lifestyle factors typical of young people and produce unintended results.

Driver Education Goals

Given the track record of driver education, there has been discussion about the appropriate goals for this endeavor, some arguing that it should be evaluated on criteria other than safety benefits. This discussion has come both from driver education advocates, who understandably do not want driver education to be judged a failure, and from those who think crash reduction benefits are out of reach, and that more realistic but worthwhile goals should be set. These goals include such outcomes as passing the licensing test, knowledge about driving rules and procedures, and on-road driving skills. Professional instruction can reasonably be expected to be superior in achieving these goals, and there is some evidence for this (Hattaka et al., 2003). Notably, in the DeKalb study, SPC students did better than the other groups on the University of Southern California road test (Stock et al., 1983). However, it is the driver education community itself that has insisted that safe driving is the overriding goal of driver education programs. For example, a 1975 report to Congress on driver education stated, "Basically, the idea of training persons to operate motor vehicles stems from the assumption that trained or experienced persons will perform better in most traffic situations than untrained or inexperienced people. The beginning of driver and safety education was based primarily on this assumption, and most programs were implemented on the basis of their face validity for accident prevention. In addition to the commonsense emphasis placed on the skills required for driving, a similar emphasis was placed on the development of assumed safe-driving attitudes, with the belief that such attitudes would result in fewer crashes and that such attitudes could be manipulated or developed" (NHTSA, 1975).

This focus on safe driving as a goal of driver education has been stated and restated many times over the years by driver education proponents. In a recent review of driver education, Mayhew and Simpson (1996) summarized the situation as follows: "Teaching skills needed to pass the

road test, however, is not the only, or most important stated objective of driver education. The principal goal of many, if not most, driver education and training programs is to produce "safer" drivers, defined in terms of collision involvement. Simply put, it is assumed that drivers exposed to formal instruction should have lower crash rates than those who do not receive such instruction, that is, those who learn to drive informally."

Given this insistence on the bottom-line goal of producing safer drivers, crash involvement is an important criterion to include in evaluations of driver education programs.

Old and Newer Types of Driver Education

The standard driver education package in the United States has been based on the 30 (classroom hours) +6 (hours behind the wheel) formula for learner drivers. The 30+6 formula fit the high school curriculum format, and for many years, driver education was primarily taken in high schools, or in commercial courses, which in most cases mimicked the high school format.

In the last decade there have been major changes in how driver education is offered. Driver education programs using public funds are now less available, and many schools that used to offer it no longer do. Traditional methods of education – classroom instruction and on-road training – continue to be used widely. However, commercial programs are more varied, and developments in computer technology have led to changes in the way driver education is delivered, featuring simulator technology and computer-assisted learning, often involving interactive programs. There are now many sources of driver education material and training, including not only schools and commercial courses, but government agencies, manufacturers, insurers, law enforcement agencies, and highway safety organizations. Moreover, there are programs available both for learners and for young licensed drivers with some experience.

Other countries also are trying out new forms of driver education. For example, the Swedish Insight program is designed to help drivers gain insight into risk factors and their own skill limitations. Drivers are exposed to various driving situations at an off-road center, up to 20 exercises such as assessing stopping distances and estimating safe driving distances, and undergo a process of self-diagnosis facilitated by group discussions. A program used in Finland includes a compulsory course for drivers with 6 to 24 months of driving experience, with the focus on self-awareness and little emphasis on skill or vehicle control. The program involves a mixture of on-road and off-road driving, one-to-one feedback and group sessions, and facilitated discussions on risk identification and management. A program offered by the Royal Automobile Club of Victoria, Australia, (Parents Plus) combines parents and professional instructors in the management of pre-license driving, starting with an initial driving lesson where a parent is invited to join the learner and instructor. The intention is to encourage parents to ask questions and request advice on how to manage supervised driving instruction, motivate the provision of 120 hours of supervised driving, and introduce parents to support and guidance materials on providing supervised on-road experience.

Evaluations of the Swedish and Finnish programs have produced somewhat encouraging but not conclusive results. Swedish-style insight training programs have been found to be associated with changes in attitudes and self-reported behaviors associated with reduced crash risk

(Senserrick and Swinburne, 2001). Participants in the Finnish training program had a decrease in crashes, but in this before-after study, there were contaminating effects from general crash trends (Hattaka et al., 2003). Other programs in the United States and elsewhere have not been evaluated. They provide, however, an illustration of the types of new driver education programs that have been developed.

