Effectiveness of Written Tests of Drivers' Knowledge of Rules of the Road

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The results of an experimental evaluation of several alternative approaches to testing drivers' knowledge of rules of the road are presented. Members of the Virginia population of drivers applying for license renewal were randomly assigned to four study groups. The subsequent driving performance of members of the four groups was monitored, and data on accidents, convictions for major and minor offenses, accidents with associated convictions, and administrative actions taken under provisions of the Virginia Driver Improvement Program were tabulated at 6-, 12-, 18-, and 24-month intervals. Of the few statistically significant differences found between the study groups, none demonstrated that knowledge testing is an effective means of promoting highway safety. Most of the differences observed involved the group who had refused to take the test at home. Except for the minor-conviction entries for this group, no comparisons showed differences across all four time periods. The overall results of the study produced no substantial evidence that knowledge testing should be required of the general license-renewal population.

The U.S. Department of Transportation's Highway Safety Program Standard 5, Driver Licensing, mandates that each state have a program requiring "each driver to be reexamined at an interval not to exceed four years, for ... knowledge of rules of the road" (1, p. A-2). However, because there has been a lack of definitive evidence in the research literature that compliance with the standard would benefit driving safety, officials of the state of Virginia took exception to the requirement for periodic written knowledge testing and requested a waiver of this provision of the standard. The waiver was granted on the condition that the state would conduct the study described in this paper.

The testing of individuals who desire to obtain a license to operate a motor vehicle has been a standard practice in Virginia for more than 40 years. The current procedure requires the applicant for an initial license to pass a battery of tests that include (a) a knowledge test of traffic laws, signs, and signals; (b) a visual screening test; and (c) a vehicle operation and performance test. On the basis of their driving records, some applicants for license renewal are also required to be tested on knowledge and/or vehicle operation. These applicants, as well as all other renewal applicants, are given a vision test in compliance with a state statute that deals with vision requirements.

Under the 1974 Virginia Driver Improvement Act, the state conducts reexaminations on rules of the road when a person demonstrates, under the point system, that he or she does not drive safely. This practice allows the state to concentrate its resources on drivers who show that they need improvement rather than scattering its resources attempting to improve everyone.

It has not yet been thoroughly demonstrated that an increase in driver knowledge results in a decrease in traffic accidents or convictions for violating traffic laws. Among the studies reported in the literature that deal with the knowledge and performance issue, a study by Pursewell (2) concluded in part that relations between written or machine test procedures and subsequent driving records are inconclusive. Levonian, Case, and Gregory (3) studied traffic accidents and violations in relation to a number of variables. The results of their study did not show a correlation between knowledge score and recorded accidents, but they did find that the person who scores low in knowledge tests is likely to have more recorded violations than a person who scores high.

The California Department of Motor Vehicles (DMV) has initiated a number of projects in the general area of license testing and subsequent driving performance. One of these studies, begun in April 1972, was authorized by the 1971 California Senate Concurrent Resolution 104. The experimental program studied the beneficial effects of an automatic license extension for individuals with clean accident and conviction records as well as an incentive procedure to encourage drivers who have prior accident and conviction entries to avoid additions to their records. According to a report by the California DMV (4, p. 12), for drivers with clean records, the reward program had no effect on subsequent convictions but did have various negative effects on subsequent collisions. It was concluded that the "good-driver" population is not a viable target for such a program as it was implemented in this case. For drivers with prior accident and conviction entries, the incentive program had no reliable effect on subsequent convictions but did have various positive effects on subsequent collisions. The reduction in subsequent collisions among drivers with prior entries was felt to have important implications for the design of future driver improvement programs.

A 1977 California study (5) found that traffic-safety materials were not effective in reducing six-month accident and conviction frequencies of the general driving population. It was also found that tailoring the material for specific groups by age and sex had no effect on the participants' driving records.

The California DMV also conducted a study (6) in which renewal applicants were mailed a pamphlet on driving principles, a set of questions, and an answer sheet. It was concluded that there was no significant difference in the subsequent six-month driving records of the control and treatment groups. The study also found that for various subgroups the effects of the new program tended to increase accidents and convictions. It was recommended that the new at-home tests not be implemented (8).

