

Special Report 151

FUTURE ROLE OF DRIVER LICENSING IN HIGHWAY SAFETY

Transportation Research Board

1974

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FOREWORD

The first eight papers in this Special Report were presented at a conference session of the 52nd Annual Meeting of the Highway Research Board. The conference session was conducted by the Subcommittee on Driver Licensing established by the Committee on Road User Characteristics. Leon Goldstein was the chairman of the subcommittee, and its members were Frederick Vanosdall, Sam Yaksich, Jr., Robin McBride, Victor J. Perini, Albert Burg, John S. Eberhard, Harold L. Henderson, Paul M. Hurst, Richard A. Olsen, John N. Snider, and Patricia Waller.

The authors of the papers describe driver licensing from several viewpoints and discuss the past, present, and, most importantly, future roles of driver licensing in highway safety. A number of the authors agree that most current li-

censing practices do little to ensure that applicants possess the knowledge and skills required for safe driving.

Most of the papers offer suggestions for research essential for development of better licensing processes. Such research is admittedly costly in both time and money, however, and is likely to suggest licensing and testing procedures that will further increase the cost of administration.

The general comments by Patricia Waller and Olsen were prepared after the conference session and are included as further perspectives on the subject of driver licensing.

Safety and enforcement officials, driver educators, and license administrators should profit from consideration of the ideas presented for improved licensing.

ON THE FUTURE OF DRIVER LICENSING AND DRIVER LICENSING RESEARCH

Leon G. Goldstein
Chevy Chase, Maryland

For many years, to become licensed, drivers in most states have been required to demonstrate knowledge of the rules and laws of the road and the ability to read signs and traffic signals and to operate the motor vehicle for which a license is sought. A written test of knowledge and a road test of performance are generally used. These requirements and procedures are based on the common-sense rationale that this ensures a kind of preparation for the tasks of driving and that it protects both the individual driver and other users of the roadway.

Licensing as related to driving performance has been evaluated scientifically by determining the correlation coefficient between performance on the tests and subsequent accidents or violations. Accidents and violations are not highly predictable, by tests or any other means. Individual accident involvement is not a highly stable phenomenon from one period to another; correlations between accidents on record for one period of, say, 3 years to another range from 0.10 to 0.20. For violations, the correlations are somewhat higher: 0.30 to 0.50. And the correlations between violations and accidents in the same 3-year period are in the range of 0.20 to 0.30.

The contribution that current licensing programs make to safe motor vehicle op-

eration is unknown. That the tests usually consist of a 20-item multiple-choice test (sometimes just true-false) and a 10-minute road test, which requires the applicant to drive around the block and to park the car, casts doubt on whether the system makes much of a contribution. In previous years, before the advent of driver education in the public schools, it could have been said that having to take a test and having to demonstrate the ability to operate a car required the applicant to do some prior learning, to have someone teach him or her. It is dubious whether the perfunctory examinations make a real contribution, particularly with people who have gone through a formal course of education or training. Moreover, it might be argued that the system works in reverse; that is, after a brief cursory examination, the new driver is given a certificate that, in effect, identifies him as a qualified driver, fit to drive anywhere, anytime. I suspect that this gives the newly licensed driver a confidence in his or her ability that is quite unwarranted.

I propose that the licensing function be a much more thorough and comprehensive examination of each applicant, with a view to preparing him or her more thoroughly for the driving task than is currently required. For this purpose, it would be necessary to develop diagnostic

tests to identify shortcomings in knowledge, skills, attitudes, and other personal or physical characteristics. The licensing function would not only identify such shortcomings but also help the individual to overcome them, either by counseling or by specifying additional training, medical attention, or other kind of treatment needed. For such a diagnostic purpose, we need tests that are based on a rationale somewhat different from that of the employee selection situation, used so widely in the military and in industry, which is based on the correlation between performance on the tests and a measure of on-the-job performance.

For the selection situation, I think this procedure is essentially correct. For the function I am discussing, namely, diagnosis and remediation, I think it is demonstrably not optimal. It turns out that drivers become involved in accidents for a wide variety of reasons. No single characteristic or small number of characteristics account for more than a small fraction of the total accidents. (Alcohol is implicated in roughly half of fatal accidents, not all accidents.) Correlation may actually obscure or mask information that is vitally needed for the purpose of diagnosis and remediation. I submit that what is needed is a comparison of the mean accident rates for a group with a given characteristic and a control group where other relevant variables are appropriately controlled or accounted for.

The classic example of how correlation may obscure meaningful information comes from studies on cigarette smoking and lung cancer. In 14 studies, the correlation between smoking and lung cancer ranged from 0.001 to 0.009, but the incidence of lung cancer among smokers ranged from 1.2 to 39 times as high as among nonsmokers. If one considers only the (zero) correlation, one would conclude that there is no connection between cancer and smoking. The relative incidence tells a very different story. We have a similar situation in accident generation. The correlation between a variable and accidents may be zero or so small that it is not statistically significant unless very large samples are used; yet drivers on the extreme of the variable may have a considerably elevated accident rate compared with those who are at the middle. The reason is that many things cause accidents, and no one characteristic accounts for more than a small part of the total. For instance, visual acuity has only about a 0.08 correlation with accidents in a given period. Yet drivers with poor visual acuity may have a much higher accident rate than those with good or average vision. The point is that there are only few drivers who have very poor visual acuity. Those few who are found at the licensing examination to have poor vision usually are so informed. Similarly, applicants with other detectable, but yet to be determined, characteristics that are shown to be associated in a causal way with an elevated accident rate may need help.

The program I am suggesting would require a large research effort that would be more expensive and difficult than the correlation approach. We need large numbers of cases of drivers with a large variety of characteristics. For each characteristic to be studied we need a sizable pair of groups, one with the characteristic and the other without, on whom we also have accident data and control data.

The research would need to be done before the implementation of such a program to justify its cost. The same rationale is applicable to driver reexamination, improvement, and education programs. It would be expected that, at different ages, at different stages of driving experience, and with different sexes, many of the critical characteristics will be different. And only thorough research can identify the differences.

There are at least four points at which such a diagnostic-remedial approach appears to have particular promise:

1. Original licensing of young drivers whose accident rate could be reduced to that of 30-year-olds in 2 years of driving instead of 10;
2. Reexamination of drivers older than about 65, whose per-mile rate is about as high as for those below 25, but for different reasons;
3. Drivers of all ages who give evidence of trouble because they get into the point systems; and
4. Original preparation of drivers.

Not all students have the same needs, the same problems, or the same know-how and

abilities. Analysis of individual students' needs seems as important as analysis of the driving task. Certainly the sexes differ in their abilities, knowledge, and needs. But again, only competent (and expensive) research can determine these issues and develop effective means to deal with them.

Discussion

Frederick E. Vanosdall, Michigan State University

Goldstein's proposal for a more thorough and comprehensive examination of each applicant points to the need for the licensing process to motivate applicants to learn and overcome the areas in which they are deficient. In his rationale supporting improvements in driver licensing, Goldstein emphasized that (a) current procedures are based on common sense; (b) the value of licensing in achieving safe motor vehicle operation is unknown; (c) short-cut examinations requiring limited knowledge and skills are not reliable; and (d) issuance of a license might actually give a new driver erroneous confidence in his abilities, which may lead him to trouble.

Although these statements might be considered by some as an "indictment" against current licensing tests, they are true. Only in a few states have driver licensing authorities and interested researchers viewed licensing programs with scientific objectivity and initiated studies to guide development of methods for improving licensing examinations. (However, some existing tests, such as the road test, have been developed by using the methods proved useful in extensive experience gained through observation of drivers in the test environment—the real world.)

To improve licensing programs, Goldstein advocates developing diagnostic tests to identify limitations of applicants' "knowledge, skills, attitude, or other personal or physical characteristics," which then are pointed out to the individuals as a remedial process—to subsequently encourage more proficient performance.

The problem of motivating drivers to drive as well as they know how remains. Thus, Goldstein's auxiliary approach—to utilize diagnostic testing to determine what characteristics account for accident involvement—is a means of studying methods for controlling the variables in such a way to provide for remedial treatment. Such an approach will surely require long-term research and a reevaluation of the traditional criteria of accidents and violations as the basis for evaluating driver performance. Is not an intermediate criterion of driver performance relative to actual and potentially hazardous traffic situations a major need?

As indicated by several other authors, it seems that successful development of plans to conduct research beneficial to drivers, licensing agencies, and the public will require interested driver licensing authorities and researchers who jointly undertake projects on a long-term basis. In addition they should recognize that success cannot be achieved without legislative and public acceptance.

Goldstein's proposed effort has a practical appeal, but demands "freer thinking" than has been evident in the driver research being undertaken. It requires that a highly reliable and valid intermediate criterion for measuring real-world drivers' performance be found or established before diagnostic testing is initiated.

WHAT HAVE WE LEARNED TO DATE?

John C. Kerrick

American Association of Motor Vehicle Administrators

Walter Cutter, an experienced traffic engineer, began his remarks at a traffic safety research symposium with "I wish I were giving this talk thirty years ago—when I knew all the answers."

That remark strikes a responsive chord because, after more than 40 years in the field of driver licensing, I can recall times when I too knew all the answers. However, the more I have learned about the complexities of our problems, the more clearly I can recognize what Cutter described in his case as "the dimensions of my ignorance about it."

In considering the future role of driver licensing, perhaps we should ask ourselves whether we are considering the role of driver licensing as it probably will be if it continues at its present rate of public acceptance or as we believe it should be if developed to its full potential as a major contributor to traffic safety. If we are thinking in terms of the latter we might as well say at the outset that the role of driver licensing as it should be under ideal conditions has been known for many years, and it has not changed. The concept is basically simple.

Perhaps I should briefly review this basic concept and possibly draw out a few of the obstacles that we have encountered in trying to develop it. This is important because the same obstacles exist today, and as long as they remain we will only

continue a form of colorful but ineffective shadowboxing with the problem.

All will agree that all drivers must be licensed and that this is basic to an effective licensing program. At the same time, no one is so naive in traffic matters as to believe that all drivers are licensed now. On the basis of state reports, spot checks, and special surveys, it has been estimated that on any given day there are at least 10 million unlicensed drivers on the road. Although many drivers are simply careless about keeping a valid license, there are also many who cannot qualify for a license and many whose licenses have been suspended or revoked for bad performance.

A recent report from one state estimated that there were 400,000 unlicensed drivers in that state and revealed that 9.6 percent of drivers involved in fatal accidents were unlicensed at the time of the accident.

Regardless of the type of licensing program under consideration, can it truly be effective under such circumstances? Certainly not. That is one of the practical problems we have faced for years, and it is still with us. Ignoring it will not make it disappear. That has been tried.

The second basic requirement of an effective program is that licenses be issued only to those who are qualified to safely operate vehicles of a type they intend to drive. For this the uninitiated might have

a quick and easy answer: Make the qualifying tests more severe, make them more exacting, make them more meaningful, and on and on.

State after state has eliminated the simple parallel parking or skill test that was at one time a common road-test requirement. Why? The public regards this simple maneuver as unreasonable and unduly severe. In fact, in one state the legislature has enacted a law with the following provision: "provided, however, that persons 60 years of age and over, when being examined as herein provided, shall not be required to parallel park a motor vehicle as part of any such examination." One can only assume in this case that too many legislators were 60 years old and over.

This public unwillingness to accept more meaningful tests is another problem that is still with us, and, as in the first case, we cannot continue to ignore it with hopes that it will disappear.

Next, an effective licensing program is one that suspends the licenses of those drivers who perform poorly after being licensed; further, those who lose their driving privileges for lawful and legitimate reasons would stop driving until their driving privileges were restored. This is not what happens very often. It is only what we like to believe.

So far this discussion has been discouraging and possibly negative, but I am only trying to point out a few of the real-world situations confronting those who work on the "front lines" of driver licensing.

In all honesty, I believe that truly effective driver licensing is not a salable product. This has long puzzled me, and it still does.

I would like to briefly characterize an ideal program of driver control through licensing procedures—Utopia. Such a program could ensure that every driver we meet or pass in traffic is a licensed driver and that as a licensed driver he could be depended on to do the right thing in any traffic situation. If he were not a driver of that type he would not have a license, and without a license he would not be on the road.

Now it is clear why I refer to this concept as Utopian, but one question remains: Are there valid reasons why it should not be, essentially at least, as I describe it? If so, what are those reasons? Personally, I list as number one public apathy, indifference, even opposition.

This will continue until the driving public recognizes, possibly from a purely selfish viewpoint, the major contribution such a program would make to personal safety.

It is a "selling" job, and it is a tremendous one. Until it is done, even the best of programs that we can develop on paper will stay right there—on paper. As you know, a primary requirement of good salesmanship is faith in the product. Do we really believe we have or can develop a good product? Are we honestly convinced that our prospective customers, the driving public in this case, would benefit by "buying" the product we offer?

If our answers to these questions are negative, we are in the wrong business.

In the traffic safety field, increasing attention is being directed toward the driver and what can be done to improve his performance. John Volpe, former Secretary of Transportation, said, "The time has come when the right to survive must supersede the right to drive." Officials in both public and private organizations have expressed similar viewpoints, but this leaves us with our original question, How do we "sell" the product?

I sometimes wonder whether the public attitude toward driver licensing is not primarily one of tolerance rather than appreciation. Understanding is limited to a general impression that one is supposed to carry a license and to have that license renewed every 2, 3, or 4 years. Of course, such a license is recognized and appreciated as a convenient identification card—useful in cashing checks—but beyond that its stature is quite insignificant.

A book written for law enforcement officials (1) points out that "In a democracy, support of the people cannot be forced. It must be won." Perhaps we have overlooked this far too long in the licensing of drivers.

We cannot hope to advance the cause of better driver licensing until the public realizes that effective driver control can do something for them, something that is constructive and definitely beneficial.

If we and the agencies we represent can help to develop such understanding, if we can advance publicly and among officials a concept that possession of a license to drive entails a responsibility—a very real and enforceable responsibility—to perform well in traffic, then we will have done much toward constructively determining the future role of driver licensing in highway safety.

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Discussion

Frederick E. Vanosdall, Michigan State University

From his extensive experience in driver licensing, Kerrick stresses how driver licensing improvements are possible if available knowledge and experience are used. Although the concept of licensing is simple—only those qualified to safely operate vehicles should—he points out that (a) possibly 10 million unlicensed drivers are using the roads (nearly 5 percent of the nation's driving population); (b) state legislatures have eliminated driving test requirements that the public regards as severe; (c) public support of meaningful tests is not evident; and (d) license suspension does not deter drivers from driving.

Kerrick suggests that the mission of driver licensing is not understood by the public and that there must be a well-designed and continuous program to gain public attention, interest, and support—a selling job—to inform the public of the positive features of driver licensing. Kerrick's facts suggest that much improvement is possible through programs that increase the value of a driver's license.

To measure the quality or sales appeal of driver licensing, Kerrick suggests that a more careful review of two major issues is needed: First, what are the consequences of licensing drivers whose abilities to respond to real-world traffic problems are unknown? Second, how can new and current state laws bring about changes to require personal appearance for license renewal, which would afford licensing authorities ample opportunity to favorably impress large numbers of drivers with the quality of driving performance needed to survive in future traffic problems? (The energy crisis offers an opportunity to propose ways to improve driving performance and conserve gasoline.)

The future of driver licensing as a safety device seems dependent on administrators who are cognizant of past and current problems and who will implement existing know-how to regain public confidence and respect in driver licensing as a service benefiting them.

PHILOSOPHY, CRITERIA, AND METHODS OF DRIVER LICENSING

Julian A. Waller

Department of Community Medicine, University of Vermont

The following statement introduced a recently published paper concerned with driver vision at freeway on-ramps (1):

Automobile drivers are required to perceive, collate, analyze, and act on information which impinges itself on their conscious intellect in a matter of split seconds. This information, complete or incomplete, is composed of a multitude of elements, each of which must be instantly placed in its proper relationship with respect to all other components of the system in which the driver and automobile travel.