The New ADTSEA Program

The latest version of the ADTSEA program expands the standard 30+6 formula to 45 hours of classroom and 8 hours of driving instruction. The driving segment is still quite limited. It represents the latest thinking on what should be taught in a driver education course and how it should be taught, but its short-term nature and the inherent difficulty of achieving lasting change in a behavior that is influenced by so many other factors puts it at a disadvantage in doing other than imparting the basic skills of driving. There are, however, two important factors to consider. The ADTSEA program is being introduced in States that now have graduated licensing systems. These systems may provide some motivation to apply safe driving practices, since many of them have "contingent advancement" provisions in which progress toward graduation is halted or reversed if violations or crashes occur. Secondly, the new ADTSEA program has a parent component, encouraging parent involvement in the licensing process in providing supervised driving practice and enforcing graduated licensing rules. This combination of elements may produce more favorable outcomes than in past evaluations of driver education programs. The goal of the evaluation is to see what the new ADTSEA program can reasonably be expected to do as part of an integrated approach to driver licensing, including effects on knowledge, on-road driving skills, and violations and crashes.

IV. EXPERIMENTAL DESIGNS

Design Alternatives for the ADTSEA Program

Outcome Measures

In designing an evaluation of the ADTSEA program, it is unlikely that the ideal can be attained, but there are some preferences that can be stated at the outset. First, it is important that the evaluation be based not only on crash and violation records, but on some intermediate measures of interest: passing the driving test, knowledge about driving rules and safety issues, safe driving attitudes, on-road skills performance, and learner and parent satisfaction with the education. It has been suggested, and it may be possible, to develop driver training effectiveness outcome measures based on driving simulators and computerized or video-based tests. As Peck (2005) has pointed out, the best measure of driving performance (even better than crashes) would be unobtrusive observations of post-license driving behavior over time in a variety of situations. That would obviously be difficult to obtain. However, all feasible intermediate measures should be captured. As will be seen, with some designs this can be done, and with others not.

Time to licensure also needs to be measured. Ideally the ADTSEA program would be introduced in a setting in which driver education does not stimulate early licensure. As indicated earlier, early licensure has negative safety benefits and complicates evaluations of driver education programs. Earlier licensing would not be a factor if, for example, driver education were required for licensure prior to age 18 and it was not available in high schools at least until the junior year (and no commercial courses were available). That situation is unlikely to exist. It would be preferable, however, to introduce the ADTSEA program in States with graduated licensing systems that impose significant restrictions on driving until age 18, which to some extent blunts the effects of early licensure.

Random Assignment

There are basically two design alternatives: the random assignment study, as in DeKalb, and some variation of a quasi-experimental design. The random assignment study is by far the superior design, allowing the establishment of comparisons groups that are truly comparable. In addition, individual student participants are accessible to provide information on all the intermediate behavior and attitude measures of interest.

Quasi-experimental Studies

The other design possibility is a naturalistic study, examining the effects of the ADTSEA program as it is introduced in schools or communities. Outcome measures in comparable schools or communities with and without the ADTSEA program could be compared. Of course, if the program were implemented in schools where some take it and some do not, these groups could be compared to assess program effects, but as discussed earlier, comparing self-selected groups constitutes a weak design, if not designed and conducted appropriately.

If schools could be studied prior to the ADTSEA program being introduced, this would allow the opportunity to study a pre-program group, collecting all outcome measures of interest. If the program has already been put in place, crash records of a pre-program group could be obtained

from official records, but not measures of knowledge, attitudes, driving skills, etc. Note that any before-after study designs provide a test of ADTSEA in comparison to whatever the prior driver education program was.

It would be preferable that the ADTSEA program be studied in a State in which driver education is a condition of licensure prior to age 18, and most students who are going to get a license take high school driver education. This would allow the entire school population to be studied, whereas if only a portion of students take the course, this would constitute a weaker test of driver education effectiveness if based on the school population. Or, it would be necessary to obtain names and crash records of individuals who took the program, and it might not be possible to do this for a pre-program group if the ADTSEA program had already been introduced.