California drivers who apply to renew their operator's license are required to pass a test of traffic-law knowledge before a renewal license is issued. A study was carried out to determine whether renewal applicants who were administered a test that stressed knowledge of the principles of safe driving and recent changes in traffic laws had better subsequent driving records than applicants who were administered the standard California DMV test on traffic law. In his report on that study, Carpenter (7) concluded that the written test on driving safety did not result in a change in collisions or convictions in the six-month period after testing and that the new form should not be used as a replacement for the standard test on traffic law given to license-renewal applicants.

The California DMV also conducted a study in which the test of safe-driving principles was administered to renewal applicants who had a moderate number of collisions and convictions on

their record; their subsequent accidents and convictions were compared with those of a control group of drivers who were given the standard traffic-law test. It was concluded that there was no significant difference in total, fatal, and injury collisions or in convictions between the control and experimental groups in the 12-month period after testing. The report by Carpenter (8) recommended that this component of the selective testing program not be implemented.

In another study, the Highway Safety Research Center of the University of North Carolina and the North Carolina DMV evaluated a North Carolina law, effective June 1, 1974, that eliminated the requirement for license-renewal applicants to take a written examination. To assess driver performance, the records of two groups of drivers were monitored during the months after their assignment to study groups. According to the report by Waller, Hall, and Padgett (9), "Generally the evaluation has examined ... the impact of the law on violations and accidents...." As a result of the study, the researchers recommended that "the test waiver program should remain in effect for operator applicants with the exception of drivers below the age of 25." The North Carolina results seem to indicate that, except for young drivers, applicants for license renewal do not benefit from a retesting of their knowledge of driving rules.

STUDY OBJECTIVE

The primary objective of this study was to test the relation between driver knowledge--as measured by a written test given to selected subjects applying for a renewal of their driver's license--and the number of accidents, convictions, and administrative actions resulting from those applicants' subsequent driving performance. The study was designed to provide both the National Highway Traffic Safety Administration and the state of Virginia with information on the feasibility of implementing driver retesting on a statewide basis.

METHODOLOGY

Study Population

Except for individuals who were specifically identified by Virginia statute or Virginia DMV regulations as requiring a specialized retesting procedure, the license-renewal applicants involved in this study were randomly selected from the statewide license-renewal population and assigned to four study groups. Individuals who had to pass a written knowledge test because they had accident and/or conviction records that fit defined categories were not eligible for participation. In addition, the population from which the sample was drawn did not include individuals who had had their licenses revoked for driving while intoxicated or for other major offenses that required them to apply for a new license. (Before they can be relicensed, members of this group are required by statute to pass a complete test involving vision, written knowledge, and road performance.) These mandatory licensing requirements excluded only a small number of Virginia drivers from the population from which the study groups were drawn.

Study Groups

Four groups of subjects were involved in the study: a control group and three experimental groups. The control group was identified for statistical purposes only and, while its members were not given any materials, written examination, or other special treatment, they did receive the standard renewal notice and take the vision test as required by Virginia statute.

Applicants in experimental group 1 received the standard Virginia Driver's Manual at the same time at which they received their license-renewal notice. Although this group was not given a written examination at the time of renewal, a notice was attached to the Driver's Manual that encouraged the applicant to study it. Members of this group took the vision test when they applied for their license.

Applicants in experimental group 2 received a copy of the Driver's Manual and a written test that was to be completed at home (the "home test") and returned to the examining station when they applied for their operator's permit. A notice from the DMV asked the applicants to study the manual and then take the test. These applicants also took the vision test at the time of license renewal.

Applicants in experimental group 3 were mailed a copy of the Virginia Driver's Manual and a notice asking them to study it. The applicants were informed that a written examination would be administered when they applied for their operator's permit (the "station test"). This group also took the vision test.

Each experimental group was chosen to test a specific application or treatment:

1. Experimental group 1 tested the effectiveness of instructional materials alone in improving driving performance.
2. Experimental group 2 tested the ability of a take-home test to effect a change in driving performance.
3. Experimental group 3, which was designed to be synonymous with federal standards for driver reexamination, tested whether in-station knowledge testing can be used to improve driving performance.

The knowledge test used in this study was designed by the Virginia DMV. Even though this examination was not tested for validity (it does have face validity) and reliability, it is the same examination that Virginia would administer to all drivers if the state were to comply with the requirements of Highway Safety Program Standard 5.