If we assume that the information the driver receives always is complete, which in fact is not the case, then the goal of driver licensing is to permit driving by persons who can appropriately receive, analyze, and act on information with high consistency and to screen out persons who cannot or will not do so. From the administrative point of view, however, this statement of goal, although basically accurate, also is basically platitudinous because it fails to give boundaries for identifying and dealing with those who perform poorly.

Although there are a relatively few individuals who never seem to "get it all together," the average driver can effectively cope with the average driving task almost ad infinitum. It is only when he is faced with a more demanding task, with an unusual event, that he may get into

trouble. Whether he fails depends both on the suddenness and size of the demand and on the amount of spare capability he has to meet that demand.

Restated, therefore, the goal of driver licensing is to license only those individuals who are consistently able to avoid creating demanding situations and also are consistently able to cope with demands placed on them from outside.

SPECIAL LICENSING

I will identify groups of persons who do not meet these vague criteria and explore the methods and likelihood of accurately identifying the individuals within these groups either at the time of initial licensing or after the license has been issued.

There are some types of impairments that are related to crashes. Figure 1 shows some human factors in major crashes, i.e., crashes in which someone has been seriously injured or killed. It is clear that some sort of impairment plays a substantial role. Although we have much less information about minor crashes, I have tried to estimate some relative contributions in these as well. These are shown in Figure 2. Figure 3 shows crash rates per 100 drivers and per unit of exposure according to age. This figure points out the special problems of the very young and the very old.

Figure 1. Impairment of drivers or pedestrians in major highway crashes.



Figure 2. Impairment of drivers or pedestrians in minor highway crashes.

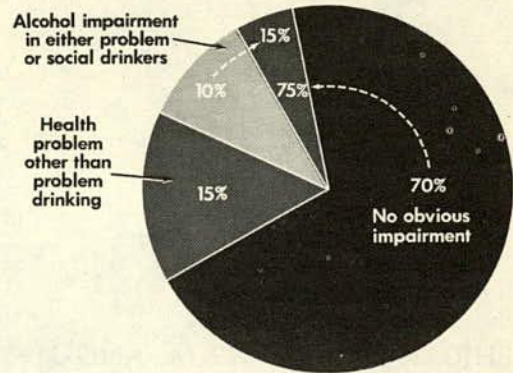
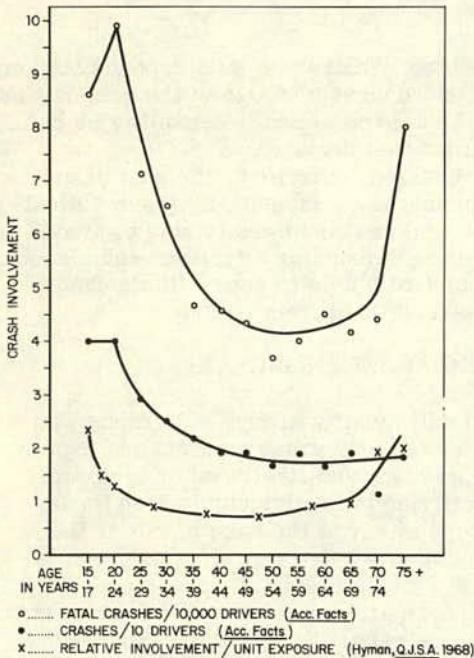


Figure 3. Involvement in fatal crashes and all crashes by age.



There are four groups of drivers that require special licensing approaches.

Persons Who Are Basically Unskilled

Group 1 consists of individuals who have difficulty handling even normal driving tasks. They are not identified in the written test, which has been shown to distinguish almost nothing with respect to safety; but the worst of them are screened out by the skill test in which vehicle handling in traffic is observed by an examiner. Studies have shown that crash rates are somewhat higher for those who pass the skill test with low scores than for those who pass with high scores. It is reasonable to assume that those whose scores were below passing, and who consequently were not licensed, would have even higher crash rates.

Two questions need to be asked here. Inasmuch as the skill test usually is given only to initial licensees, would it be worthwhile to repeat it periodically? My answer is no, because many if not most of those who are unskilled also are inexperienced and they gain skill as they gain experience.

The few who do not learn from experience, I believe, can be picked up in other ways.

Second, because low passers have higher crash rates than high passers, is it worthwhile to retest the low passers? If we assume that the test is reliable over time and with different examiners, which has not been adequately tested yet, then it may be cost-effective to retest after 1 year of driving persons who score in the lowest 5 or 10 points above passing. Given that I am neither an economist nor a mathematician, I am in no position to calculate the actual cost of the modest excess of crashes among the low passers versus the administrative costs of retesting and excluding those who remain low scorers. To this must be added the costs of the false positives among passers who are screened out the second time. Such a calculation is not impossible, however, and I urge this as an option to be explored further.

Those Who Are Skilled But Inexperienced

Group 2 consists of individuals who have not yet internalized the boundaries of safe behavior and so are more likely to get into tight situations. Once in such situations, they have not developed sufficient spare capacities of skill and judgment to handle themselves successfully. One or two minor crashes may be all the learning they need. The epitome of this group is the teenaged driver.

I do not believe these drivers can be identified through the usual skill test; they commonly pass with flying colors. We can, however, identify the sorts of emergency mismaneuvers most commonly made by new drivers who crash, develop training for these, and also test for these during initial and first renewal licensing. Only those who pass both the usual skill test and the emergency maneuver test would be licensed. Actually, some important work is already under way at Ohio State University to identify the visual scan patterns of new drivers and at General Motors and elsewhere to teach handling of skids and blowouts.

Is this likely to be cost-effective? The only way to answer, of course, is to try it with adequate evaluation. However I would give this very high priority because new drivers are substantially overrepresented in crashes both per person and per unit of exposure. This excess exists even in the absence of alcohol but is accentuated by alcohol.

A recently proposed federal standard on driver licensing suggests that new drivers be given probationary licenses so that corrective efforts can be made quickly if the driver has one or two traffic offenses or mishaps during the probationary period. As I noted, at present there is not only greater likelihood that they will have mishaps but also high probability that these will provide the necessary learning experience. No further corrective action need be taken for most of these drivers; moreover, I do not believe the average licensing inspector is capable of distinguishing which of these drivers needs further action or what action is most appropriate. Therefore I suggest that the screening level for administrative action be more than one or two episodes after the initial license is given.

Those Who Create Demanding Situations

Group 3 consists of those who have skills and experience but create demanding situations beyond their spare capacities. Within group 3, there are three subgroups: problem drinkers, sociopaths, and those with serious medical impairment.

Problem Drinkers

Because alcohol is a factor in about half of all serious crashes and because persons with drinking problems are estimated to constitute about two-thirds of those involved with alcohol, identification of individuals in this particular group is crucial to highway safety. Most of the social drinkers in alcohol crashes are teenagers in group 2 or heavy-drinking males in their early 20s.

Currently, two projects are under way to determine whether problem drinkers can be identified through questions given at the time of licensing. One of those is the Selzer-Mortimer MAST test; another is the driver profile originally developed by Perrine and being used by Project CRASH in Vermont. I suspect that these tests will have relatively few false positives but perhaps as many as 50 percent false negatives. Even with such a low "hit rate," however, they are much better than what we have had in the past for screening.

For those individuals who get through the net the first time, we can improve the secondary identification process by (a) lessening the sentence for DWI so that arrest and conviction rates are likely to increase; (b) requiring mention of the presence or absence of alcohol in all citations issued, whether or not the citation is for DWI; (c) identifying at license renewal or even earlier persons with a DWI arrest or with alcohol mentioned at least twice in other traffic infractions; (d) evaluating before sentence or before license renewal persons with alcohol involvement on their records to determine whether

a chronic drinking problem exists; and (e) referring those with drinking problems to treatment and license revocation or restriction. Again, what is perceived as a good idea does not necessarily make an effective program. I am simply suggesting therefore that this is another set of options to be carefully tried and even more carefully evaluated.

Sociopaths

I am not sure how sociopaths can be screened out at the time of licensing. Usually they are identified only after they have gotten several tickets, and I have no method to suggest for identifying them earlier or dealing with them more effectively once identified. Fortunately, they represent only a relatively small part of the crash problem.

Serious Medical Impairments

Probably about one in every five drivers has a medical condition other than problem drinking that may carry some potential for impairing driving ability. Only relatively few have such severe conditions, however, that they actually create a hazard. I refer, of course, to those who have seizures or other periods of altered consciousness or conscious control while operating a motor vehicle. I will discuss the identification and licensing of such drivers in the context of all drivers with medical conditions, however, a subject that is considered in the next group.

Those Who Lack Spare Capacity

Group 4 is probably the largest. It consists of those who lack spare capacity to respond effectively to demanding driving situations. Any task can be made so demanding that all but a rare few will fail at it. Unfortunately, we still know relatively little about the driving environment. Even more unfortunately, we still apply much too little of what we do know, so that almost all of us occasionally are faced with demands beyond our capability to react effectively and consequently get into crashes. Those of us who do so represent those who have crashes in one license period but not in the next.

Some individuals, however, have the skills and experience to handle most driving but have less-than-average capabilities for dealing with stress. Consequently, they have higher-than-average crash rates, much of this attributable to crashes at intersections or in relatively heavy traffic. Because they require somewhat different approaches I will identify two categories of persons here—those with medical impairment secondary to cardiovascular disease, diabetes, epilepsy, or other medical condition, and older persons with aging processes, including evidence of cerebral vascular disease. It is important to recognize that, when these individuals have crashes because of reduced spare capacity, generally their medical impairment is not obvious to an investigating police officer. Nevertheless, the fact that such reduced spare capability exists has been identified in laboratory and epidemiologic studies.

Those with general medical conditions should be required to report any diagnosed medical condition at the time of license renewal or when a new condition is discovered. These conditions should be reported by physicians. The third line of defense, of course, is and has been reporting of individuals already licensed who have crashes or citations attributable to clinically obvious episodes, that is, persons in group 3.

I believe that reporting by individuals and physicians is both warranted and feasible, but only if the following guidelines are adhered to.

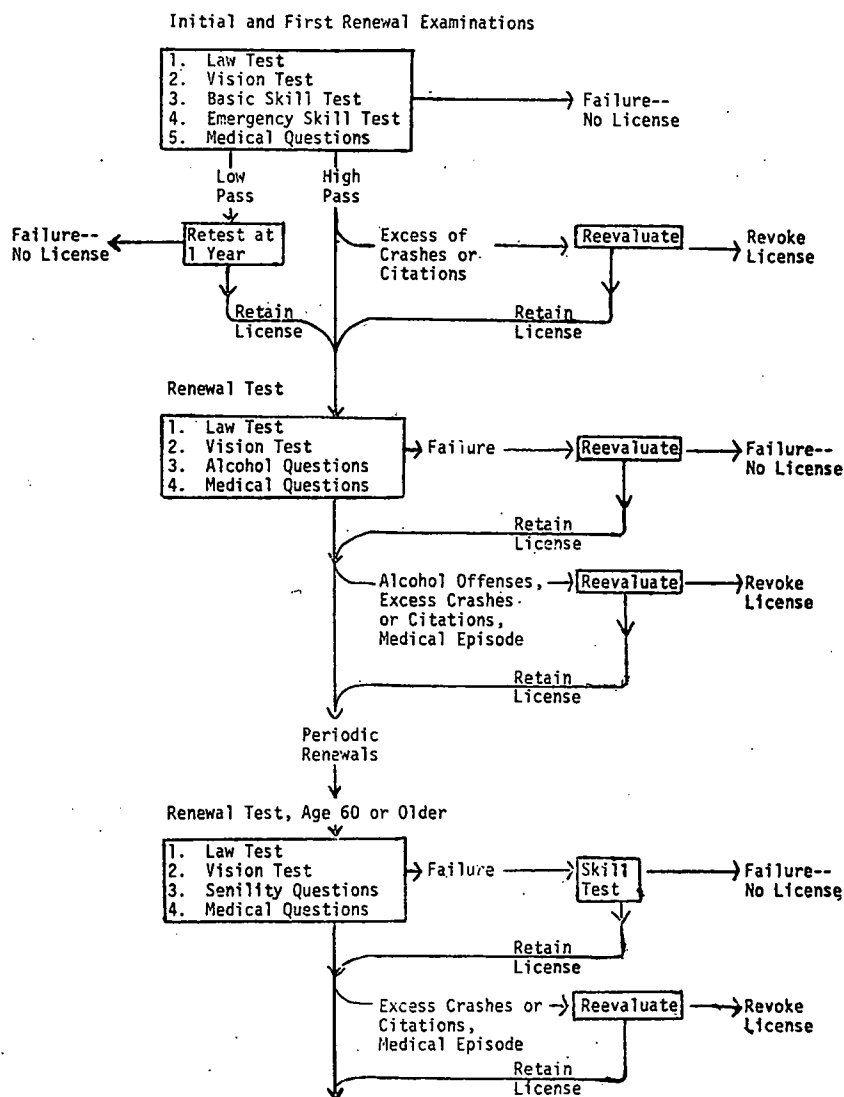
1. Conditions are reportable only if active within a specified time period (e.g., 3 years) and only if in persons of driving age. Some state laws and regulations still require drivers and physicians to report seizures that have occurred in childhood.
2. There must be an active and capable medical advisory committee to the Department of Motor Vehicles with clearly defined criteria to guide evaluation and regulation of drivers.
3. Probably no more than 25 percent of persons with medical conditions need have their driving privileges removed for a period of time.

The point is that all persons with medical conditions should be known to the Department of Motor Vehicles, but only about one in every four should be restricted. If the public and physicians can be made to realize that reporting is not tantamount to loss of a license, there will be much better cooperation with the reporting laws. In fact, even with the current misunderstanding of the law, there was evidence that, in California at least, most persons with epilepsy are coming to the attention of the motor vehicle authorities.

Can reasonable criteria be established for evaluation and regulation? I think yes, especially based on recent work by a group of Israeli physicians, which relates ability to handle driving stresses specifically with functional status of the cardiovascular system.

Identification and regulation of drivers with cerebral vascular disease and other deficits related to aging present other problems. I have noted elsewhere that elderly drivers present an administrative dilemma because they do not have higher crash rates

Figure 4. A scheme for driver licensing.



per unit of drivers (because many of them do not drive very much). Per unit of exposure, however, they are at greater risk of crashing and of serious outcome from even relatively modest injuries. From the epidemiologic point of view they clearly require special attention. From the administrative viewpoint, however, the argument could go either way. If a decision is made to take special action, I believe the following steps are warranted:

1. A few key questions can be asked of all drivers age 60 and older at the time of license renewal to identify those persons who drive 5,000 miles per year or more and who show signs of cerebral vascular disease. Those identified should have driving skill tests.
2. All older drivers who have two or more crashes, citations, or both in a period of 2 years should be reexamined, including the driving skill test. Family members and family physicians should also be questioned inasmuch as these individuals often are quite concerned about the increasingly erratic driving they observe but feel hesitant to notify the motor vehicle authorities without specifically being asked to comment.

At this point, I would like to place the categories mentioned and the countermeasures into broader perspective. I am always a bit uneasy when asked to discuss only a single type of countermeasure, because such a discussion cannot be justified without consideration of cost-effectiveness relative to other types of countermeasures. This is especially the case with driver licensing.

The question of spare capacity relates not only to the abilities and characteristics of the driver, but also to the sorts of traffic situations he is exposed to. In a study of highway crashes in Birmingham, England, Mackay and his associates indicated that vehicular and roadway factors contribute to 88 percent of crashes. Based on other data, even this high figure may be an underestimate. In my opinion, removal of stress points in the driving task is as important as regulation of the people who drive. We have traditionally placed too much attention on the doer and not enough on the deed.