In terms of past studies, the most analogous are those in Quebec and Denmark where a new driver education program was introduced (Denmark) or a new law came in requiring all to take driver education (Quebec). In both cases the study design involved a before-after analysis of the affected population, compared with age groups unaffected by the change, used to control for jurisdiction-wide changes over the time period studied. However, in both cases these were system-wide changes. In the case of the ADTSEA program, it will likely be instituted in some schools or communities and not others within the same State. If so, this presents the possibility of matching schools that introduce the ADTSEA program with schools that are similar demographically but do not introduce the program. Various research designs ranging from weaker to stronger are possible: comparison of students across schools or communities; before-after studies in ADTSEA schools or communities; or double comparisons involving crash records (and available intermediate variables) of students at the ADTSEA schools or communities before and after the program was introduced, compared with before-after changes in the crash records of presumably similar students at the matched non-ADTSEA schools.

The ADTSEA program cannot be evaluated presently using any of these possible designs. This is because the program has been implemented in schools or communities in only limited ways (Chaudhary et al., in progress). To the extent it is used, it has generally been added to existing driver education programs, often in piecemeal fashion. Individual schools (with their own guidelines) use what they want but rarely the whole program. Given this situation, a fair test of the ADTSEA program is not presently possible.

To evaluate the ADTSEA program, it will be necessary to have it be fully implemented in schools or communities. This has the advantage of potentially enhancing the ability to bring in the program in a way that facilitates its evaluation. The disadvantage, of course, is that it involves convincing schools or communities to replace their current driver education program with ADTSEA, rather than being able to set up an evaluation of an existing situation.

As discussed earlier, the preferred evaluation from a scientific standpoint is a random assignment study. One major downside to a random assignment study is cost. The DeKalb study, which included more than 5,000 participants per group and cost more than $4 million in 1970s/1980s dollars, was designed to detect a 15% reduction in 1-year crash rates with a confidence (power) of .80. More realistically, a 5-10% reduction in crash rates is probably the most that could be expected. To detect differences of this magnitude with sufficient power would require larger

sample sizes per group than DeKalb. Assuming that 20% of newly licensed drivers will have a motor vehicle crash in the first year of licensure, a study designed to detect a 10% crash reduction (to 18% incidence) as statistically significant at the .05 level at .80 power would involve 6,200 students per group (i.e., 12,400 for a two-group study). Detecting a 7.5% crash reduction would take 11,000 per group (22,000 total); a 5% crash reduction would require 25,000 students per group (50,000 total). These sample sizes would allow only overall comparisons. Comparisons of subgroups, for example, males and females, could be done but with reduced power to detect differences. Study elaborations such as investigating ADTSEA program effects in States with strong and weak graduated licensing systems would double sample size requirements.

There are other issues with a random assignment study. Finding a jurisdiction willing and able to host such a study can be a major issue. The administrative burden is large. The DeKalb school system had a superintendent who championed the program, on the basis that a large number of students would be getting quality driver education cost-free, and the school system would have permanent ownership of the four Federally funded driver education centers. Another issue is that many control group parents wanted their sons and daughters to have driver education, which was being withheld from them, and they wanted the insurance discount that driver education students received (about 10%). This was partly handled by arranging for the control group students to get the same discount. Withholding driver education from students who want to take it would assuredly be a major issue in any re-do of a DeKalb-type random assignment study. On the other hand, assigning students to a program similar to those that in the past have had no effects, or negative effects, also will be an issue. A third issue is possible contamination of the groups. In the DeKalb study, students in each group had friends who were in the other groups, an inevitability of school-based random assignment studies. What effect, if any, this had is unknown. One possible effect is that control students got their licenses earlier than they otherwise would, as they saw their friends in the driver education groups getting licensed. This is another reason why the early licensing effect of driver education may have been underestimated in the DeKalb study. This is also a reminder that ethical standards call for steps to be taken in introducing the ADTSEA program that would blunt the early licensing effect, which increases crash risk. A school or community would need to agree to adjust the timing of the course in a way that did not allow driver education students to drive sooner than non-driver education students.