Applicants in the two groups for which a knowledge test was part of the experimental conditions were not required to pass the test before being relicensed. Those individuals who did not pass the station or the home test were licensed anyway, and their driver history files indicated this action. A number of applicants refused to take the knowledge test; they also were licensed, and their refusal to take the test was recorded in their files. Data on accidents, convictions, and administrative actions were tabulated according to whether the applicant had passed, failed, or refused to take the knowledge test.

In computing study-group sample size, conservative assumptions were made concerning rates of accident and conviction involvement. Rates for 1973 (the most current year, before the development of the study proposal, for which data were available) were used for the computations. An expected reduction of 10 percent for each category (e.g., from 5 to 4.5 percent) was also used in the computations. The largest sample size was needed to determine a reduction in the accident category, and this determined the size of the study groups. More applicants were selected for each group than were calculated as being necessary because of expected attrition due to factors such as deaths and applicants moving out of the state.

Figure 1. Framework for within-group comparisons.

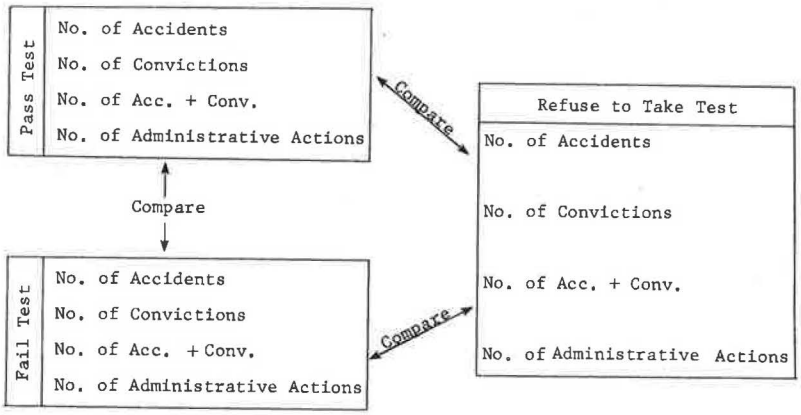
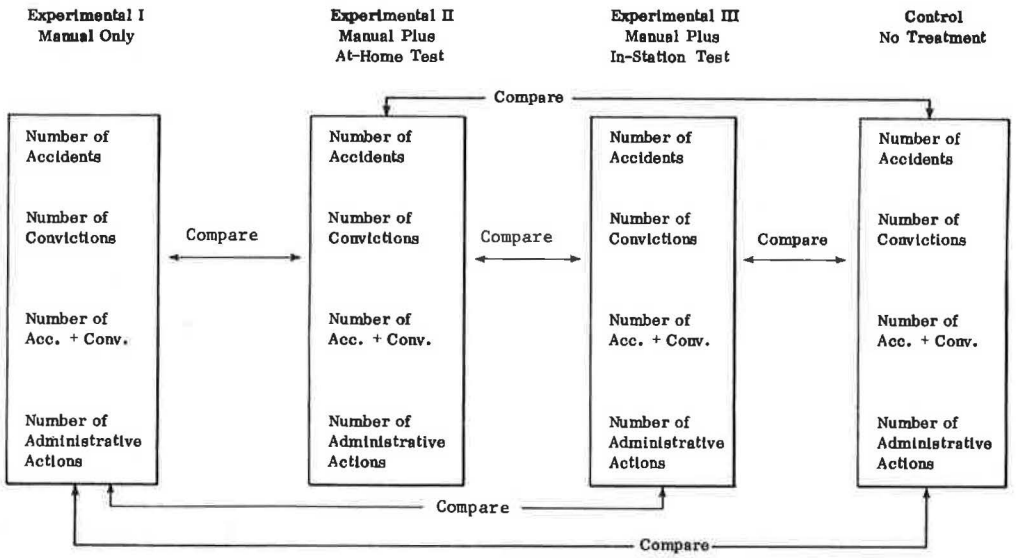


Figure 2. Framework for between-group comparisons.



Each month, a list of individuals was generated from the population of drivers whose licenses were due for renewal that month. The list was generated in a systematic way, so that every nth individual was chosen from the computer-tape list of renewal applicants. After the list was obtained, individuals were systematically assigned to one of the experimental or control groups previously described. The first person selected was assigned to the control group, the second to experimental group 1, and so on. By this procedure, 2084 subjects were placed in each study group for each of seven months, and a total of 14 588 persons were assigned to each of the four study groups.