SUMMARY

With this important word of caution I would like to summarize in graphic form the groups, subgroups, and methods proposed (Fig. 4). I believe that such a schema is administratively feasible and, after evaluation, may also be found to be warranted as well. Despite its apparent complexity, it would actually introduce very few tasks not already being done by agencies such as the California Department of Motor Vehicles. These additional tasks are the emergency skill test for new drivers, the retest at 1 year for initial low passers, the alcohol questions, and the senility questions.

REFERENCE

1. Sinha, K. C., and DeCabooter, P. H. A Computer Simulation Model of Driver Vision While Emerging From Freeway On-Ramps. *Traffic Quarterly*, Vol. 26, October 1972, p. 589.

Discussion

Frederick E. Vanosdall, Michigan State University

Waller presented a straightforward and methodical discussion. After introducing Sinha and DeCabooter's description of the behavioral demands that drivers must meet at freeway on-ramps, Waller very succinctly restates the goal for driver licensing—"to license only those individuals who are consistently able to avoid creating demanding

situations [exceeding their abilities to control] and also are consistently able to cope with demands placed on them from outside."

Waller's discussion of four groups of drivers who require special licensing approaches actually presents as the final criterion drivers' capacity to cope with demands of the driving task, a noncompromising position often advocated by many driver licensing people.

Waller discusses drivers who are basically unskilled, those who are skilled but inexperienced, those who exceed their capacity for performance, and those lacking spare capacity to respond effectively to demanding driving situations. It appears that Waller has taken the divided attention concept, inherent in the driving task, as the basis for discriminating between groups of drivers. For each group he describes the deficiency of driver licensing testing procedures for identifying their capacity to drive safely.

Those in group 1 pass the written test, but fail the road test if they are obviously ineffective. Realistically a road test route may not yield demands that exceed the driver's capacity, which enables him to pass it. A few seconds later, a situation could develop that might exceed his capacity, and he might fail the test. Although Waller does not suggest it, many driver licensing people recognize such limitations in driving tests.

Waller suggests that repeating road tests periodically for selected drivers in the unskilled group seems practical: Experience may increase skill and with it spare capacity for low scorers (a valuable point for licensing authorities to consider). The followup driving test has potential for more than just this group.

Perhaps those in group 2 should recognize their own limits, providing that their driving exposes them to a wide range of experiences in which their performance is inadequate but not disastrous.

Accident involvement is rarely predictable; therefore, Waller's insight into group 1 for retesting some drivers may be applied to group 2, providing for additional instruction or tests if near-misses or emergency mismaneuvers are realized and reported during a driver's first 6 or 12 months of driving experience.

However, Waller's suggestion of increasing the ability of licensing inspectors to distinguish skilled but inexperienced drivers' needs seems premature. The techniques for testing drivers' performances on the street can be developed to yield far more critical test situations and performance measures if exploratory efforts in this direction are pursued. The economics of such improvement may however be impractical initially.

Waller's experience in alcohol and medical studies justifies his recommendations for group 3, which reflects the need for practical methods for early identification and experimental treatment programs. In an epidemiological sense, current field projects in these areas, both alcohol and physical impairment, should yield data and insight on methods for developing programs that reduce alcohol abuse and medical conditions as regular components of driver licensing examination and driver improvement programs.

In discussing group 4, Waller presents a logical argument concerning the average driver whose usual performance and capacity enable him to resolve typical emergencies. By introducing an invisible stress, Waller identifies a factor that reduces spare capacity and increases chances for crashes. He suggests other invisible factors that may also reduce spare capacity and thereby contribute to crashes (e.g., cardiovascular disease, diabetes, and aging).

Early discovery and control of these conditions are possible through driver licensing efforts. Traditional fears of drivers, young and old, that medical impairments will delay or result in denial of a license results in their falsifying statements of physical condition. Waller's views seem to focus on the importance of honesty and integrity in driver licensing to emphasize one critical aspect—a report "is not tantamount to loss of a license."

Driver license administrators have revised and are revising policies on medical issues, relying on medical advisory boards to overcome the real problem of gaining public understanding and confidence in government by informing the public of the successes achieved, i.e., establishing trust in the licensing agency. Waller's suggestion concerning medical impairment reflects his long interest and involvement in this area. Consideration of his suggestions for experimental programs will offer licensing authorities valuable experience in achieving improved public support while protecting motorists.

From this paper, the need for accurate measures of driver reaction to critical driving situations, where deficiencies in information processing, judgment, and vehicle control are identifiable, should receive high priority in future studies for improving the validity of license examinations.

Few driver license administrators would find serious disagreement with the basic concepts presented here. Waller's insight to drivers' problems and their interaction with such problems suggests that future driver licensing research needs Waller's involvement to an increasing degree.

DRIVER LICENSING LAW: HELP OR HINDRANCE?

Victor J. Perini, Jr.

Highway Users Federation for Safety and Mobility

Discussions of the law in the field of driver licensing frequently generate more heat than light. However, we are seeking perspective and direction for the future in terms of the contribution of law to safer highway transportation.

HISTORY OF DRIVER LICENSING

When the new breed of highway users took to the streets in the early days of automotive transportation, there were those who felt that some regulation should be imposed on them, since motor vehicles occasionally frightened horses and got into accidents.

Unfortunately this early thinking, if any, tended to be negative. So the driving license started out as a receipt for the payment of a small tax by the motorist for the privilege of operating his vehicle. In some places, the local hardware store provided this handy tax service. But, with the revenue aspects of licensing firmly established, it was only a matter of time before the early tax receipt became a sophisticated document, which today serves as a status symbol for teenagers, a convenient identification for cashing checks, and a mechanism that helps control problem drivers, whoever they may be!

Average driving license fees have not kept pace with inflation, perhaps because those empowered to raise these fees do

not readily equate the level of the fee with the value or cost of the services performed by the function. It is perhaps ironic that the driving license is often less costly than a hunting license, and, whether by accident or design, one of the results of their use is on occasion the same: death.

I suspect that we still think of a driving license as a form of tax rather than as a means for performing important safety services for the motoring public. Only when threatened do its possession and value become apparent to the average driver. But, even then, the loss of a license does not seem to be too threatening, inasmuch as a great number of drivers operate their cars without a license or with a suspended or revoked license. The seeming lack of public concern for this situation suggests to me that the licensing function really is not that important in the public mind.

This is not to suggest that the service aspects of the function have been neglected. On the contrary, today's licensing encompasses concepts for driver improvement, rehabilitation, and related efforts to assist the driver to do a better job behind the wheel. Indeed, the future direction and perhaps even salvation of driver licensing will be tied to its ability to provide essential safety services that will benefit both the individual driver and the public.

The courts have laid to rest the classic

debate over whether a driving license is a right or a privilege. Ask the administrator who is holding hearings on suspension and revocation orders or the motor vehicle department counsel who is defending the rules and regulations in court. The idea of a benign sovereign granting the driver a privilege that can be withdrawn with impunity is fast becoming part of history, although the word privilege still has some currency in discussions on the subject.

HELP OR HINDRANCE

The title of this paper is ambiguous because I am not sure whether driver licensing law is a help or a hindrance. I will illustrate my uncertainty by commenting briefly on four points that bother me, among others of course.

Licensing Legislation

Driver licensing is a creature of statute and therefore legislative in inception. Implicit in the legislative process is the role of the protagonist who wants a particular law, the antagonist who does not, and the legislative function that somehow strikes a balance between these conflicting interests.

The chief protagonist in driver licensing frequently is the motor vehicle administrator, who believes that he needs additional legal authority to do the kind of job that he thinks should be done. He is aided to an extent by safety-oriented organizations and groups and, in more recent times, by pressures emanating from the federal government's implementation of the Highway Safety Act of 1966. The antagonists range from those with interests that might be affected by change to those with sincere convictions. Both protagonists and antagonists abound in legislatures. The protagonists frequently lose the battle.

An underlying reason for defeat is that the legislators do not believe that the proposal will do the job; this lack of belief—perhaps credibility or even faith—is the result of poor communications between sides. I take little comfort in the old excuse that legislators do not want to spend money and therefore turn down good proposals. My state and local tax bills tell me differently. And if I had to point the finger at the side that fails to do a good communications job, I would turn toward the protagonist.

So, in a sense, the legislative process itself is a hindrance to more effective driver licensing. We could reverse this situation if we could convince legislators to give broader discretionary authority to the administrator, with minimal legal constraints. I like to think of driver licensing as a continuing relationship between the administrator and the public—a relationship that calls for understanding, sensitivity, trust, and a host of other things that are impossible to legislate. Whereas this may smack of idealism, I see this relationship as a partnership in which both partners are working toward common goals.

Suspension and Revocation

It is difficult to decide whether suspension and revocation laws are of any help, and I suspect that they often are a hindrance. Licensing is a way of ensuring that properly qualified persons are licensed, unqualified persons are helped in their efforts to meet standards, and disqualified persons are effectively kept off the road. The trouble is that the disqualification element gets the greatest exposure, while the other aspects of licensing are frequently misunderstood or perhaps unknown.

A comparative study of state laws on suspension and revocation of driving licenses showed that every state has its own ideas on how suspension and revocation should be applied but that they give less concern to what should be done to errant drivers once suspended or revoked. Perhaps in the future these procedures will be viewed as trigger mechanisms for subsequent remedial action aimed at improved safety through upgraded driving performance and not as an end in themselves.

Point System

Does the existence of a point system suggest that the administrator is less than secure in the exercise of his discretionary powers? Or does it suggest that the legislature wants to make sure that the administrator does not become overzealous in his license removal power? I suspect that a little of both comes close to reality. Maybe our national obsession with point spreads in athletic events makes points an acceptable element of the licensing game as well. I find it difficult to explain why similar offenses have different point values and consequences in different states. Again past research seems to suggest that point systems are more an exercise of parochial judgment than useful tools for evaluating driver performance.

The Nature of Law

Once a statute is on the books, it is difficult to change or remove—which of course is good in one sense, bad perhaps in another. My point is that the administrator loses a good deal of flexibility and incentive to try innovative approaches when everything he does involves the protagonist-antagonist conflict I mentioned earlier.

Interestingly enough, Reese (1) suggests that administrators already have the needed discretionary power to do many of the things they now feel must be reduced to legislation. He suggests that the power to promulgate rules administratively is an important and available tool but that it is not being used enough by the motor vehicle administrators. He says a great number of other things that are of interest and concern to anyone involved in this field.

FUTURE OF DRIVER LICENSING

The following are a few comments on what I hope the future holds for driver licensing law in terms of highway safety.

1. More discretionary power should be given to the administrator of the licensing function, and he should make more effective use of powers he already has.
2. Driver licensing should be less involved in legislation per se and the power exercised thereby. And it seems to work pretty well.
3. Better communication between the legislature and the administrator would overcome credibility gaps and foster cooperation in the creation of needed legal authority.
4. Better communication should be established between the administrator and the public on what the law is, and why. People might be receptive to the idea that these laws are not designed to hinder their freedom of mobility, but are designed to help ensure that they can exercise this freedom in safety for themselves and their loved ones.
5. More research should be conducted to validate practices and procedures before they get locked into the system. If they have a safety payoff, wonderful; if they do not, try something else. How many records are kept around the country just because someone once thought that this information would be useful? And now the records keep piling up even though their usefulness is long past.

Everyone is presumed to know the law. Rules of the road are law, and there is probably no body of law more essential to daily survival in our automotive society. To ensure that people understand the law, motor vehicle departments translate the law into attractive manuals, heavy with graphic art and loaded with simple language. The media can intelligently inform people on everything from tooth decay to interplanetary travel. When do we start using some of these proven techniques to tell people why and how their driver licensing system is helping and not hindering them?

REFERENCE

1. Reese, J. H. Power, Policy, People: A Study of Driver Licensing Administration. HRB Spec. Rept. 123, 1971.

Discussion

Frederick E. Vanosdall, Michigan State University

Driver licensing law is rarely presented well and interestingly. Perini, however, displays an understanding and knowledge of the function and law indicating his experience and study of this field. The history of driver licensing as a revenue-gathering mechanism seems to be perpetuated by driver licensing agencies and legislatures. As Perini points out, a driving license has public uses other than its proof of the holder's driving qualifications. For many license holders the true value is not fully understood nor held in high regard unless it is threatened.

Perini stresses four areas of concern: the administrator's tendency to advocate the need for more law to do what he thinks is needed; exaggerated use of license suspension and revocation; point systems as a basis for evaluating driver performance; and the nature of law.

He suggests development and use of administrative policy; improved understanding of the legislative process and development of public policy; establishment of public understanding, confidence, trust, and mutual partnership; and development of programs with remedial treatment in place of punishment. These needs may very well be essential if more responsible programs for licensing and control of qualified drivers are to be achieved.

Perini implied in various ways the increasing need for administrators to document and prove the reasonableness of, or scientific support for, standards in driver examinations provided for in existing policies.

Of Perini's future needs, the most beneficial method by which to achieve desired improvements may be to select competent personnel to staff programs to improve public, legislative, and professional regard for driver licensing programs. Efforts to establish these regards must make use of the professional media, as Perini suggests.

Future programs may progress more rapidly and meet public program objectives more proficiently under strong administrative programs. From Perini's views, administrators should establish good relations with the legislature to gain support for testing alternative programs developed through research projects to replace existing and rigid laws and public policy.

THE FUTURE OF DRIVER LICENSING: THE NEED TO GET IT ALL TOGETHER

Robin S. McBride
American University

What is the future of driver licensing? Some proposals indicate a driver incentive program and licensing on the basis of a nationally standard, more comprehensive examination than those currently administered in most states. It is clear, however, that such proposals cannot be realistically evaluated or effectively implemented without the conscientious consideration and cooperative efforts of all groups involved in the problems of driver licensing.

There is need to unify efforts to respond to the differing viewpoints of the groups involved. For instance, some of the following concerns are typical: The public questions the necessity of a rigid licensing standard that imposes some inconvenience. In turn, legislators are concerned that comprehensive and lengthy testing could be perceived as an infringement on individual rights. Driver licensing administrators at local and national levels need to be convinced that the costs of implementing and monitoring a sophisticated diagnostic testing and training program are justified by the benefits to be derived. Finally, researchers involved in the scientific evaluation of alternative approaches need to be advised of the practical constraints affecting research application; needs, goals, and priorities must be more carefully defined

before their findings can be translated into administrative, operational, and cost-effective terms.

Although increasingly sophisticated studies defining the driving task and bearing on the development and evaluation of training procedures, improved restraint systems, vehicle and roadway design, and mass communication techniques have been conducted in the 7 years since enactment of the Highway Safety Act of 1966, basic philosophical, legal, and administrative issues remain to be resolved. Some of these follow.

1. Is driving a privilege or a right?
2. To what extent are the public, private enterprise, and government agencies committed to developing safer highways and willing to provide the necessary resources, given competing domestic problem areas?
3. How committed are local and national governments to developing more effective licensing standards?
4. What are the priorities in the field of transportation, and to what extent do various goals (e.g., efficiency, economy, convenience, safety) interact?
5. To what extent should the development of licensing standards take into account the problems of enforcement and judicial process, traffic design and engineering, and automobile design?

During the past 7 years, driving-related research has been funded, and committees, seminars, conferences, symposiums, and workshops have met to share ideas and generate constructive criticism in the planning stages of research projects. These activities suggest that progress is being made. However, when the participants at these meetings return to their own work environments and are confronted with their daily activities and operational programs, they seem to lose the sense of unity and purpose. This discontinuity, which impedes further progress, can be overcome in several possible ways.

One possibility is for NHTSA to require that the states comply fully with the driver licensing standards it establishes. There are two difficulties in this approach. First, the states may resist implementing standards that are forced on them, arguing that each state has some unique problems. Second, they may argue that standards should not be imposed until they have been proved effective.

A second possibility is for NHTSA to provide guidelines and depend on the states to develop their own licensing standards. This approach to a comprehensive program implies a degree of cooperation and coordination between agencies at all levels that, unfortunately, has not occurred thus far and is unlikely to in the future.