Any of the quasi-experimental studies discussed to evaluate the ADTSEA program would have the same sample size issues. This approach would also involve convincing multiple schools or communities to adopt a new driver education program, conducting a before-after study, or convincing demographically similar schools or communities without the ADTSEA program to participate as comparisons. The recruitment challenge with studies of this type may be even greater than in the case of a random assignment study.

V. CONCLUSIONS

This report has chronicled the history of driver education in the United States and provided a review of studies of the effects of driver education programs around the world. Design alternatives and guidelines for evaluating the new ADTSEA program have been presented and discussed. Thus far the program has not been utilized in a way that can be scientifically evaluated, and it would need to be introduced in schools or communities in ways that facilitate its evaluation. An adequate evaluation of the ADTSEA program will be an extremely high-cost venture, and will require an environment in which there is community acceptance and leadership, and the administrative apparatus to support such a program. However, given the popularity and overwhelming public support of driver education as a viable traffic safety intervention for teen drivers, the benefits of evaluating such programs may outweigh the costs. Since almost all prior driver education program evaluations have not found positive effects on crashes, and some have found adverse effects, the possibility of these outcomes also needs to be considered, with steps taken to eliminate the early licensing effect.

VI. REFERENCES

Allgaier, E. (1964). Driver Education Reduces Accidents and Violations (No. 3782). Washington, DC: American Automobile Association.

Arnett, J. (1992). Reckless behavior in adolescence: a developmental perspective. *Developmental Review, 12*, 339-373.

Baer, J. S., MacLean, M. G., & Marlatt, G. A. (1998). Linking etiology and treatment for adolescent substance abuse: towards a better match. In: Jessor, R. (Ed.), New Perspectives on Adolescent Risk Behavior. Cambridge, UK: Cambridge University Press.

Barner, B. M. (1987). Final summary: youthful driver record comparisons: commercial vs. high school trainees licensed 1984 and 1985. Washington, DC: National Highway Traffic Safety Administration.

Butler, G. T. (1982). Effectiveness and efficiency in driver education programs (DOT HS 806 135). Washington, DC: National Highway Traffic Safety Administration.

Carstensen, G. (1994). Evaluation of a new driver education in Denmark. In: Proceedings of the Conference Strategic Highway Research Program (SHRP) and Traffic Safety on Two Continents, Hague, Netherlands, September 22-24, 1993. Nr 1A, Part 2, 287-298. Linkoping, Sweden: Swedish Road and Transport Research Institute.

Chaudhary, N., Bayer, L., Ledingham, K., & Casanova, T. (In progress). Process Evaluation of Driver Education. Washington, DC: National Highway Traffic Safety Administration.

Christie, R. (2001). The effectiveness of driver training as a road safety measure: A review of the literature. Royal Automobile Club of Victoria, Australia.

Conger, J. J., Miller, W. C., & Rainey, R. V. (1966). Effects of driver education: the role of motivation, intelligence, social class, and exposure. *Traffic Safety Research Review, 10*, 67-71.

Davis, C. S. (1990). The DeKalb County, Georgia, Driver Education Demonstration Project: Analysis of its Longer Term Effect. Iowa City, IA: University of Iowa, Department of Preventive Medicine.

DeWolf, V. A., & Smith, M. F. (1988). Re-evaluating a federally-funded driver education experiment. Poster Session, American Statistical Association annual meeting, New Orleans, LA.

Dielman, T. E., Shope, J. T., Leech, S. L. et al. (1989). Differential effectiveness of an elementary school-based alcohol misuse prevention program. *Journal of School Health, 59*, 255-263.

Ellickson, P. L., & Bell, R. M. (1990). Drug prevention in junior high: a multi-site longitudinal test. *Science, 247*, 1299-305.

Ellickson, P. L., Bell, R. M., & McGuigan, K. (1993). Preventing adolescent drug use: long-term results of a junior high program. *American Journal of Public Health, 83*, 856-861.

Glad, A. (1988). Phase 2 driver education, effect on accident risk. Oslo, Norway: Transport Institute.

Gregersen, N. P. (1994). Systematic cooperation between driving schools and parents in driver education: an experiment. *Accident Analysis & Prevention, 26*(4), 453-461.