Research Framework

An independent tape file accessed by a special identifier was developed by the state DMV for use in this project. The tape contained the applicant's test score and the number of knowledge items answered incorrectly. The tape file was matched to the applicant's driver-history file to obtain data for program analysis.

For four periods of six months each from the date an applicant renewed his or her license, DMV files were flagged and the following data were accumulated:

1. Convictions for traffic violations [both major (mandatory and six-point) convictions and minor (four- and three-point) convictions are included as separate categories],
2. Accident involvement (because fault in an accident is not determined by the DMV, the category includes all drivers involved),
3. Drivers who were involved in an accident and were convicted of a violation in connection with their accident involvement, and
4. Administrative actions of the Driver Improvement Program (advisory letters, group interviews, personal interviews, clinics, and probations) and suspensions (in this study, suspensions were not counted for failures to pay fines, failures to file or maintain insurance, failures to attend driver improvement interviews, etc.).

Figures 1 and 2 show the frameworks that were used in seeking answers to questions concerning the comparison of data (a) within each study group and (b) between study groups. These questions were as follows:

1. Was there a difference in the subsequent driving record of those who had passed the station test and those who had failed it or refused to take it?
2. Was there a difference in the subsequent driving record of those who had passed the home test and those who had failed it or refused to take it?
3. Did applicants who had received only the

Table 1. Number of comparisons and statistically different results for each study time period.

Criterion	6 Months		12 Months		18 Months		24 Months	
	C	D	C	D	C	D	C	D
Accidents								
Total	28	1	28	6	28	0	28	0
Two or more	6	1	6	0	21	0	28	0
With conviction								
Total	21	4	21	0	28	0	28	0
Two or more	0	0	0	0	0	0	0	0
Convictions								
Major								
Total	15	0	21	0	28	0	28	3
Two or more	0	0	0	0	3	0	10	1
Minor								
Total	28	4	28	6	28	6	28	6
Two or more	6	0	10	2	15	2	21	0
Administrative actions								
Advisory letter	10	0	21	0	21	0	21	1
Group interview	15	0	15	0	15	0	21	0
Personal interview	0	0	6	0	6	0	6	0
Improvement clinic	0	0	3	0	6	0	6	0
Probation	0	0	3	0	6	0	6	0
Suspension	6	0	6	0	10	0	10	0
Total	135	10	168	14	215	8	241	11

Note: C = comparisons (number of chi-square values computed); D = significant differences.

Table 2. Comparisons made and information sought.

Comparison	Items Compared	Information Sought
A	Control group with each experimental group	Did treatment reduce accidents and convictions in comparison with no treatment?
B	Experimental groups with each other	Was any part of the experimental program more effective than other parts?
C	Pass, fail, and refuse on each test	Were test performance and subsequent driving record related?

instructional material (the Virginia Driver's Manual) have different subsequent driving records than applicants in the no-treatment group or applicants in the other treatment groups?

4. Did applicants who had passed, failed, or refused to take the home test have different subsequent driving records than applicants in the no-treatment group or those in the other treatment groups?

5. Did applicants who had passed, failed, or refused to take the station test have different subsequent driving records than applicants in the no-treatment group or those in the other groups?

ANALYSIS OF THE DATA

Not all of the 14 588 applicants assigned to each of the study groups actually renewed their driver's license within 90 days of the required date. Anyone who does not obtain a license within this time is required by statute to be tested as an original-license applicant. Records were kept not only on those persons who had originally been assigned to the study groups but also on applicants who had renewed their licenses, and it was noted whether they had passed, failed, or refused to take the test they had been assigned. Accidents, convictions, and administrative actions posted on an individual's driver-history file were accessed and tabulated by categories.

Because of the design of the study, a large number of comparisons were theoretically possible. At the end of each 6-month period of vehicle operation after an applicant's license renewal, there were not sufficient data for the computation of chi-square values for every one of the possible comparisons. There were 135 comparisons of 6-month data, 168 for 12-month data, 215 for 18-month data, and 241 for 24-month data. The full report by Stoke (10) contains 13 appendix tables that present all of the chi-square values computed and their probabilities of occurrence. In only a few of the comparisons that were made were statistical differences reached--i.e., $p \leq 0.05$. There were 10 significant differences at the end of 6 months of vehicle operation after an applicant began participation in the study, 14 at the end of 12 months, 8 at the end of 18 months, and 11 at the end of 24 months. These data are given in Table 1 along with the number of chi-square values that could be computed for each of the criterion variables during each of the four time periods.