A third possibility is for the states to continue to conform to basic licensing procedures until a cost-effective system can be developed and tested. A concentrated pilot effort in one or a few states might ultimately lead to a comprehensive program.

Each of these approaches implies that meaningful direction can occur without prior resolution of basic philosophical, legal, and administrative issues that bear on the formulation of national policy in driver licensing. A fourth alternative is for these issues to be resolved before efficient and effective implementation of proposed measures is begun.

A group representing all interests involved in the problems of driver licensing should be assembled on a full-time basis to seek consensus and supportive legislation defining the needs, goals, and priorities of a comprehensive driver licensing program. Private industry, foundations, and government agencies (e.g., insurance companies, safety organizations, the Department of Transportation), as well as the public at large should provide support for this activity. It is especially important that cross-sectional representation and support be sought to help ensure highly comparable levels of involvement on the parts of representatives whose interests may often be in conflict. Ideally, the participants in such a task force would possess public relations as well as technical skills and would actively seek contact with the news media as a means of relating current research activities and national driver licensing concerns to the public. The interaction stimulated and pursued by full-time task force representatives would lead to clarification of licensing needs, goals, and priorities and would enable research and implementation activities to impact more rapidly and effectively on the problem.

Discussion

Frederick E. Vanosdall, Michigan State University

McBride's prior experience as a researcher in the California Department of Motor Vehicles enables him to state in a rather direct manner the direction he considers necessary when viewing the future and research needs in driver licensing. His suggestion that researchers, motor vehicle administrators, and legislators join forces in scientific efforts to improve driver licensing is hindered by one major obstacle: the absence of sustained unity of purpose by these participants to review existing programs and incorporate new knowledge and experiences. Realistically this obstacle may simply be due to limited funds and interest in changing the existing licensing system.

McBride offers three possible courses of action to achieve an improved future in driver licensing. Cognizant of the reactions these possibilities face, he urges a

coalition of the varied interests concerned with problems in driver licensing.

The critical factor in McBride's approach is the necessity for a powerful demand for improved performance. Responsibility fixed by an authority such as the Congress has indirectly brought attention to driver licensing, but not in the public arena. More attention might be given if the collective dollar value of efforts committed annually to this function was compared to the research effort for its development.

In addition, those believing research results can bring change through implementation must realize the practical facts that implementation requires recognition of differences in state laws, training needs of personnel, revision of policies and procedures, development of public information, and consideration of the impact 40 to 50 million drivers will create on field facilities when they try to comply with what is requested of them.

From McBride's presentation there is indication that resistance to improvement is not characteristic of driver license administrators. Theirs is a desire for operationally sound improvement that does not require massive changes that destroy the existing system before the new one is ready for 100 percent service.

McBride reflects the desires of many administrators, but only highly regarded authority can bring about success. Cooperative relationships between researchers and practitioners must be developed, as suggested in this presentation. The precise mechanism may be different from that proposed, but certainly it indicates that some valuable lessons have been learned in department of motor vehicle research activities. McBride states it very well: "There is need to unify efforts to respond to the differing viewpoints of the groups involved." The major issue may be, what or who is the unifying force?

Future research in driver licensing may not save drivers from error, may only reduce error, or possibly, and more important, may enable drivers to discover the criticality of recognizing the consequence of error in hazardous situations.

OVERVIEW OF NHTSA RESEARCH ACTIVITIES IN DRIVER EDUCATION AND LICENSING

John W. Eberhard
National Highway Traffic Safety Administration

Under the Highway Safety Act of 1966, the National Highway Traffic Safety Administration was charged with the responsibility to reduce the accidents and injuries of highway users. As part of the efforts to identify the potential of driver education and licensing in reducing accidents, the NHTSA (then the National Highway Safety Bureau) initiated analyses of driver education evaluation requirements (2) and of driver licensing practices (1). The results of this research pointed to the need for a detailed analysis of the driving task to determine educational program needs and a new set of standards for determining an individual's qualifications to receive a driver's license.

DRIVING TASK ANALYSIS

The basis of NHTSA's program to develop driver performance objectives is analyses of passenger car (3), truck and bus (4), and motorcycle (5) tasks. These analyses identified the driver and non-operational tasks involved in safe performance within the highway system under a variety of environmental and traffic conditions. Criticality indexes that have been established for each passenger car task (3) and each truck and bus task (4) serve as a guide for selecting the instruc-

tional and testing objectives that are most critical to safe driving performance. With criticality indexes for each task and improved accident investigation data, NHTSA will be able to identify the skill, knowledge, attitude, and physical/medical fitness requirements for safe driving.

PROGRAM RATIONALE

Based on state-of-the-art reviews and several task analyses, a program plan has been established to improve driving performance by upgrading driver preparation, initial driver licensing, driver reexamination, problem driver rehabilitation, and license restriction. A tailored treatment approach to education, training, and control will be used as the basis for developing programs in these areas. With this approach, the individual is first screened to determine whether training or regulatory action is needed. Emphasis in the research program is, for passenger car operation, on finding ways to make it possible for greater numbers to drive safely; it should not be limited to removing greater numbers of drivers. Therefore, there is a need to provide those responsible for training and examining drivers with the most efficient and effective techniques for guaranteeing that all road users possess the minimum capabilities for safe operation

in the highway system. Thus, there is need to develop (a) a safety-oriented curriculum for driver preparation, (b) safe driver performance standards against which applicant capability can be compared, and (c) driver improvement techniques for those whose capability is below standard. Furthermore, based on evidence that drivers whose licenses are suspended or revoked continue to drive (7), more effective enforcement of license restrictions needs to be developed and implemented.

In the case of motorcycles, trucks, and buses, there might be greater potential to use traditional selection methods that would result in a greater proportion of applicants being denied a license. This may be particularly true for truck and bus operators whose vehicles pose a great threat to life and property. This is not to say that NHTSA is not concerned with providing safety-oriented training materials for such vehicle operators; rather, emphasis will be placed on more stringent and comprehensive performance standards for initial licensing and for retention of the license by those with one.

DRIVER PREPARATION

Of all of the highway safety programs, driver education is one that has an outstanding opportunity to effect accident reduction. Drivers are motivated to develop their driving capability most as they prepare to qualify for initial licensing. Because of this, the bulk of the research in driver education has been focused on the development of a safe performance curriculum for the largest group of initial license applicants in the country: high-school-aged youth.

Driessen (6) points out that, in current driver education courses, "Much time is spent in learning about the car and in 'learning to drive,' but, only secondarily, 'learning to drive safely'." As Driessen and others have recognized, there is a need for more safe performance material in driver education. Consequently, the safe performance curriculum places great emphasis on the knowledge and skills required for safe performance and deemphasizes some more traditional topics such as engine repair and automobile insurance.

The NHTSA program in driver preparation consists of a safe performance curriculum for secondary schools, traffic safety education program, advanced driver education, motorcycle safety education, commercial truck and bus operator training, and driver education for special groups (e.g., handicapped, aged).

Safe Performance Curriculum for Secondary Schools

Based on the driver education task analysis for passenger car operation, instructional objectives for driver preparation have been defined. In turn, based on these objectives and a need to perform a definitive evaluation of the accident reduction potential of driver education, a study to develop and evaluate a safe performance curriculum has been initiated (9). This study, being conducted in Kansas City, Missouri, is an attempt to overcome the deficiency in curriculum development and research methodology that has been a problem in driver education. A consistent research issue has been failure to randomly assign students to the various programs to be evaluated. In Kansas City, students will be randomly assigned to either a safe performance curriculum, a minimum-skills program designed to enable the individual to pass the licensing exam, or no formal driver education program (i.e., the experiment's control group). The project is designed to answer the basic question, "Can driver education reduce accidents and injuries?"

As part of the curriculum development program, performance measures are being developed to determine students' comprehension of course content during the program, pace students' progress through the course, and determine students' qualifications for graduation at the end of the course. NHTSA intends to develop these measures into standardized performance measures for use not only by teachers in assessing student performance but also by state departments of education or other responsible state agencies in evaluating program quality and effectiveness. It is intended that preliminary standards will be available for this purpose in 1975; these standards will be revised and refined after careful regional implementation of the driver education program.

The next phase in the development of an effective high school driver education program will be to determine which components of the safe performance curriculum are successfully meeting the training needs of students in both inner-city and rural environments. The purpose of this effort is to systematically implement the curriculum and curriculum parts on a broad base to determine which components of the curriculum are most effective and which need enhancement. It is during this period that plans call for a more refined diagnostic test program to be used to assign students only to those components of the training program that they need. As part of this evaluation it is anticipated that the requirements will be identified for training devices and aids to reduce teacher work load and to improve the effectiveness of the instructional experience. Furthermore, research designed to improve in-car instruction will be conducted.

Traffic Safety Education

Because novice and young adult drivers are overrepresented in the accident statistics, it is necessary to develop more effective training programs for these groups. Specifications are being prepared for a research program to identify the potential benefits of certain types of driver experiences prior to licensing age. This program will include preparation of a study series at the junior high and elementary levels on motivating the development of perceptual skills and knowledge. When practical and educationally sound, these experiences prior to driver training will be combined with early road user experiences (e.g., motor bike and bicycle use and passenger and pedestrian education).

Advanced Driver Education

NHTSA's research program in advanced driver education is evolving from evaluating existing driver training programs (10) to designing innovative training programs. The new programs will be based on instructional objectives from the task analysis, accident experience, and driver performance data. These programs will identify new requirements for accident investigation and data analysis dealing with driver errors that lead to accidents.

A study using existing classroom and emergency skills training procedures is being evaluated by American University in cooperation with the U. S. Coast Guard to determine the accident and injury reduction potential of a program designed for young adult males (i.e., USCG recruits) (10, 11). This program uses combinations of the Air Force traffic safety materials for the classroom phase and selected basic and emergency skills training exercises for behind-the-wheel instruction. Data on both intermediate (instructional objective attainment) and ultimate (accident and injury involvement) criteria were obtained from the recruits. Information on driving behavior patterns relative to the use of alcohol, drugs, night driving, and fatigue was also obtained to determine the characteristics of accident-involved recruits. The results of this effort should provide a strong basis for the design of better advanced driver education and driver improvement programs.

Another study to evaluate existing techniques was conducted by Pelz and Schumann (12) who compared (a) police highway safety assemblies, (b) trigger films (i.e., 1- to 3-minute films on driver behavior designed to trigger safety discussion among participant groups), and (c) trigger films with mailings on highway safety tips and activities. The trigger film technique, which had a lot of appeal, was experimentally evaluated before distribution to determine the accident-violation reduction potential. The evaluation showed that the trigger film technique as employed in this study was not an effective traffic accident countermeasure.

Currently, American University is designing an advanced driver training program in conjunction with the USCG driver improvement program. This program, which is also based on driver task analysis, uses recruit performance test data and accident data to generate innovative driver training techniques.

A second program being developed that relies heavily on new training technology is the accident avoidance training and testing program. Investigators will attempt to

derive the skill requirements associated with accident avoidance and will identify classroom and behind-the-wheel procedures for training and testing. A pilot test will be conducted to determine program effectiveness and the costs associated with achieving prescribed skill levels. The project will also identify the characteristics of groups that might benefit from such training (e.g., emergency vehicle operators and young adult drivers). The program will be based on the data obtained from multidisciplinary accident investigation teams and other accident investigation and analysis results. Furthermore, it will aid in the design of advanced accident investigation procedures, which will enable the next generation of training programs to be based more on observable and measurable driver performance characteristics. Finally, specific accident avoidance training programs will be evaluated with selected groups to determine the accident reduction potential.

Motorcycle Safety Education

Motorcycle accidents are most likely to occur in the first year of operation: 30 percent of the accidents in California involve riders with less than 1 year's experience (13). There is concern about whether motorcycle safety training will reduce the total number of motorcycle accidents, for it may encourage more people to ride. However, the 12 percent accident reduction resulting from the Honda course in Japan is encouraging (14).

NHTSA is considering a cooperative agreement with the Motorcycle Industry Council Safety and Education Foundation to develop and evaluate safety-based motorcycle training programs and driver licensing test procedures. Curriculum development for the motorcycle training program will follow the same steps taken in the development of a safe performance curriculum in secondary schools, which made use of the task analysis, and development of instructional objectives based on that analysis. The requirements for data on motorcycle operator performance in both normal and accident situations will be specified, which will facilitate development of advanced countermeasures and training programs. Because of the inherent danger of motorcycle operation caused by the design of the vehicle, NHTSA will place emphasis on establishment of more comprehensive, more stringent licensing standards.

Evaluation of the curriculum will be designed to determine the effect of motorcycle training on total accidents and the possibly negative effects of encouraging people to ride who might not otherwise do so. Both trained and untrained riders will be followed for several years to determine whether trained riders have fewer or less severe accidents than untrained riders.

Commercial Truck and Bus Operator Training

NHTSA is assisting the Bureau of Motor Carrier Safety in the development of a driver training program for commercial truck and bus operators (22). BMCS's goal is to upgrade the training provided for motor carrier operators and to determine the feasibility of developing a training program that would enable 18-year-olds to be commercial operators. As part of its consulting services, NHTSA is attempting to determine the feasibility of testing the new training program in a setting that affords the same type of experimental evaluation used to evaluate other NHTSA education and training programs. Possible test sites and cooperating organizations have been identified including the U. S. Army at Fort Eustus, the Office of Education through their career education development program, the Department of Labor, North Carolina State University, and Ryder's National Professional Driver Training School.

Adult Education

In the area of adult education, NHTSA, in cooperation with the Air Force Inspection and Safety Center, has plans to develop traffic safety education materials for the general driving public. It includes ten 1-hour audiovisual presentations on the principles of safe driving. NHTSA will evaluate the accident reduction potential of the new materials for

both Air Force personnel and the public.

In a study by Hutchinson (15), driving errors and total accidents were reduced 17.4 and 12.5 percent respectively at eight urban intersections in Kentucky. This reduction was due to a series of announcements on local television, inasmuch as in-county residents who had the opportunity to view the TV programs improved whereas out-of-county residents did not.

Following the promising work of Hutchinson, FHWA and NHTSA agreed to jointly evaluate motorists' problems in effecting freeway entrance and exit maneuvers. After the proper and improper maneuvers are identified, driver training materials and signs, markings, and traffic engineering improvements will be developed. Controlled studies designed to determine the effect of the driver training and the traffic engineering improvements will be conducted.

DRIVER LICENSING

NHTSA's approach to improving the effectiveness of driver licensing is based on the development of safety-related driver performance standards. The factors being investigated are (a) an analysis of critical driving tasks according to vehicle types, (b) accident investigation data including vehicle and highway factors, and (c) driver characteristics. The intent is to develop measuring instruments (e.g., driver vision tests, background questionnaires) to determine the degree of licensing privilege an individual should be granted. Four grades of licensing requirements (by vehicle type) are currently anticipated: (a) initial applicant testing and weakness identification with emphasis on determining the requirement for issuing a probationary license; (b) renewal applicant testing and weakness identification; (c) aged driver testing with emphasis on identifying medical, senescence, and physical limitations and assigning appropriate restrictions or rehabilitation requirements to each limitation; and (d) diagnostic testing of problem drivers (negligent operators).

The initial licensing examination could be used to ensure that novice drivers receive instructions in avoiding accidents. Certain elements in the licensing examination do relate to accidents (16, 17), but they do not identify those activities that may cause accidents. For example, McRae found a relationship between parallel parking and accidents, and many states, including North Carolina, have now eliminated the parallel parking test from licensing examinations.

NHTSA has emphasized development of accurate, objective, and economical performance-measuring instruments. Once task analyses were performed for passenger cars (3), trucks (4), and motorcycles (5), it became feasible to establish test requirements relatable to the driver's tasks.