Hansen, W. B., Malotte, C. K., Fielding, J. E. (1988). Evaluation of tobacco and alcohol abuse prevention curriculum for adolescents. *Health Education Quarterly, 15*, 93-114.

Hattakka, M., Keskinen, E., & Baughan, C. (Eds.) (2003). Basic driver training: new models. EU-project, Final Report. Turku, Finland: University of Turku..

Insurance Institute for Highway Safety. (2006). U.S. Licensing Systems for Young Drivers (www.iihs.org).

Jonah, B. A. (1986). Accident risk and risk-taking among young drivers. *Accident Analysis & Prevention, 18*, 255-271.

Jonah, B. A. (1997). Sensation seeking and risky driving: a review and synthesis of the literature. *Accident Analysis & Prevention, 29*, 651-655.

Jones, B. (1993). The effectiveness of skid-car training for teenage novice drivers in Oregon. Salem, Oregon: Driver and Motor Vehicle Services.

Jones, B., & McCormac, K. (1989). Effectiveness of student driver training in Oregon: driving record comparisons after one year. Salem, Oregon: Oregon Department of Motor Vehicles.

Katila, A., Keskinen, E., Laapotti, S., & Hattaka, M. (1995). Changes in slippery road accidents as an effect of renewed driver training in Finland. Turku, Finland: University of Turku.

Langford, J. (1988). Further evaluation of Tasmania's pre-driver education program. Hobart: Road Safety Branch, Department of Transport, Tasmania.

Langford, J. (1997). Evaluation of Tasmania's pre-driver education program. Hobart: Road Safety Branch, Department of Transport, Tasmania.

Levy, D. T. (1988). The effects of driving age, driver education, and curfew laws on traffic fatalities of 15 year-olds. *Risk Analysis 8*(4), 565-570.

Levy, D. T. (1990). Youth and traffic safety: the effects of driving age, experience and education. *Accident Analysis & Prevention, 22*(4), 327-334.

Lund, A. K., Preusser, D. F., & Williams, A. F. (1987). Licensing decisions of teenagers. *Alcohol, Drugs & Driving, 3*, 93-105.

Lund, A. K., Williams, A. F., & Zador, P. L. (1986). High school driver education: further evaluation of the DeKalb County study. *Accident Analysis & Prevention, 18*(4), 349-357.

Mayhew, D. M., & Simpson, H. M. (1996). Effectiveness and Role of Driver Education and Training in a Graduated System. Ottawa, Canada: Traffic Injury Research Foundation.

McCartt, A. T., Mayhew, D. R., & Ferguson, S. A. (2006). Effects of age and experience on young driver crashes. Review of recent literature. Arlington, VA: Insurance Institute for Highway Safety.

McGuire, F. L., & Kersh, R. C. (1969). Evaluation of driver education: study of history, philosophy, research methodology, and effectiveness in the field of driver education. Berkeley and Los Angeles, CA: University of California Press.

McKenna, C. K., Yost, B., Muzenrider, R. F., & Young M. L. (2000). Program evaluation of Pennsylvania's driver education program. Harrisburg, PA: Pennsylvania Department of Transportation.

National Highway Traffic Safety Administration. (1975). Driver education and evaluation program (DEEP) study: A report to Congress. Washington, DC.

National Highway Traffic Safety Administration. (1996). 1995 Customer satisfaction survey. Washington, DC: U.S. Department of Transportation.

New York University (1968). Driver education and training plans for evaluating the effectiveness of programs (DOT FH 11-6560). Washington. DC: National Highway Safety Bureau.

Nichols, J. L. (1970). Driver education and improvement programs. In Heimstra, NW. Injury Control and Traffic Safety. Springfield, IL: Charles C. Thomas.

Ohlson, K. A., & Stoke, C. B. (1986). Driver education in Virginia: an analysis of performance report data (Report No. VHTRC 86-R22). Charlottesville, VA: Virginia Highway and Transportation Research Council.

Page-Valin, L., Simpson, H. M., & Warren, R. A. (1977). Effectiveness of driver education: what do we know and where do we go from here? Ottawa, Ontario: Traffic Injury Research Foundation of Canada.

Peck, R. C. (2006). Novice driver training effectiveness evaluation. In: Driver Education; the path ahead. Transportation Research Board Circular (No. E-C101), Washington, DC.