Table 2 describes the comparisons carried out and the information sought. Table 3 gives the results obtained based on the accident, conviction, and administrative-action data available in applicants' driver-history files.

Accidents

Accident data were analyzed with respect to three major divisions: (a) all applicants who had had an accident, (b) all who had been involved in two or more accidents, and (c) all who had been convicted of a violation in connection with their accident involvement. Each of these divisions of data was further categorized by comparisons made within each of the groups assigned to take a knowledge test and comparisons made between the various study groups (Figures 1 and 2).

Statistical analyses were performed in cases of applicants who were involved in an accident. At the end of six months of driving exposure, no differences were found in the number of individuals who had had an accident in comparison with whether they had passed, failed, or refused to take the station test. In addition, there were no within-group differences on the basis of whether the applicants had passed, failed, or refused to take the home test. When between-group comparisons were

Table 3. Statistical results obtained in comparisons based on accident, conviction, and administrative-action data.

Criterion	Comparison	Number of Statistical Differences			
		6 Months	12 Months	18 Months	24 Months
Accidents					
Total	A	ND	1	ND	ND
	B	1	3	ND	ND
	C	ND	2	ND	ND
Two or more	A	1	ND	ND	ND
	B	ND	ND	ND	ND
	C	ID	ID	ND	ND
With conviction	A	ND	ND	ND	ND
	B	2	ND	ND	ND
	C	2	ND	ND	ND
Convictions					
Major					
Total	A	ND	ND	ND	ND
	B	ND	ND	ND	2
	C	ND	ND	ND	1
Two or more	A	ID	ID	ND	1
	B	ID	ID	ND	ND
	C	ID	ID	ID	ND
Minor					
Total	A	1	1	1	1
	B	2	3	4	4
	C	1	2	1	1
Two or more	A	ND	ND	ND	ND
	B	ND	2	2	ND
	C	ID	ND	ND	ND
Administrative actions					
Advisory letter	A	ND	ND	ND	ND
	B	ND	ND	ND	1
	C	ND	ND	ND	ND
Group interview	A	ND	ND	ND	ND
	B	ND	ND	ND	ND
	C	ND	ND	ND	ND
Personal interview	A	ID	ND	ND	ND
	B	ID	ND	ND	ND
	C	ID	ID	ID	ID
Clinic	A	ID	ID	ND	ND
	B	ID	ND	ND	ND
	C	ID	ID	ID	ID
Probation	A	ID	ID	ND	ND
	B	ID	ND	ND	ND
	C	ID	ID	ID	ID
Suspension	A	ND	ND	ND	ND
	B	ND	ND	ND	ND
	C	ID	ID	ND	ND

Note: ND = no difference established; ID = insufficient data for chi-square computations.

carried out, in only one case, which involved applicants who had refused to take the home test, was a difference found. Statistical differences were not established in the other 21 between-group comparisons.

Differences still did not occur in the station-test accident comparisons after 12 months of subsequent driving exposure. For the remainder of the 12-month data, in the six cases that involved individuals who had refused to take the home test, statistical significance at $p \leq 0.05$ was reached: More applicants in the group that refused to take the test had had an accident. In the remaining 19 comparisons, in which 12-month accident results were used, no statistical differences were established. In addition, none of the 28 chi-square values computed on total accident data for both 18- and 24-month driving exposure were significant.

For applicants who had been involved in two or more accidents, there were not sufficient data to compute chi-square statistics in every 6-month driving exposure category. Of the six comparisons that could be made, applicants who had passed the station test had better records than those in the control group. This is the only accident-related finding over the first 6 months of the study that had practical value for driver-licensing officials. It must be pointed out, however, that both the rates and numbers of multiple accidents were very small and subject to the random variations associated with small sample sizes.

Of the applicants who had been involved in two or more accidents, there were data for the computation of six chi-square values at the end of 12 months of driving exposure, 21 at the end of 18 months, and 28 at the end of 24 months. A statistical difference was not proved to exist in any of these comparisons.