Driver Knowledge Tests

Development of the national item bank for driver knowledge (18), which helped to spawn the development of the task analysis for motorcycles, trucks, and buses, was an initial step in driver testing. In addition to the Manual on Uniform Traffic Control Devices and the Uniform Vehicle Code, the research made use of several task analyses to identify safe driving knowledge requirements and tests. As a consequence, many of the new items cannot be found in the prelicense driver manuals currently provided by the states. For passenger car operators, a 1,300-item pool and a series of seven 40-item tests for initial licensing and twenty-eight 10-item tests for driver reexamination were developed. Psychometric data on test/retest reliability, item-total test correlation, and proportion of correct and incorrect responses have been obtained. The effects of geography and age on performance were analyzed. Findings indicated that inner-city residents, Coast Guard recruits, and the aged had the lowest test scores. The aged perform significantly worse than the other groups; however, it is not known whether these differences are simply inferior test-taking ability or an accurate reflection of ignorance that could increase accident likelihood. More than 300 motorcycle items have been developed and test/retest reliability and other statistics are being obtained. Preliminary information on the truck and bus item pool is available; however,

refinement of this pool will be performed at a later date. The project represents the most complete development of driver knowledge test items to date, and guidelines for state implementation will be available from NHTSA in 1974.

Driver Knowledge Manuals

Based on the instructional objectives from the task analysis (8), the safe performance curriculum development (9), and development of the knowledge item bank, a research program will be performed to identify the accident reduction potential of a new set of driver manuals and tests. This study will determine how well manuals designed for initial applicants, renewal applicants, aged drivers, and problem drivers effect accident reduction. The manuals will emphasize safe driving practices for each group. In the evaluation, individuals will be randomly selected to receive either the safe driving manuals or current manuals. Where learning handicaps are identified, alternative systems will be established to guarantee that the total driving population will acquire the most important information on safe driving practices. It is anticipated that these materials will be used for driver improvement as well as driver licensing and will provide at least some minimum level of knowledge in driver training programs that emphasize skill training.

Visual and Auditory Test Requirements

Studies have been undertaken by NHTSA (19) and the Bureau of Motor Carrier Safety (20) to identify the minimum visual and auditory capabilities necessary for safe vehicle operation. Minimum requirements for passenger car operation were identified, and a prototype driver vision test was designed to measure dynamic and static visual acuity, movement in depth, angular movement, and saccadic, steady, and pursuant movements under varying lighting conditions. Many of these items are not currently measured by optometrists and ophthalmologists. Some preliminary normative data are being obtained on initial applicants, aged drivers, and renewal applicants as well as accident-involved problem drivers, particularly those who have visual problems that may have been a causative factor in the accident.

A study of visual factors for truck and bus drivers is being performed for BMCS. NHTSA is providing consulting service. BMCS, as part of its driver physical examination program, is interested in identifying whether an applicant has satisfactory visual and auditory capabilities. In addition to the visual functions identified above, accommodation facility and visual field were identified as functions of special importance to the motor carrier operator. Because motor carrier operators have limited rear visibility, which requires extensive use of mirrors, the need for accommodation facility is obvious.

Also, as part of the BMCS study, the System Development Corporation (23) has analyzed auditory requirements for truck and bus operators. Unlike the case with vision, no studies on the minimum auditory capabilities required for safe passenger car, truck, or bus operation have been reported. Based on an analysis of the driving tasks (3, 4), essential auditory capabilities for truck drivers were identified: (a) detection of auditory stimuli related to equipment and vehicle inspections and checks prior to driving and during frequent stops and (b) detection of auditory stimuli related to the status of essential equipment under conditions where masking noises are present. Prototype devices that measure visual acuity are being developed for truck and bus operators, and a commercially available audiometer has been selected. Preliminary normative data will be collected to establish standards for vision and hearing of motor carrier operators.

NHTSA extended the vision test development program to include analysis of vision and hearing requirements for motorcycle operation. The need to establish special tests for motorcycle operations will be determined from these analyses. Engineer drawings of integrated visual and auditory test devices will be available in 1974, and preliminary normative data relative to initial, renewal, and problem drivers should also be available.

Driver Background Factors

Because any kind of impairment (21) is crucial to driving, we need to detect whether individuals tend to or do overuse alcohol while driving or are otherwise physically or emotionally impaired. Procedures are needed to identify potential weaknesses in this area for use either in counseling during the examination or reexamination process, or in developing new licensing restrictions. Information on accident-related impairments will be used in the driver education and training research program.

Driving Skill

Additional performance measurement requirements include basic and emergency skill tests. The data for development of these measures will come from the safe performance curriculum evaluation program in Kansas City and the accident avoidance skills training/testing program. Additional measures of behind-the-wheel driver performance will be obtained in conjunction with the development of advanced driver improvement programs for both general and problem drivers.

Driver performance measures for motorcyclists and truck and bus operators will be developed as part of the curriculum and training programs for these vehicles. Implementation of the training programs will provide information on driver demographic factors (i.e., occupation, race, geographic areas, education), knowledge, perceptual skills, visual and auditory capabilities, physical and medical factors, and additional behind-the-wheel data that will enable an identification of the overall contribution of each characteristic to safe highway performance. It is from these curriculum development and evaluation studies that more refined measures of applicant entry requirements can most logically and efficiently be developed.

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Discussion

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Eberhard reviewed existing NHTSA research activities and driver licensing efforts, state-of-the-art studies, and programs to improve existing elements of driver licensing. His assertion that the easiest way to ensure that novice drivers will obtain adequate accident avoidance instruction is to improve the quality and difficulty of the initial license examination expects a great deal of tests.

Several projects are under way to improve driver testing. The imaginative research instrumentation of visual testing systems has been an outstanding move toward controlled testing. Comprehensive analysis of the driving task has provided the necessary reference material for development of driver knowledge tests. Actual guides for implementation, standardization of procedures, performance levels, and information value understandable by drivers should be part of the research project.

Administrators responsible for driver licensing programs regard practical matters such as test time, test difficulty, examiner time, and public reaction as more important than the more reliable and valid scientific tests. The communication gap between researchers and administrators may retard implementation of new tests. Thus, new examinations may be of little value if they must be proved through long-term studies of subsequent driver performance.

Driver licensing officials consider the road test as one of the most important licensing tests. Eberhard mentions only the skill tests developed for use in measuring driver performance in the Kansas City project. Will such tests be of value in driver licensing programs? Will they be feasible in on-street testing programs? It is hoped that these questions will be answered in later papers as a means of demonstrating the value of such research to driver licensing.

In another area, future driver licensing programs are certain to employ various electronic and automated testing equipment; however, little effort has been made to bring interested researchers together to review and evaluate existing testing systems that, once adopted on a large scale, may lock the entire system into a mechanized era that may retard improvements being developed in current and future research programs.

Future driver licensing research needs include consideration of programs linking driver education, licensing, and improvement to the enforcement and adjudication processes. Integrating these functions into a systematized and coordinated service for drivers may help achieve public respect and appreciation for the quality of safety that driver licensing programs afford. Such efforts, however, need to be demonstrated by laboratory projects. Perhaps such projects are the best method for proving the benefits of research.

A CASE FOR DIAGNOSTIC TESTS IN DRIVER EDUCATION

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Driver education courses have been made available to almost all novice drivers in an effort to produce safer drivers. Providing the courses for these millions of new drivers requires a large investment in manpower, money, materials, and time. Consequently, the effectiveness of current driver education programs must be continually reassessed. Clearly, if the expenditures on driver education programs are to be justified, evaluation tools must be provided. To be of greatest value, such tests not only must evaluate current programs but also must assist in identifying effective methods to further improve driver education. The ultimate goal of traffic safety effectiveness in driver education is unquestionably accident reduction. However, as many researchers have reported, the use of accident data as an evaluation criterion is undesirable because of their statistical unreliability, i.e., the rarity of occurrence, the multiple causes of accidents, differences in reporting (2, 3). There is, therefore, a need for intermediate criteria that are operationally useful and reliable and related to driving behavior and accidents. In response to the need for evaluative tools, the aims of this project were to

1. Develop objective tests and measures for the assessment of driver characteristics including driver attitude, knowl-

edge, and performance (i.e., skills, judgment, and safe driving practices); and 2. Use these measures of driver attitudes, knowledge, and performance to assess student driver capabilities upon entering the driver education course, on completion of the driver education course, and 1 year after completing the course for comparison with experienced drivers.

During the past 2½ years the Systems Research Group at the Ohio State University and the Nationwide Research Center, in cooperation with the Ohio Department of Education, developed and administered evaluative tests. The Nationwide Research Center developed tests of driver attitudes and knowledge, and the Driving Research Laboratory (of the Ohio State University) developed tests of driver performance (skills, judgment, safe driving practices). Though many interesting and useful results were derived from the attitude and knowledge tests, the focus of this paper is on driver performance.

TEST DEVELOPMENT AND ADMINISTRATION

Test development proceeded in essentially two stages. First, several pilot studies were conducted on a large set of candidate tests and measures. Then, in the main study, a reduced set of the best tests was administered to a large number

of students. In the pilot studies, novice student drivers and experienced drivers were compared in

1. Car handling on a range,
2. Freeway driving,
3. Judgment studies (1),
4. Visual search patterns (4), and
5. Narrow gap negotiation (7).

The tests, measures, and results from the pilot studies were reviewed and reduced to a smaller set of tests to be used in the main study. The final performance tests were selected for their

1. Sensitivity to learning by novices,
2. Discrimination between novices and experienced drivers, and
3. Administrative feasibility (reasonable time to complete, use of noninstrumented vehicles).

In the main study the tests were administered to 71 students before they began driver education. Fifty-seven of these students were again tested after completing driver education, and 38 were retested 1 year after completing driver education. Six experienced drivers who had driven at least 6 years and more than 5,000 miles per year were also tested.

The Ohio Department of Education chose the 10 participating schools to represent a cross section of types of driver education programs. The standard program consisted of about 6 hours of driving time (range was 4 to 8 hours), 18 hours observing other students drive (range was 8 to 22), 36 hours in the classroom (range was 30 to 63 hours), and 6 hours in a simulator (range was 6 to 15 hours). Two schools also had a training range. Individual driving instructors assisted in the random selection of students.

Five range tests were conducted to determine driver performance:

1. Serpentine,
2. Cornering,
3. Narrow gap,
4. Quick lane-change, and
5. Parallel parking.

Table 1. Skill tests and performance measures.

Test	Description	Measures
Serpentine	Winding track outlined with cones, 12-foot lane width, 120- and 180-degree curves, three trials (last two scored)	Time from beginning to end; cones displaced
Cornering	180-degree curve with inside radius of 19 feet, 12-foot lane outlined with cones; 10 trials (last eight scored)	Cones displaced
Narrow gap	Drive through 100-inch gap at 15 mph; styrofoam posts and plates; 10 trials (last eight scored)	Variance of center-line position of car
Quick lane change	Driver approaches simulated intersection at 20 mph; when light turns red, driver stops if possible or changes to left lane quickly if no time to brake; 10 trials (last seven scored)	Weighted error score
Parallel parking	25 feet by 80 inches; two trials	Time to park, distance from curb

Data given in Table 1 describe the tests and measures, and course layout is shown in more detail in Figure 1.

TEST RESULTS

Frequency histograms (Figs. 2 and 3) of the test measures revealed that novice drivers entered driver education with widely varying levels of skills.

In the cornering test (Fig. 2), some novices performed as well as experienced drivers, but most performed poorly. In the quick lane-change test (Fig. 3), experienced drivers had no difficulty responding correctly to the traffic signal, whereas many novices were unable to respond appropriately. Similar results were found in the other tests.

Though the individual test results are

Figure 1. Layout of test tracks.

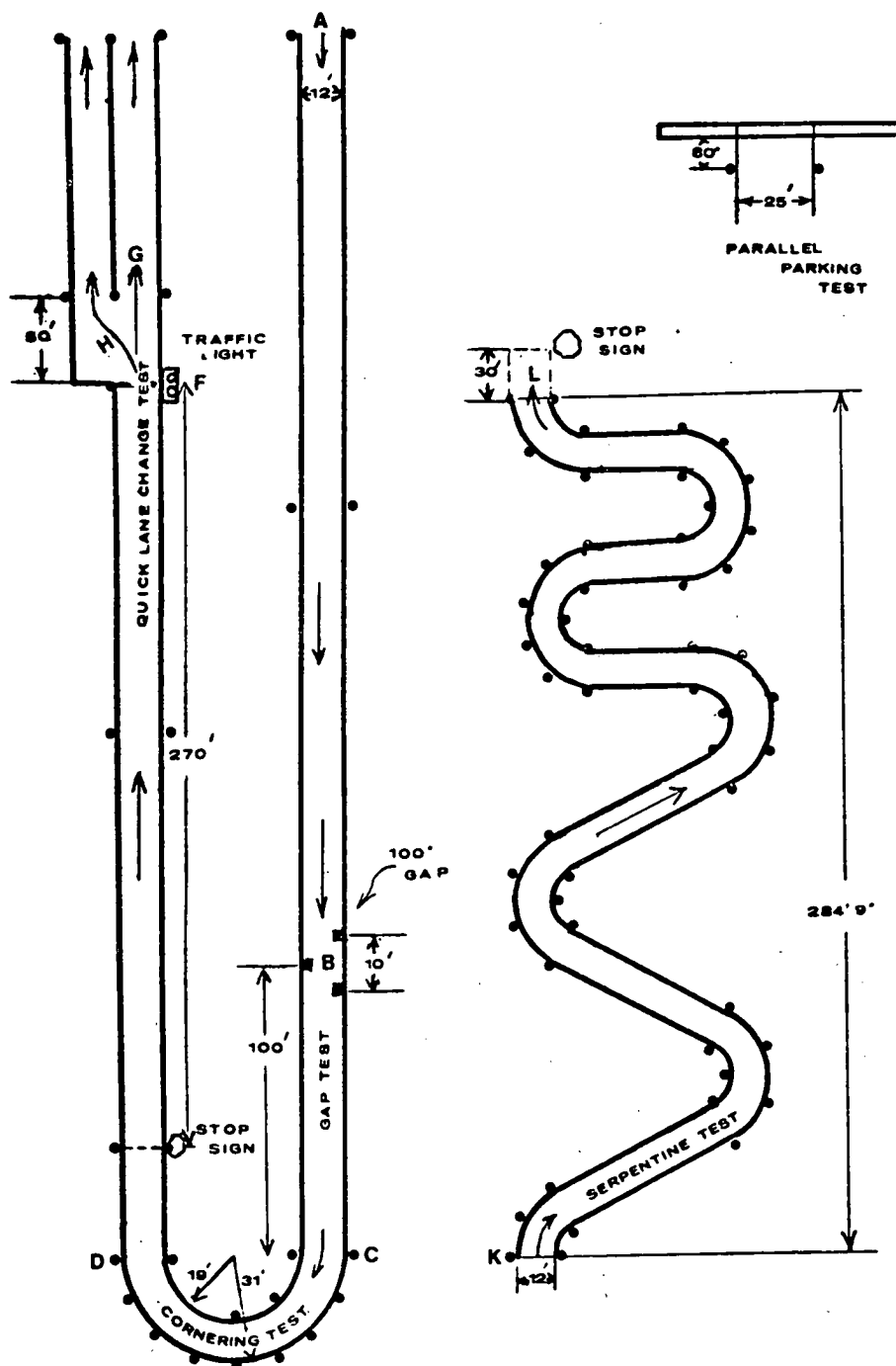


Figure 2. Cornering test results for novices before driver education.