Potvin, D., Champagne, F., & Laberge-Nadeau, C. (1988). Mandatory driver training and road safety: the Quebec experience. *American Journal of Public Health, 78*(9), 1206-1209.

Potvin, L. (1991). The evaluation of compulsory driver training policy: Quebec 1980-1984. In Proceedings—New to the Road Symposium: Prevention Measures for Young or New Drivers, Halifax, Nova Scotia, Canada.

Public Technology. (1986). Driver education: fifty years of youth instruction. Falls Church, VA: AAA Foundation for Traffic Safety.

Roberts, I., Kwan, I., and the Cochrane Injuries Group Driver Education Reviewers. (2002). School based driver education for the prevention of traffic crashes. Oxford, England: The Cochrane Library, Issue 1.

Robertson, L. S. (1980). Crash involvement of teenaged drivers when driver education is eliminated from high school. *American Journal of Public Health, 70*, 599-603.

Robertson, L. S., & Zador, P. L. (1978). Driver education and fatal crash involvement of teenaged drivers. *American Journal of Public Health, 68*(10), 959-965.

Romanowicz, P. A., & Gebers, M. A. (1990). Teen and senior drivers. Sacramento, CA: Department of Motor Vehicles.

Seaver, W. B., Nichols, J. L., Carlson, W. L., & Voas, R. B. (1979). Driver education and the licensing of 16-17 year olds. *Journal of Safety Research, 11*(2), 50-61.

Senserrick, T. M., & Swinburne, G. C. (2001). Evaluation of an insight-training program for young drivers. Victoria, Australia: Monash Accident Research Center.

Shaoul, J. (1975). The use of accidents and traffic offenses as criteria for evaluating courses in driver education. The University of Salford, England.

Smith, M. F., & Blatt, J. (1987). Follow-up evaluation—safe performance curriculum driver education project: summary of preliminary results. Paper presented at American Driver and Traffic Safety Education Association Research Division Annual Conference, Spokane, WA.

Stack, H. J. (1966). History of driver education in the United States. Washington, DC: National Commission for Safety Education, National Education Association.

Stock, J. R., Weaver, J. K., Ray, H. W., Brink, J. R., & Sadoff, M. G. (1983). Evaluation of Safe Performance Secondary School Driver Education Curriculum Demonstration Project (DOT HS 806 568). Washington, DC: U.S. Department of Transportation.

Strang, P. M., Deutsch, K. B., James, R. S., & Manders, S. M. (1982). A comparison of on-road and off-road driver training. Hawthorn, Victoria: Road Safety and Traffic Authority.

Ulmer, R. G., Preusser, D. F., Ferguson, S. A., & Williams, A. F. (1999). Teenage crash reduction associated with delayed licensure in Louisiana. *Journal of Safety Research, 30*(1), 31-38.

Vernick, J. D., Li, G., Ogaitis, S., MacKenzie, E. J., Baker, S. P., & Gielen, A. C. (1999). Effects of high school driver education on motor vehicle crashes, violations, and licensure. *American Journal of Preventive Medicine, 16*, 40-46.

Waller, P. F. (1977). Driver education: where does it belong? *Journal of Traffic Safety Education, 25*, 7-9.

Warner, W. L. (1972). A brief history of driver education. *Journal of Traffic Safety Education, 19*(2).

Weaver, J. K. (2006). Personal communication.

Williams, A. F., & O'Neill, B. (1974). On-the-road driving records of licensed race drivers. *Accident Analysis & Prevention, 6*, 263-270.

Williams, A. F., Ferguson, S. A., & Wells, J. A. (2005). Sixteen-year-old drivers in fatal crashes, United States, 2003. *Traffic Injury Prevention, 6*, 202-206.

Wooley, J. (2000). In-car driver training at high schools: a literature review (Report No. 6/2000). Adelaide: Transport South Australia.

Wynne-Jones, J. D., & Hurst, P. M. (1985). The AA Driver Training Evaluation. Traffic research Report No. 33. Wellington, NZ: Ministry of Transport.

DOT HS 811 108
April 2009

U.S. Department of Transportation
National Highway Traffic Safety Administration