Statistical analyses were also performed on the data for applicants who had been convicted of a violation in connection with their accident involvement. In the 6-month data comparisons carried out for the station-test group, a statistical difference occurred only in the case of a comparison between those who had refused to take the test and those who had failed it: More drivers in the group who refused the test had an entry on their driver-history files than did those in the group who had failed the test. For applicants who had received a test to be completed at home, there were 6-month data for only one within-group comparison. More applicants who had refused to take the test had an accident-with-conviction entry than did applicants who had passed the test.

Seventeen accident-with-conviction comparisons were carried out between the various subgroups, and two reached statistical significance at $p \leq 0.05$. One case, a comparison between applicants who had failed the station test and those who had passed the home test, is of no practical importance to an operational driver-licensing program. In the other case, a comparison of applicants who had refused to take the home test with those who had refused to take the station test, the group who refused the home test had the worse record.

Of the 21 between- and within-group comparisons computed for 6-month data, 17 did not reach statistical significance at $p \leq 0.05$ in the number of applicants who had an accident combined with a conviction. Although statistical differences were found in 4 cases, the frequency of occurrence did not exceed 1 percent of those applicants in any category. Because of this low frequency rate and a small individual count (6 or fewer applicants), these statistical differences have little practical operational value. Chi-square statistics could be computed for 21 pairs of data at the end of 12 months and for all 28 pairs at the end of 18 and 24 months of driving exposure. None of the results reached significance at $p \leq 0.05$.

Insufficient data existed for the computation of chi-square values at the end of all four time periods for the category of two or more accidents with convictions. Even after two years of subsequent driving experience, multiple entries in this category did not seem to be a very common occurrence among Virginia drivers.

Convictions

Conviction data were broken down for analysis into four main divisions: major convictions, two or more major convictions, minor convictions, and two or more minor convictions. Comparisons for each of these data divisions were computed for applicants who had been assigned the station knowledge test and who had either passed, failed, or refused to take it. A second set of comparisons was computed for applicants who had been assigned the home knowledge test and who had either passed, failed, or refused to take it. A third set of comparisons, between the various study groups and subgroups, was also made.

Statistical analyses were performed for applicants who had a major conviction on their

driving record. For the first three time periods (6, 12, and 18 months), none of the chi-square values that were computed reached statistical significance at $p \leq 0.05$. Three statistical differences were found in the 24-month data. More of the members in the group who had failed the station test incurred a major conviction than did the members of the group who had passed the home test or the group who had passed the station test. Applicants who had received only a test manual compiled worse records than those who had passed the home test; that is, more of them were found to have a major conviction.

Although mathematical differences were found in these three cases, the practical significance was less than firmly established. In the worst case, that of applicants who had failed the station test, less than 2.5 percent of the group had a major conviction on their driving record.

For applicants who had incurred two or more major convictions, there were insufficient data for computations of chi-square values at the end of 6 and 12 months of vehicle operation. The data at the end of 18 months allowed 3 comparisons, and those at the end of 24 months allowed 10. The only statistical difference was found in a comparison between applicants who had refused the station test and applicants in the control group at the end of 24 months of driving exposure: More of the former were found to have multiple major convictions. In this case, less than 0.3 percent of the applicants had a multiple entry on their record.

When comparisons were made in the minor-conviction category between those who had passed, failed, or refused to take the station test, only in the 12-month data was there a statistical difference: More applicants who had refused to take the test had an entry on their driver-history files than did those who had passed the test.

When comparisons were made within the group of applicants who had been assigned the home test, more of those who had refused to take the test had a minor conviction on their driving records than did those who had passed the test. This was found at the end of each of the four time periods. There were no differences in the number of minor convictions in the other two home-test comparisons.

Comparisons were also computed between the various study groups and subgroups to determine whether there were differences in the number of applicants who had a minor-conviction entry in their files. In every case in which a statistical difference was found, it involved members of the group who had refused to take the home test. Each time, a larger percentage of these applicants had a minor conviction than did those in the group with which they were compared.

Analyses were also done of applicants who had received two or more minor convictions. The data allowed the computation of 6 chi-square values at the end of 6 months of driving exposure, 10 at the end of 12 months, 15 at the end of 18 months, and 21 at the end of 24 months. A statistical difference was not proved to exist in any of the 6- and 24-month comparisons, whereas the same comparisons for 12 and 18 months did reach significance. These two results occurred in the between-group comparisons, where more applicants who had passed the home test had multiple minor convictions on their records than did applicants who either had passed the station test or had received only a driver's manual.