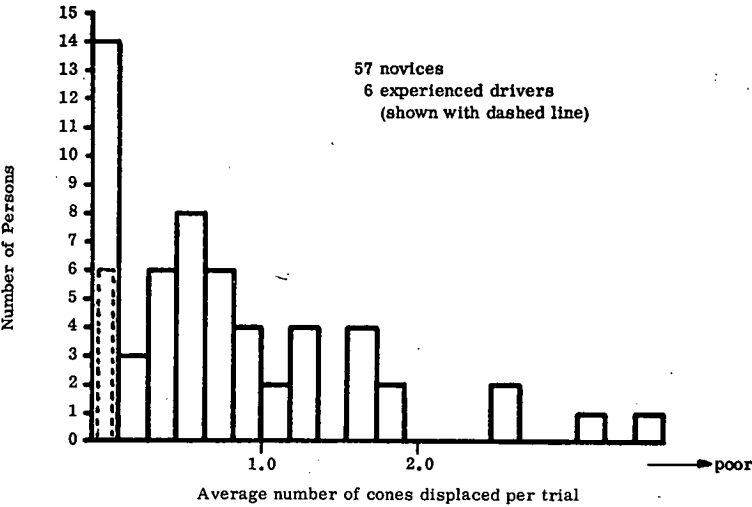
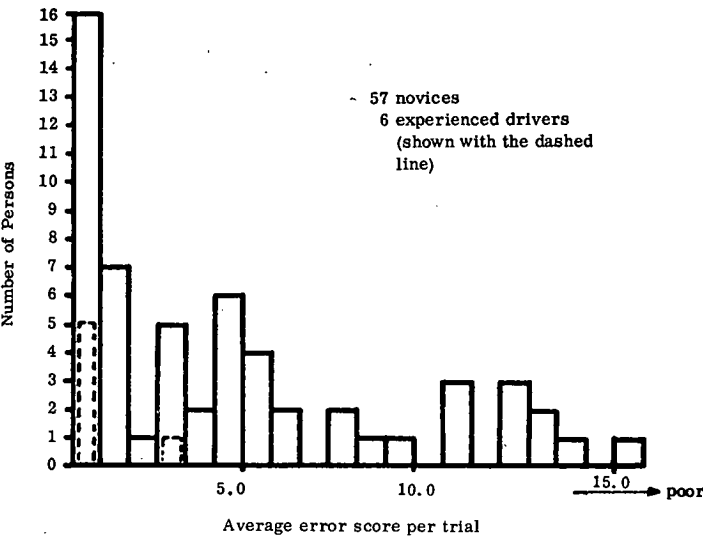


Figure 3. Quick lane-change test results.

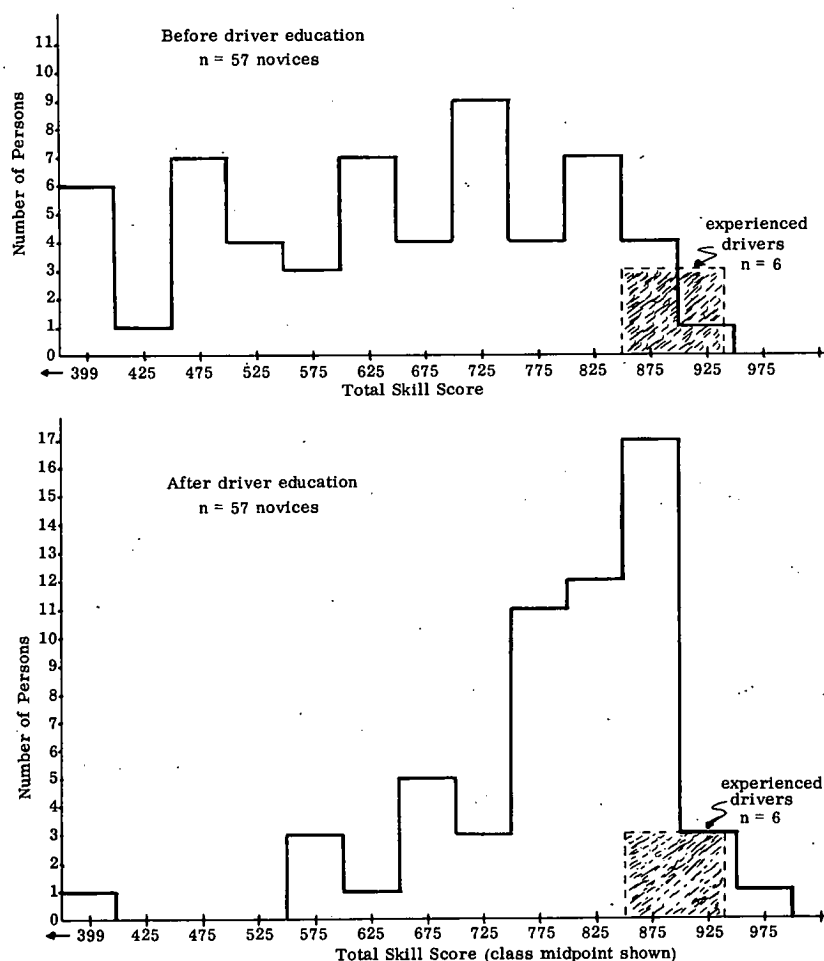


interesting to examine individually, analysis of each measure separately is somewhat cumbersome. Although each test measures specific skills, all tests measure different aspects of general driving skill. For ease of analysis and interpretation of changes in driver skill, we combined the individual test scores into a single index of driving skill, the total-skill score. The method used to combine the test scores was to add them after an appropriate scaling and relative importance rating were applied to each score.

The distribution of the total-skill scores is shown in Figure 4. Note that, like the individual test scores, the total-skill score shows a wide range of performance ability before driver education and much poorer performance by most novices than by experienced drivers.

Upon completion of driver education, most novices showed great improvements in performance. Many students approached the levels of skill exhibited by experienced drivers (Fig. 4). Strikingly, however, almost half the students still performed well

Figure 4. Total-skill scores before and after driver education.



below the level of skill of the experienced drivers after completion of driver education.

The students were tested again 1 year after completing driver education (Fig. 5). Most of the students attained the skill level demonstrated by experienced drivers, but about 15 percent were still below the level of experienced drivers.

In addition to exhibiting a wide range of skill scores on the tests before driver education, novices exhibited a wide range of improvements in scores after driver education. Furthermore, the amount of skill improvement after the course was highly correlated with the score before driver education ($r = -0.66$, $\alpha < 0.05$). That is, students who scored very poorly before driver education improved greatly, whereas students who scored very well before the course improved little. The students were divided into three groups based on the total-skill score before driver education; the top group was the high skill group. The average performance for each of these groups on the total-skill score is shown in Figure 6.

This figure shows clearly that the low performers improved the most after driver education. In spite of this improvement, however, the skill level of the lowest group after driver education was not at the skill level of the highest performers before driver education ($\alpha = 0.05$).

Further analysis of the data revealed an interesting profile of driving exposure time for the initially low performers. The low group appeared to receive less driving exposure than the middle and high performers (Table 2). The initially low group tended

Figure 5. Total-skill scores 1 year after driver education.

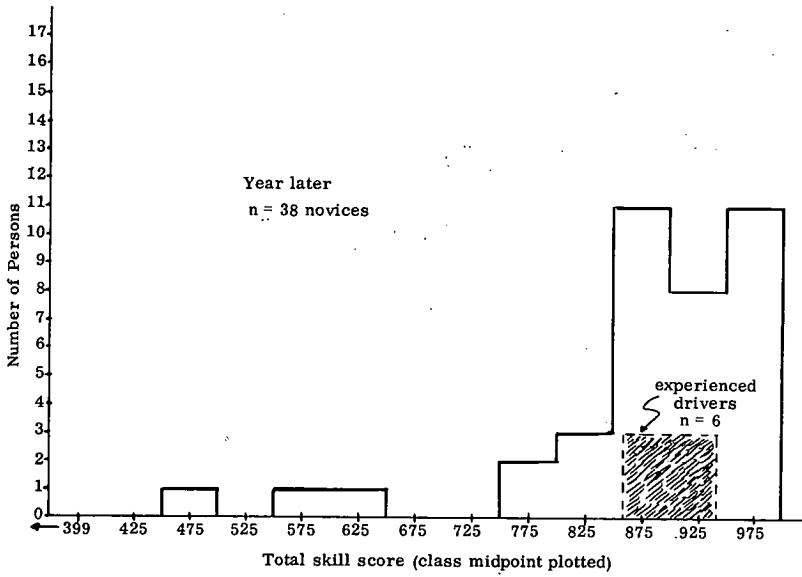


Figure 6. Total-skill scores for each group.

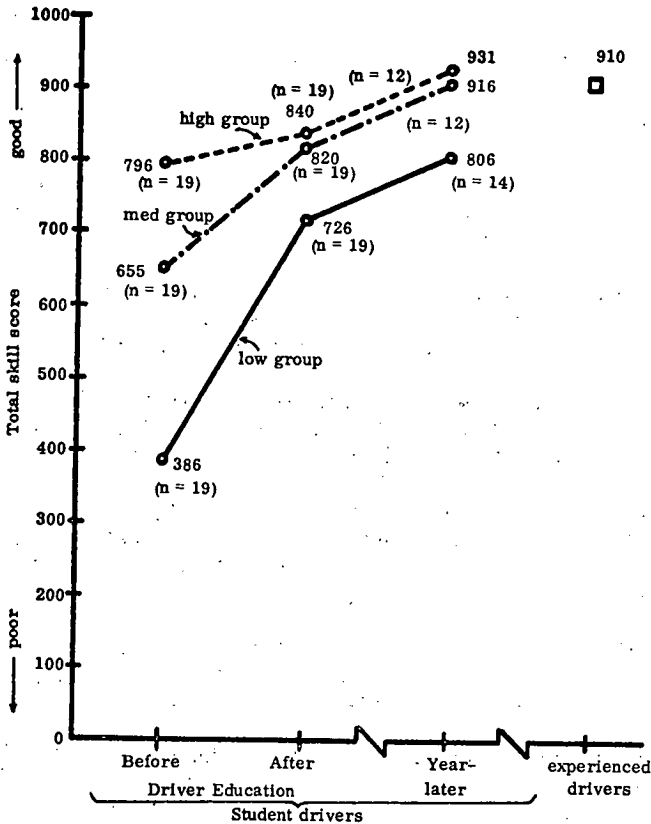


Table 2. Driving exposure of student drivers.

Student Data	Student Skill Groups		
	Low	Medium	High
Average hours of informal driving before driver education	2.2	3.8	14.7
Persons reporting more than 5 hours of informal driving during driver education	6 of 19	12 of 19	14 of 19
Persons driving daily after driver education	4 of 12	10 of 12	14 of 14
Average hours of driving under instructor supervision	4.7	6.1	7.1

Note: n = 19 for each skill group.

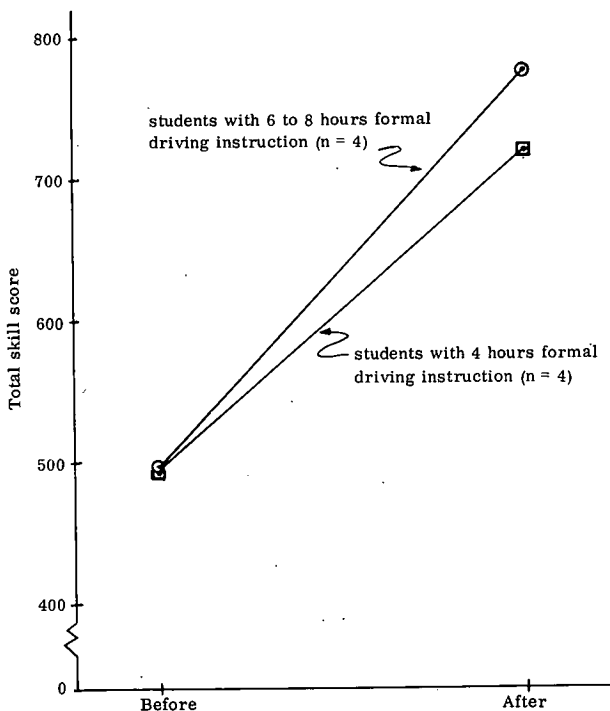
to drive fewer hours informally before entering driver education; they drove fewer hours outside the classroom with informal instruction; they received fewer hours of formal instruction; and they drove less within the first year after completing driver education. Unfortunately, the persons who needed extra practice the most received it the least.

As is shown in Figure 6, the lowest initial performers have much room for improvement after completion of driver education. It seems reasonable to suspect that those students who receive more time behind the wheel attain higher levels of

skill. The data for the lowest third were examined for the possible effect of the number of hours of formal instruction behind the wheel. To analyze the effect of the number of formal hours, we classed the students in two groups: those with few formal hours (4 hours) and those with high formal hours (6 or 8 hours). Of these, only students with similar initial skill levels were included in the comparison (earlier results have shown that skill improvement is largely determined by initial skill level). Only four students within each group could be matched in initial skill level. Though the results shown in Figure 7 are not statistically significant, the trend in the data suggests that more formal hours of instruction may result in higher skill levels. Of course, the strength of this conclusion must be tempered by the small sample sizes available.

A separate study with fewer subjects (12 novices and 6 experienced drivers) was conducted after the main study. Although the primary purpose of this study was to develop tests of safe driving practices (6), the range skill tests were also administered

Figure 7. Effect of formal driving on skill.



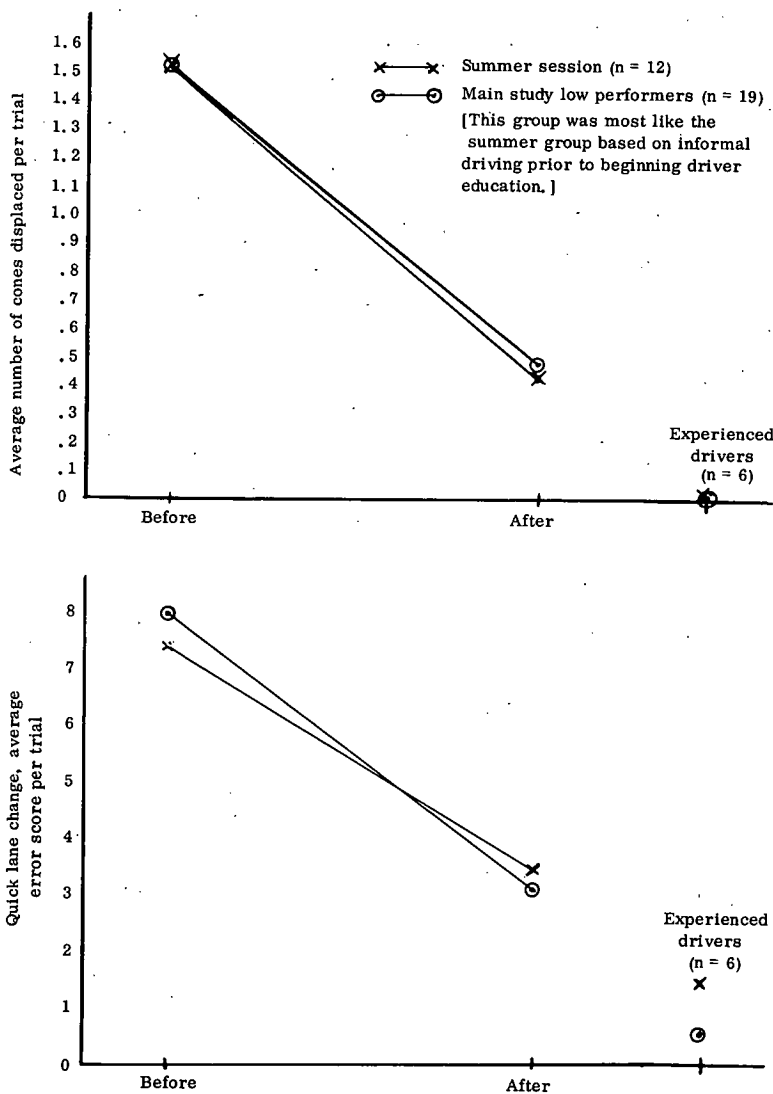
to these subjects. The range tests yielded extremely reliable results from two studies with different subjects, different setups, different experimenters, and different cars (Fig. 8).

CASE FOR DIAGNOSTICS

Novice drivers exhibited a wide range of skill levels before entering driver education. Students who entered driver education with high skill levels had little room for improvement but were relatively near the skill level of experienced drivers. Poor initial performers, on the other hand, improved greatly during driver education, but, by the completion of the course, they still had not attained the level of skill exhibited by high performers before driver education. Thus, the results suggest that some students need more training than others to attain higher levels of skill.

A promising application of the tests developed thus appears to be the use of the tests

Figure 8. Comparison of range test scores in separate experiments.



and measures as a diagnostic tool. Upon entering driver education, students can be tested and ranked as high, medium, or low performers. Low performers, who need training beyond the standard program, can be assigned to enriched programs with a greater number of hours of driving time. (The actual number of hours and types of experience required are still a topic for research.) If limited budgets prohibit enriched programs, perhaps giving more training to the poor performers and less to the high performers will result in more effective use of existing driver education resources.

SUMMARY

The main objective of this phase of the research project was to develop objective tests of student driving performance. The tests developed proved sensitive to students' levels of driving performance before entering driver education and to changes in performance after driver education. The results of the tests showed that students bring widely varying levels of skill to the driver education program. Furthermore, the results indicated that some students need additional training to attain requisite high levels of skill. The performance tests developed in this study can be used as a diagnostic tool to identify student needs. With such a diagnostic approach, programs can be matched to students' needs.

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A COMPUTER-BASED SYSTEM FOR LICENSING ELDERLY DRIVERS AND POSSIBLY OTHERS

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For years the power of the states to license and regulate local matters for the general welfare has gone unchallenged. Under the legally dubious doctrine that driving is a privilege and not a right, arbitrary standards and procedures were established to implement state laws, to select those drivers who would be issued permits, and to revoke or suspend the permits of licensed drivers who were considered to have abused their privilege.

But the right-privilege distinction is now in demise, and the whole issue may soon be meaningless. Recent court decisions have all but destroyed this distinction.

The shaky legal basis of licensing now brings into sharp focus the problem of predictive validity and may soon put states on the defensive in court to justify their tests. Legislators and license administrators may now have to turn to researchers for help in devising driver quality control devices that are scientifically valid and therefore legally defensible under the due process clause. Perhaps the only reason this has not arisen already is that so few persons are denied licenses and many elderly "voluntarily" surrender their licenses for fear of failure and, in so doing, do not force the issue.

APPROACHES TO LICENSING AND EXAMINATION

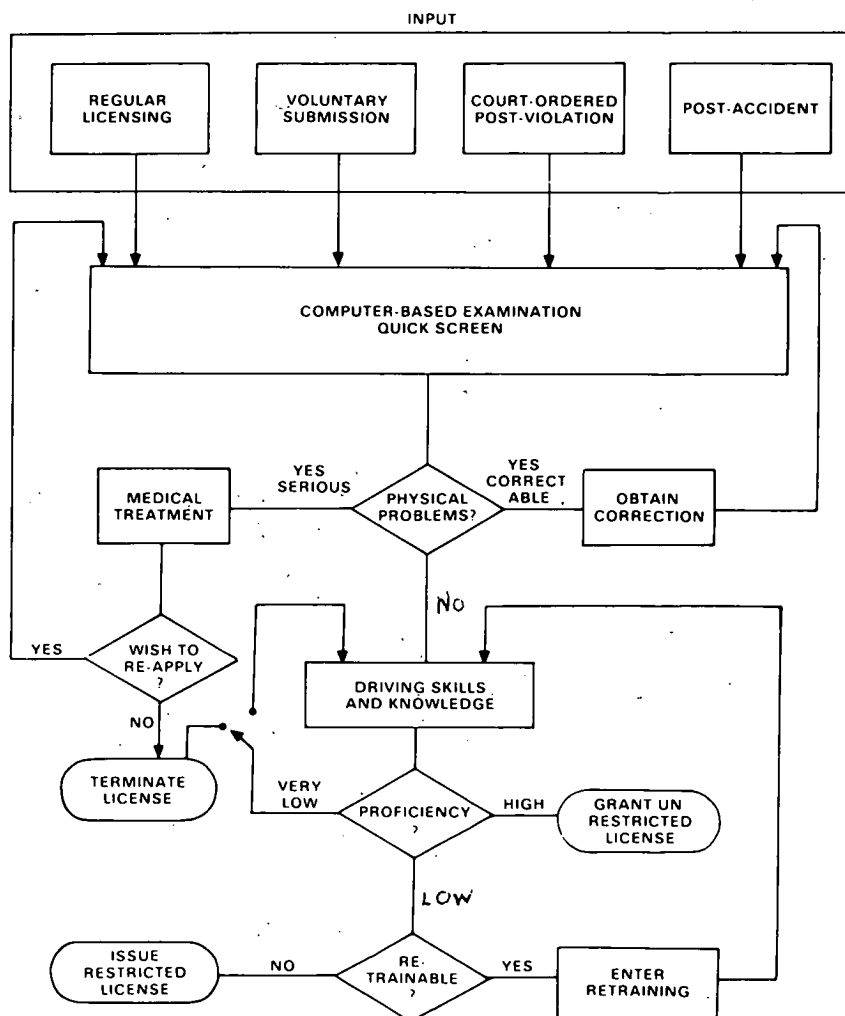
A system for examining the elderly driver must meet the following criteria:

1. It must be legally defensible;
2. It must be socially relevant—that is, it must achieve some goals for the betterment of society; and
3. It must be scientifically valid (otherwise it could not meet the first two conditions).

The proposed system is applicable not only to the elderly driver but also to any "problem class" of driver, such as the young, those with diagnosed illness or physical impairment, and those with high violation records or recent accidents.

The proposal is that certain drivers be submitted, either voluntarily or by court decree, to a multiphase driving examination, not unlike the automated screening devices being implemented in health maintenance organizations. The actual hardware would be computer-based; more will be said of the technique later. Figure 1 shows the input and output of the system. Although there is no reason why ordinary license applicants and reexaminees could not be put through the same screening device, the focus here is on elderly drivers

Figure 1. Proposed computer-based licensing system.



whose participation would be voluntary (possibly as an alternative to voluntary surrender or lapse of their permits) or be based on a court decree.

As the flow chart indicates, subjects first submit to a rapid screening of vision, hearing, and gross measures of sensorimotor functioning. Those passing legally acceptable criteria, as specified by the Highway Safety Act of 1966, are tested for driving skills. Those with remediable defects are referred to the proper source of correction (physician, ophthalmologist, etc.) and reenter later for examination. Those with serious or possibly irreparable problems are referred for more extensive examination or treatment, and may or may not later reenter the licensing system for another attempt. This aspect of the screening system may yield a considerable social dividend quite apart from quality control of drivers; as Waller has pointed out, traffic accidents can be the first indication of presymptomatic physical conditions.

The next stage of examination is testing of knowledge of driving laws and signs, basic skills, and a simulated driving task. (Such items as knowledge of laws and recognition of traffic signs may indeed have low predictive validity, but they will probably always be included in license examinations for their high face validity in the eyes of legislators and administrators.) Exactly what should be included at this stage of examination is,

of course, the question that we are not prepared to answer, but through extensive research such a determination can be made. There are no shortcuts: Development of the items to be included in this battery will require years of research and followup. But no items currently included in licensing examinations have proven ability to predict accidents and violations, so we can only improve. Even a seemingly obvious item such as visual acuity appears to be unrelated to driving performance, except possibly in the extreme.

As the flow chart indicates, after the basic skills are tested and the subject has completed a simulated driving task, a proficiency measure is computed. Those with high proficiency scores could be issued unconditional licenses. Those with extremely low scores may reappear for retesting later. And those with moderate scores, or certain classes of deficiencies, could be branched to a number of alternatives including

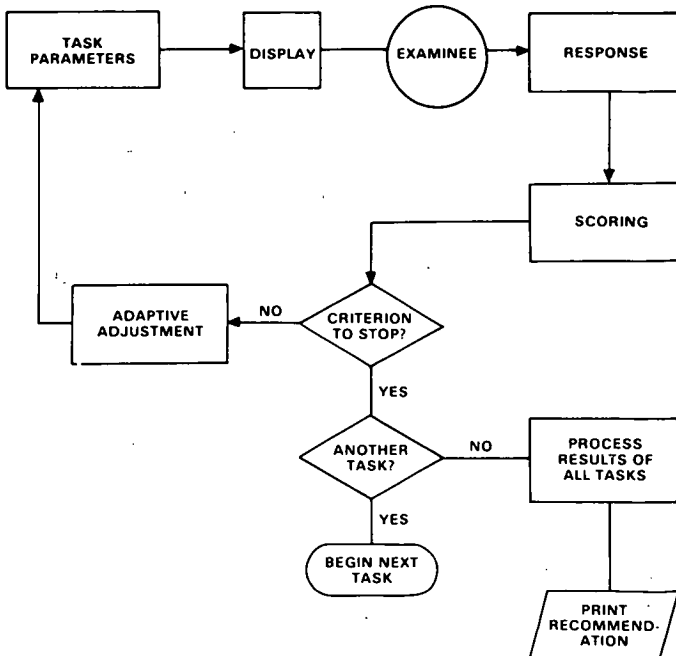
1. A road test with an examiner,
2. A restricted license (e.g., daylight hours only or city streets only), and
3. Retraining and reexamination.

A computer-based system for implementing such an examination would combine elements of conversational computing as applied in automated health screening, driver examination by a simulated road test, and adaptive measurement techniques.

Laboratory computers allow use of adaptive or self-adjusting tasks for proficiency measurement. Adaptive tasks are those in which the subject's scored output mediates or adjusts the input in such a way that, as he masters the task, as reflected in his measured score, the task is made more difficult, and vice versa (Fig. 2). The subject is thus essentially an element in a closed-loop system. The advantage of adaptive techniques is that they allow rapid determination of proficiency level without wasting time testing the subject at levels too easy or too difficult.

Using adaptive measurement, we could very quickly determine scores on a battery of multiphase tests. These individual scores would form a performance vector, and, by another series of decision rules, which only a great amount of research could

Figure 2. Self-adjusting system as applied to testing of a license examinee.



determine, a recommendation for action on the examinee would be typed out, perhaps as one of the alternatives already listed. A few of the tests that might be considered for inclusion in a first approximation of a test battery are

1. A fast-adapting test of visual acuity,
2. A fast-adapting test of auditory threshold,
3. A test of vigilance or alertness,
4. Various biographical, health-related, and driving experience data, and
5. A simulated driving task.

THE CHALLENGE TO RESEARCH

This paper outlines a double-barreled research problem:

1. To develop individual items, for inclusion in the battery, that have predictive validity, and
2. To combine scores on these items according to a series of decision rules that permit a logical, valid, and legally defensible recommendation for licensure.

ACKNOWLEDGMENTS

The author gratefully acknowledges the assistance of Larry Keeler, Rhea Schwaber, and Anne Manchester. The computer system discussed here was made available from a research project of which the author is principal investigator, sponsored by the National Institute of Occupational Safety and Health.

Discussion

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In proposing a computer-based driver licensing system, Wiener points to the need for a comprehensive system that provides legal, socially relevant, and scientifically valid means for screening various "problem driver" types. The major concern expressed is for the elderly.

To develop systematized methods for rapid screening of vision, hearing, and gross measures of sensorimotor functions requires that criteria suitable for evaluating all drivers' performance on these tests and their pertinence to safe driving be developed.

The essence of Wiener's presentation, "a logical, valid, and legally defensible recommendation for licensure," agrees with concerns and objectives of enlightened administrators. They recognize the need for interested and competent researchers who will discuss, review, and identify problem areas in driver licensing. From joint interests by governmental agencies and researchers, projects could be undertaken to resolve problems thwarting improvements in driver license examinations. As Wiener points out, "Exactly what should be included at this stage of the examination is, of course, the question we [researchers] are not prepared to answer, but through extensive research such a determination can be made."

In his proposed examination of the elderly, Wiener develops concepts having general application to all beginning drivers. The value of consolidating examinations into a test battery is yet to be determined. The most important aspect of Wiener's viewpoint is his recognition that researchers must consider what is needed to establish and substantiate driver licensing examinations based on performance levels for drivers that relate to the demands likely to be experienced by drivers and how their conditions influence their performance.

Realistically, application of this approach may not be financially possible, except at

an experimental level, and only if joint or multidisciplinary study efforts can be funded by the public or private sector.

In his review of the limitations of existing driver license examining procedures, Wiener implies that licensing examinations should predict accidents and violations. There is an increasing body of research concerning this issue. It is clear, however, that Wiener's consideration of the research needs in driver licensing includes the complexity of the driving task. In determining drivers' qualifications, he goes beyond all but a few of his predecessors. Indirectly he also identifies a question for future research: What can be done to overcome drivers' human tendency to adopt fixed habits of driving in a highly dynamic and changing environment, which may be characteristic of elderly drivers?

Scientific foundations for future driver examinations and a criterion for their evaluation are major challenges for both the researcher and driver licensing administrators; it is hoped that they will soon begin traversing that course jointly and cooperatively.

For future consideration, a forum for administrators and researchers offers one approach to identifying what is needed and feasible.

THE CHANGING TASK OF DRIVER LICENSING

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There has been a growing trend in our society to look at a driving license as a right rather than a privilege. So much of our society depends on the automobile that many people could not continue gainful employment were they not able to drive. Likewise, large portions of our economy rely directly on the individual's use of the private automobile. Furthermore, the courts have moved in the direction of interpreting a driving license as more in the nature of a right than a privilege. In the face of such trends, the screening concept of driver licensing will no longer be defensible. Consequently we must consider the task of driver licensing in a new light.

We must first be concerned with improving methods of evaluating license applicants by developing more valid procedures than we can currently demonstrate. This improved evaluation would be combined with specific training programs aimed at meeting the deficiencies indicated in the evaluation. Second, we must move toward providing programs in which drivers who are not able to qualify for full-fledged licenses can drive under prescribed conditions until they are able to qualify at a higher level.

EVALUATION AND TRAINING

If licensing is more a right than a

privilege, then we can no longer focus on granting only the fit driver a license. We must also be concerned with how we can improve the performance of those persons who do not measure up to the standards. We must combine a screening approach with a more in-depth diagnostic and training approach.

The first step in developing such a program is to identify from the literature those factors that correlate with driver performance (e.g., age, sex, driving experience, socioeconomic status, personality factors, physical characteristics, medical factors). Once key factors have been identified, they should be incorporated into a comprehensive evaluation and training program. For example, if biographical factors, medical conditions, level of driving experience, and personality factors are all found to relate significantly to driver performance, then an inventory designed to obtain such information could be administered to all driving license applicants. (Whereas questions concerning medical history are usually considered acceptable to the public, measures of personality factors are likely to raise hackles. If such measures are used, they must be employed judiciously.) It should be possible to obtain a usable amount of information in a relatively short period of time and with relatively little of the examiner's time being occupied by a single

applicant. (It is recognized that not everyone will answer truthfully, and indeed this is currently the case concerning medical and psychiatric questions. However, on the whole it should be possible to glean considerably more useful information than is now collected and at a minimal increase in cost.)

In addition to basic biographical information, all applicants should receive the more traditional tests, including a well-constructed rules-of-the-road examination, vision testing, and on-the-road performance testing.

An essential consideration in development of such a system of driver evaluation and training is public acceptance or political feasibility of implementing the program. It is one thing to identify high-risk groups; it is quite another to take any measures based on an individual's membership in such a group. Still there is more leeway here than might be anticipated. For example, discrimination on the basis of age is a time-honored practice. The founding fathers required that presidential candidates be at least 35; most public school systems impose minimal age restrictions. Because driving performance shows such a strong association with age, this is an area in which it should be possible to implement reasonable programs.