From the data collected on total major convictions and two or more major convictions, none of the within- or between-group comparisons had chi-square values that reached significance at the end of 6, 12, or 18 months of driving exposure. Four comparisons did reach significance at the end of 24 months of driving exposure: Three were in the data on total major convictions, and one was in the data on multiple major convictions. In only one instance did the results provide some evidence that knowledge testing is beneficial. Fewer applicants in the group that had passed the station test had a major conviction than did applicants in the group that had failed the station test (1.42 versus 2.46 percent). The other statistically significant results provided little guidance of practical value for licensing officials in developing and administering a knowledge-testing program. The majority of the 24-month within- and between-group comparisons did not result in findings of statistical significance between comparison groups. Therefore, no benefit for a knowledge-testing program was established in cases of major convictions or multiple major convictions.

For the data on total minor convictions, when applicants who refused to take the home test were compared with those in other groups, statistical differences were found at the end of each of the four time periods. In each case, more in the group who refused the test had minor convictions than did those in the group with which they were compared. Although these differences are important from a mathematical point of view, they have limited application for DMV personnel in an operational setting. The state of Virginia does not require license-renewal applicants to pass a knowledge test. Those who refused to take the test at home may exhibit personality traits and driving behavior that call for additional study. Except for applicants who refused to take the home test, comparisons of data on total minor convictions did not reach a statistical difference at the end of any of the four time periods. There were 22 comparisons (24 for 6-month data) for which a difference was not proved to exist in the data. Knowledge testing does not appear to improve the total-minor-convictions records of license-renewal applicants.

At the end of six months, none of the within- or between-group comparisons of the data on multiple minor convictions reached statistical significance at $p \leq 0.05$. For both 12- and 18-month data, more applicants who had passed the home test had a minor-conviction entry on their record than did those who had passed the station test or those who had received only a driver's manual. Data collected over the full 24 months of the study were also compared to see whether within- or between-group differences existed in relation to multiple minor convictions. Among the 21 comparisons carried out, none reached statistical significance at the level set. In the majority of cases in which the chi-square could be computed, no differences were proved to exist in the number of multiple minor convictions obtained by the various study groups during the four time periods. The taking and passing of a knowledge test, whether a station or home test, did not improve the subsequent driving records of study groups with respect to multiple minor convictions.

Administrative Actions

Under the Virginia Driver Improvement Program, there are six levels of administrative actions: advisory letters, group interviews, personal interviews, improvement clinics, probation, and suspension. The number of applicants who had been the subject of each type of action was analyzed with respect to the within- and between-group categories previously discussed.

There were insufficient data at the end of the first six months to allow any comparative analyses for three of the administrative-action criteria. The number of individuals who had attended personal interviews or improvement clinics or been put on probation was so small that statistical values could not be computed. In addition, not all of the 28 possible comparisons could be carried out for the other criterion variables at the end of each of the four time periods.

In the advisory-letter analyses, no differences were found in any of the comparisons performed on data at the end of 6, 12, and 18 months. A statistical difference was found for only 1 of 21 comparisons at the end of 24 months of driving exposure, and in this single case more of the applicants who had passed the home test had received an advisory letter than had those who had received only a driver's manual.

Where data existed for the computation of chi-square values for study-group applicants who had had to attend a group interview, a personal interview, or a driver improvement clinic, or who had received a probation notice and/or been suspended, there were no results that were statistically significant at $p \leq 0.05$. Out of all of the comparisons computed on data obtained as a result of administrative actions pursuant to points accumulated under the Driver Improvement Program, in 218 out of 219 comparisons no statistical differences were proved to exist at the $p \leq 0.05$ level.

OTHER STUDY ISSUES

There are several issues for which some additional elaboration would seem appropriate. One of these is a question of whether the hypothesized impact of the project was to screen out unsafe drivers--i.e., those with high accident and/or conviction records--or to educate drivers on safe driving practices. The design was to consider both of these issues. The use of experimental group 1, the applicants who were not given a knowledge test, dealt mainly with the educational aspects. The use of the other two experimental groups, the applicants assigned to either a home or a station test, dealt primarily with the screening aspects of the knowledge-testing portion of a state relicensing program. The results did not produce evidence of either a beneficial screening or an educational effect.

Another factor that deserves comment is the method of assigning applicants to the control group. They were assigned by a computer program developed by the Virginia DMV, which selected every nth subject from the driver file, and a special identifier was placed on the driving record of each person so selected. These people were not notified of their selection by the state, nor was a list of these applicants produced. During the first two months of the study, it was given some newspaper publicity, but this was general in nature and limited in its coverage (only some areas of the state) and contained few, if any, specifics. Since members of the control group were not informed that they were part of a study, there is no reason to suspect that a general news item would influence their driving behavior and thereby influence the results of the study.

All applicants for both the control group and the experimental groups were required to pass a vision test at the examining station before being licensed. No procedures were used to selectively eliminate applicants from the various study groups. There was no variation in the procedures used for the groups except in those procedures described earlier that involved the experimental conditions. Failing, passing, or refusing to take the knowledge test did not keep applicants from being licensed if they met all other requirements. There were no statistical differences among groups in the numbers of applicants who renewed their licenses.

It is recognized that the data from succeeding time periods encompass those from previous time periods; that is, the 12-month accident data included all accidents recorded in the driver-history files from the time an applicant began participating in the study and therefore included the counts made at 6 months. Even though there was a dependence of one time period on another, the statistical results for each of the four time periods reviewed did not indicate that the driving behavior of one experimental program was better than that of another or superior to that of the control group. Because of the lack of consistency in the results of the comparisons that were carried out and found to be different, it can be concluded that there were no program carry-over effects between the earlier and later stages of the study that would mask important but undetected factors.

In any research study, the emphasis placed on the results is based on the manner in which the data are aggregated. One method is concerned only with intact groups, or those that have not been reduced into subgroups, and it is only at this point that there is true randomization. A second method, which deals with comparisons of data other than those for entire groups, represents some subjective selection and therefore presents a potential for bias. In the study reported here, some applicants refused to take a test whereas others either passed or failed it. Each option--pass, fail, or refuse--represents a principle of selection for the two groups for which knowledge testing was part of the experimental program.

Although there may be some research conditions in which entire groups represent the only procedures to be used, this study was carried out under the driver-licensing procedures in use in Virginia when the study was conducted. The study was also being used to evaluate the program that would be put in operation if beneficial results were found. For these reasons, it was necessary to analyze the results in relation to the subgroups of applicants based on their performance on the knowledge test.

It is recognized that the three categories of data for each group of applicants assigned to take a knowledge test are not random samples in the true statistical sense. Even so, there is no indication that the results are biased in such a way as to mask the benefits that might be present in such a knowledge-testing program.

CONCLUSIONS AND RECOMMENDATIONS

The research reported here was designed to answer five questions concerning the effect on driver performance of administering a written knowledge test to persons applying for a renewal of their driver's license. Data on accidents, convictions, and administrative actions taken as part of driver improvement programs were used as measures of effectiveness for various experimental test conditions. The major conclusions can be stated as follows:

1. For applicants who were assigned to take the knowledge test at the examining station, there were no differences among the subsequent driving records of applicants who had passed, failed, or refused to take the test.

2. There were no differences among the subsequent driving records of applicants who were mailed a test to be taken at home, except among those who refused to take the test.
3. There were no differences between the subsequent driving records of applicants who received a Virginia Driver's Manual and those in the control group or applicants in the other treatment groups.
4. When comparisons were made between home-test applicants and those in the other study groups, the results generally indicated that subsequent driving records could not be distinguished on the basis of whether the applicant had passed or failed a knowledge test.
5. Comparisons between applicants in the station-test group and those in the other study groups generally indicated that subsequent driving records could not be distinguished on the basis of whether the applicants had passed, failed, or refused to take a knowledge test at the examining station.

Statistical tests on data obtained at the end of the four study time periods contained no substantial evidence to justify requiring the general population of license-renewal applicants to take written knowledge tests, since neither short- nor long-term driving performance was shown to improve as a result of such testing.

In light of these results, it is recommended that the U.S. Department of Transportation make permanent the temporary waiver of the requirement for reexaminations on knowledge of rules of the road in the driver-licensing standard granted the state of Virginia. The results further indicate that the standard should be amended to eliminate the requirement for such reexaminations.

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