A comprehensive evaluation for driver licensing could be set up in such a way that portions of the evaluation could be weighted differentially and a person could qualify for licensure in a variety of ways. A certain minimum total score would be required as well as minimum scores on separate portions of the evaluation. The analogy of earning a college degree may clarify this point. A person may receive a bachelor of arts degree in any one of a number of ways. He may need a specified number of credits in each of several general areas such as natural science, foreign language, and humanities. Beyond these core requirements he could earn his other credits in electives, but he would still need a minimum number of total credits in order to graduate. In the same way the applicant for a driving license could be given credit for certain characteristics or experience. The middle-aged driver may be given a certain number of credits simply by virtue of his age. Driving experience may also earn an applicant credits. A teetotaler could be given some credits toward a driver license for his nondrinking status. There would still be a minimum number of credits that would have to be earned on the rules examination, the vision test, and the road test, but the drinker may need to score extra credits in other areas that the nondrinker would not.

The analogy is not complete. In the case of a college degree, the institution is prepared to offer training to meet deficiencies. Although this would be true to some extent in this system of driver licensing, it would not always be the case. Indeed, there are some instances in which deficiencies could not be overcome. Although denial of a license should be considered a last resort, there are times when it may be necessary for the protection of the greater society.

Such a system would have to be viewed not as penalizing certain groups but as allowing other groups some credit for the characteristics they possess that have been shown to be related to driver performance. Such a system would be based on empirical evidence and would be far more defensible than any system currently used.

To make such a comprehensive evaluative system even more defensible requires that, wherever possible, constructive programs be developed to deal with the problems of the high-risk groups identified. To some extent this is already done in that we provide driver education to the young driver and driver improvement programs to those who have had more than their share of trouble. However, should personality testing show that persons who feel that they have little control over their destiny run a higher risk of accident, perhaps we can develop methods of countering such feelings of powerlessness, at least in regard to driving behavior. If such techniques are developed, they could be applied in driver education and driver retraining.

The development of such programs would mean that most drivers who failed to qualify for licensure the first time would have the opportunity to better prepare themselves for licensure the next time.

GRADUATED LICENSING

The second major focus of this paper concerns the way in which the licensing

procedures could be used more extensively in the control and monitoring of driver behavior.

There is a great need to develop more effective programs for the young driver. It is recognized that the beginning driver is likely to have more than his share of accidents. Data from North Carolina show that young drivers experience greater accident risk, given their presence in the driving population (not just the licensed population). Their overrepresentation in accidents is highest at the earliest ages (≤ 16) and gradually decreases through age 24. Drivers from age 25 through 54 are underrepresented in accidents compared to their presence in the driving population. After age 54 there is a gradual increase in risk. These results are similar to those found elsewhere in the country. The fact that the young person shows a gradual decline in accidents suggests that experience is at least part of his problem.

The driver licensing program in North Carolina has recognized that beginning drivers are likely to have more difficulty. Driver education is a requirement for obtaining a license before age 18. Upon successful completion of an approved driver education course and upon passing the driving license examination, a 16-year-old receives an operator's license that entitles him to drive any time, anywhere, and under any circumstances allowed other drivers with a regular operator's license in North Carolina. The only distinction made between the young driver and an older driver is that the young driver is a provisional licensee. This means that if he gets into trouble, i.e., has a moving violation, he may be penalized much more severely than his older counterpart. In other words, we know that he is inexperienced and more likely to have difficulty, but the only recognition we make of this fact is to mete out harsher penalties for an offense. Surely we can provide a more constructive solution to the problems of the young driver!

The driver education program in North Carolina consists primarily of the standard 30 hours of classroom work and 6 hours behind the wheel. Traffic safety educators are well aware of the inadequacies of such a program. Major strides have been made to upgrade the training and qualifications of the driver education instructors in North Carolina and to extend driver education to a full semester course, including time on driving simulators and increased time behind the wheel, either on ranges or on the highway. In addition, it is recognized that special training in emergency procedures is desirable.

The need for expanded training is recognized, especially behind-the-wheel training, but financing is a major consideration. Behind-the-wheel training is the most expensive part of driver education. However, the appropriate licensing system could provide the young driver with an opportunity to acquire behind-the-wheel experience under monitored conditions at little or no cost to the state. The initial licensing of beginning drivers could be done in such a way that the beginning driver is introduced gradually into the driving population. Although the driver licensing authority cannot control the actual amount of driving done by a young person, it could control some of the conditions under which driving occurs over specified periods of time. For example, it could require that, once an approved driver education course is completed and the driver licensing exams are passed, for the first year (or 6 months) of driving the young person must drive only during daylight hours or only between 9:00 a.m. and 4:00 p.m. and then only with a responsible adult (parent or guardian) in the front seat. After the initial time period had passed, driving would be allowed during these same hours without the presence of an adult. In successive stages the evening hours and finally the night hours could be added. Each time the adult could be required for the time period during the day that is added but could be eliminated for the time periods already completed.

To extend the period of time during which a driver is so limited immediately raises problems. Young people want cars, and many parents are only too eager to escape the role of chauffeur. It would be possible to lower the age of initial licensing (and hence driver education) so that behind-the-wheel experience could begin at age 14, for example, instead of 15 or 16. The requirements for graduation from one license level to another could be based on a combination of both experience (here based only on length of time licensed rather than actual driving) and demonstrated skill, i.e., a higher score on the road test. However, the latter would not replace the former. Even high scores would be required to wait a specified period of time before becoming eligible for a

higher level of license.

If the age of initial licensing is lowered, young persons could be eligible for a regular operator's license at the same age that they may now acquire one. The difference would be that by that time they would, on the whole, have much more experience behind them than is now usually the case, and this behind-the-wheel training would be at minimal cost to the taxpayer.

At the present time the newly licensed young person may immediately embark on night driving with other young people present in the car, a situation characterized by complexity. Experience in night driving is not included in most driver education courses. The inexperience in driving and the customary inexperience of young people in such complex social situations may be more than the novice driver can handle. If a beginning driver could acquire his initial driving skill under less complicated circumstances, he might be better able to handle more complex driving situations.

Such a proposal is by no means offered as a substitute for whatever innovations may be developed in driver education. Indeed, not every young person will have a responsible parent or guardian who can supervise his driving. Clearly for such youngsters a graduated system of licensing would have little merit. However, if parents can assume some of the responsibility for the acquisition of driving skill, driver education specialists could devote more of their efforts to those youngsters whose needs are greatest. This proposal is just one procedure that may provide considerable benefit for the cost that would be involved. Such a program would necessitate the cooperation of parents, license administrators, enforcement personnel, and driver education personnel.

Several license levels should be considered not only for the beginning driver but also for all drivers. It may be that greater use of restrictions would be appropriate for many drivers, particularly older drivers, to enable them to drive as long as possible under reasonably safe circumstances.

The implementation of such a program of graduated licensing should be combined with a system of identification so that the program can more readily be enforced. Some visible sign of a driver's status could be displayed, e.g., in the lower right corner of the windshield, during the time that that driver is operating a vehicle.

SUMMARY

The purpose of driver licensing should be not only to identify and license those drivers who are most likely to be able to safely operate motor vehicles on public highways but also to provide the unqualified applicant every opportunity to meet the minimum requirements for licensure. It is desirable, therefore, to move toward a more comprehensive evaluation of driver license applicants wherein greater use is made of information on the relationships between certain factors and driving performance. Such information could be incorporated into the licensing system to improve the predictive validity of the licensing procedures. In addition, wherever possible constructive programs should be developed to deal with special subgroups of drivers so that the applicant who fails to qualify for a license the first time would have the opportunity to participate in remedial activities. We do not have enough information to develop all the remedial programs that should be included, but we have enough information to make a respectable start.

In addition to expanding the evaluative function of driver licensing, we could also extend the function of monitoring and controlling driver behavior. Through a graduated system of licensing, young drivers could be introduced into the driving population in a way that decreases their risk of injury or death. By the same token, older drivers could be gradually phased out of the driving population so that a greater number of people could continue to drive for longer periods of time under conditions more conducive to their safety.

Such changes in driver licensing programs should not incur undue expense. The potential payoff per dollar spent may prove to be much greater than the alternatives, e.g., a significant expansion of behind-the-wheel training in driver education.

Although the need for research on important aspects of driving continues, we need not wait for additional research findings to begin to use the information currently available.

IS THERE A SELECTION RATIO IN THE FUTURE OF LICENSING?

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Although the controversy over the causes and extent of the current energy crisis continues, the world has known for decades that fossil fuels are limited and that the United States is the foremost energy glutton. It has become obvious, however, that the United States cannot continue to expand its wasteful use of energy nor can other countries hope to attain the "American dream" of luxurious vehicles and superhighways available to every man for every trip. Only the Federal Republic of Germany reports a higher annual death rate than the United States with its 43 deaths for every 100,000 males. The United States, with its trend toward liberating women, now has the highest rate of traffic deaths among women: in 1970, 14.7 for every 100,000 women. If we assume that the average driver is exposed to such a threat for 50 years, more than two out of every 100 drivers will be killed by an automobile before they are 50 years old, given the annual death rate. Even if this extension is not completely accurate, the order of magnitude is clear.

By far the great majority of these fatalities are from individual, privately owned and operated automobiles. The only hope for reducing such a toll lies in reducing the exposure of the population to such threats.

Those of us who have studied driver

licensing and accident involvement know that it is difficult to identify a minimum amount of knowledge that is "essential" or attitudes that are "optimal" and correlated with driving success; the "problem driver" constitutes a very small portion of the total problem. Driver inattention, fatigue, confusion, and distraction are involved in more accidents than causes such as mechanical conditions or equipment failure. The fact is that driving is incidental to many other activities and often does not receive the emphasis and practice or motivation to keep it at a very high level of performance. In short, use of public transportation vehicles, driven by a relatively small number of experienced drivers who have a minimum of other distracting duties and interests, would reduce the likelihood of the thousands of errors, incidents, and accidents that occur in conjunction with distraction or temporary incapacity.

The one thing that the energy crisis has done is put the problem in a slightly more reasonable perspective. This, presumably, will result in providing some alternatives to individual automobile mobility in those places where it is practical. The pricing pressures arising from fuel shortages will make many things practical that, until recently, were not within the realm of possibility. If there are alternatives to driving automobiles, drivers can be

selected on a more systematic basis. In fact, only when a selection ratio exists can any kind of a selection based on performance or likelihood of success be instituted. Under existing practices in the United States, virtually all of the drivers who submit themselves to "examination" for licensing are eventually licensed. On the other extreme, commercial airline pilots probably are selected from the greatest number of potential applicants. Some intermediate between these extremes is found in commercial truck and bus drivers. Professional firms have demonstrated that it is possible to develop successful drivers from a group of potential drivers, even if their selection techniques have lacked a truly scientific basis.

We do not yet have an infallible system for selecting drivers, but the possibility of accepting only two out of three applicants for a driver's license, instead of almost all applicants, indicates that some measure of success can be developed.

The impact of the fuel shortage on speed alone is not likely to be very effective. For example, in 1972, 32,000 fatalities occurred on rural roads where speed limits already were 50 to 55 mph. The reduced speed now mandated will not affect the likelihood of fatalities on these roads, although reduced volume will. In contrast, only 8,000 fatalities occurred on Interstates, freeways, or turnpikes. Here the reduction from 65 or 70 to 50 or 55 mph is likely to reduce the percentage of fatalities somewhat, but the overall effect on total fatality is likely to be small. On rural roads where three-fifths of the fatalities continue to occur, two-thirds of these are at night even though the volume then tends to be lower. Undoubtedly a great number of these fatalities are related to alcohol use, but, once more, the drinker often has no alternative to driving. If he is provided an alternative transportation means or if a substantial change in values and mode of living eventually occurs, the fatality rate would be affected.

Demand for automobile travel exceeds the reasonable capacity of many urban areas. Energy waste and urban congestion are more reasons for reducing automobile use in populous areas. Providing alternatives to individual automobile use makes higher driver qualifications possible, especially as a means for increasing the traffic flow and reducing the noise, visual, and air pollution that results from excessive use of automobiles in congested areas. Pricing will undoubtedly make public transit more attractive in certain areas, but driving performance in urban areas truly is beyond the capability of a considerable portion of the people now attempting to drive. Anecdotal evidence is sufficient in this case, for we all are held up occasionally by inept, confused, lost, or otherwise (at least temporarily) unqualified motorists.

A great deal of effort is being directed toward providing alternatives to the more conventional transportation that has evolved under a purely demand system. The cost of personal rapid transit, dial-a-bus, and other modes often makes them appear beyond reach, especially given that drivers tend to perceive out-of-pocket automobile cost as 5 to 10 cents per mile rather than the 15- to 20-cent per mile true ownership cost. Especially in rural areas, the problem of public transportation becomes a complex one.

One proposed system is a "demand-stop" bus system that is somewhere between the regular bus and the dial-a-bus concept. In this system, a large number of stopping points are provided for users; each one includes a visible signal that may be activated by a person waiting at the bus stop. The signals are located along a through route so that the driver is required to make occasional small detours from a set of options in response to the signal light or the requests of passengers. No elaborate equipment is involved; communications equipment consists of a pair of clocks that state the time at which the last bus passed and the last interval between buses at that stop. There is only a simple visual link between the signal light and the driver. In this way, a passenger can rely on the bus—not a fixed schedule but on the interval between buses and the time elapsed since the last bus passed.

For rural areas, this demand-stop system allows a large number of potential points, each of which has a very small frequency of use, to be serviced. The variable bus circuit time thus would be compensated for by dependable, demand-regulated service and the customizing of routes based on actual demand without the delays inherent in regular stops in a large number of stations. Such concepts have not been seriously evaluated in many rural areas, and the result is that no transportation is available to a significant portion of the rural aged or rural poor and that multiple car ownership is

almost essential in rural areas. Such systems would require modifications in individual life-styles, perhaps. The perpetual rush demonstrated by Americans and the completely arbitrary work schedules that penalize an employee for an occasional minor tardiness would have to be relaxed or modified. The changes are coming eventually. The goal should be equitable treatment of all concerned and management of limited energy resources.

There has always been an energy shortage, and only now is the American public becoming aware of it. Those who should have known better have acted as though no energy shortage would ever exist. The current crisis has only served to remind us that energy is a limited commodity. Until new systems and new ways of using systems are developed, we will always be under the threat of curtailing our way of life and our ways of transportation. Some aspects of transportation and our way of life could stand improvement. The selection ratio is one possibility for improved driver selection that tends to reduce the great number of fatalities, injuries, and losses related to accidents that are purely "accidental," i.e., they are made up of random distractions, temporary incapacities, frivolous demands, and overly selfish motivations. This selection process does not yet exist, for it has been meaningless to search for one where there was no likelihood of rejecting a reasonable portion of the applicants and where no provisions were made for ensuring that drivers remain qualified and appropriately involved in the actual demands of driving in a complex environment.

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The Transportation Research Board operates within the Commission on Sociotechnical Systems of the National Research Council. The Council was organized in 1916 at the request of President Woodrow Wilson as an agency of the National Academy of Sciences to enable the broad community of scientists and engineers to associate their efforts with those of the Academy membership. Members of the Council are appointed by the president of the Academy and are drawn from academic, industrial, and governmental organizations throughout the United States.

The National Academy of Sciences was established by a congressional act of incorporation signed by President Abraham Lincoln on March 3, 1863, to further science and its use for the general welfare by bringing together the most qualified individuals to deal with scientific and technological problems of broad significance. It is a private, honorary organization of more than 1,000 scientists elected on the basis of outstanding contributions to knowledge and is supported by private and public funds. Under the terms of its congressional charter, the Academy is called upon to act as an official—yet independent—advisor to the federal government in any matter of science and technology, although it is not a government agency and its activities are not limited to those on behalf of the government.

To share in the task of furthering science and engineering and of advising the federal government, the National Academy of Engineering was established on December 5, 1964, under the authority of the act of incorporation of the National Academy of Sciences. Its advisory activities are closely coordinated with those of the National Academy of Sciences, but it is independent and autonomous in its organization and election of members.