

THE EFFECTIVENESS OF
WRITTEN DRIVER KNOWLEDGE TESTS

by

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ABSTRACT

Highway Safety Program Standard 5, Driver Licensing, issued by the U. S. Department of Transportation requires, in part, that the states test applicants for a renewal of their operator's license on rules of the road at least once every 4 years. The state of Virginia requested a waiver of the knowledge testing portion of the standard until evidence could be presented to show that it had the desired safety benefit.

The Virginia Highway and Transportation Research Council and the Virginia Division of Motor Vehicles conducted an experimental evaluation of several alternative approaches to implementation of the standard. This evaluation randomly assigned members of the renewal population of drivers to four study groups: (1) a control group receiving no treatment; (2) a group that received only a driver's manual; (3) a group that received a manual and a test to be taken at home; and (4) a group that received a manual and were requested to take a test in the DMV examining station at the time of application for license renewal.

The subsequent driving performance of members of the four groups was monitored and data for accidents, major convictions, minor convictions, accidents with associated convictions, and administrative actions taken under provisions of the Driver Improvement Program were tabulated at 6-, 12-, 18-, and 24-month intervals. For the two groups administered a knowledge test, comparisons were made of the performance of those who had passed, failed, or refused to take the test.

Of the few statistically significant differences found between the study groups, none would suggest the practicality of knowledge testing as an effective highway safety countermeasure. A large number of the differences observed involved the group who had refused to take the test at home. Other than for the minor conviction entries for this group, there were no comparisons which showed differences across all four time periods.

The results obtained at the end of the four study time periods supplied no substantial evidence for requiring the reexamination of the general renewal population. In light of these results, the U. S. Department of Transportation should make permanent the temporary waiver of the requirement for reexaminations on knowledge of the rules of the road in the Driver Licensing Standard granted the Commonwealth of Virginia. Further, the results indicate that the Standard should be amended to eliminate the requirement for such reexaminations.

FINDINGS

At the end of 6-months' driving exposure, 10 of the 135 chi-square values computed reached statistical significance ($p \leq .05$). Seven of the 10 involved the group who had refused to take the test at home. More of these applicants had a minor conviction entry in 4 cases and an accident entry in 3 cases than did those in the group to which they were compared. In the other 3 cases where a difference was found, only 1 had a bearing on the effectiveness of testing applicants for knowledge; for the people who had passed the test in the station there were fewer who had a multiple accident entry than for those in the control group.

For the driving records examined 12 months after the applicants' entry into study groups, 14 of the 168 comparisons computed were statistically significant. Applicants in the refuse-home-test group accounted for 11 of the 14 cases. For comparisons between groups, more of these applicants had a minor conviction entry in 5 cases and an accident entry in 6 cases. Only one of the remaining three comparative differences had a relationship to the main issue of knowledge testing and countermeasure effectiveness; fewer applicants who had passed the test in the station had a minor conviction entry than did those who had refused to take the in-station test.

For data collected at the end of 18 months of driving, 8 of the 215 comparisons carried out were statistically significant at $p \leq .05$. In all 6 minor conviction comparisons involving the group who had refused to take the test at home, more of these applicants had an entry on their driver history file. The other two findings of a difference did not occur between groups which would provide data useful for an operational program of knowledge testing of renewal applicants.

A statistically significant difference was found in 11 of the 241 computations at the end of 24 months. Again, for all 6 minor conviction comparisons in which they were involved, the refuse-home-test group had more applicants with an entry on their DMV driver record. In only one of the other five findings of a difference between two groups was there a result of importance in relation to the knowledge testing issue. In this case, for those applicants who had passed the test at the station there were fewer who had a major conviction entry than there were for those who had failed the in-station test.

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CONCLUSIONS

The research reported here was designed to answer five questions by using accident, conviction, and driver improvement program administrative action data as measures of effectiveness for the various experimental test conditions. Each of the questions is discussed in the research framework section of this report and the major conclusions are given below.

1. For applicants who were assigned to take the knowledge test at the examining station, the general conclusion was that there were no differences in the subsequent driving records among the applicants who had passed, failed, or refused to take the test.
2. For applicants who were mailed a test to be taken at home, except for those who had refused to take the test, it was concluded that there were no differences in their subsequent driving records.
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 at-home-test group applicants and those in the other study groups, the results generally indicated that the subsequent driving records could not be distinguished on the basis of whether they had passed or failed a knowledge test.
5. The results of the comparisons of the in-station-test group with applicants 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.

This study was completed as part of the requirements for a "partial temporary waiver of Highway Safety Program Standard No. 5, Driver Licensing, (23 CFR 1204.4)" granted the state of Virginia.(17) The results of statistical tests on data obtained at the end of the four study time periods(6, 12, 18, and 24 months) contained no substantial evidence for requiring the reexamination of the general renewal population on knowledge items as neither the subsequent short-, intermediate-, nor long-term driving performances were improved.

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RECOMMENDATION

In light of the results of this study, the U. S. Department of Transportation should make permanent the temporary waiver of the requirement for reexaminations on knowledge of the rules of the road in the Driver Licensing Standard granted the Commonwealth of Virginia. Further, the results indicate that the Standard should be amended to eliminate the requirement for such reexaminations.

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INTRODUCTION

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⁾ However, because of a lack of definitive evidence in the research literature that compliance with the standard would have a desired safety benefit, 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 and was predicated on an agreement that the state would conduct the study herein reported.

The testing of individuals who desire to obtain a motor vehicle operator's license has been a standard practice in Virginia for over 40 years (see Appendix A). The current procedure requires the applicant for an initial license to pass a battery of tests which include (1) a knowledge test of traffic laws, signs, signals, etc., (2) a visual screening test, and (3) a vehicle operation and performance test. On the basis of their driving records, some applicants for a renewal license are also required to be tested on knowledge and/or vehicle operation. These applicants, as well as all other renewal applicants, are tested in compliance with a state statute dealing with vision requirements.

Under the 1974 Virginia Driver Improvement Act (see Appendix B for a description), the state conducts reexaminations on rules of the road when a person demonstrates, under the point system, that he is not safely operating a motor vehicle. This practice allows the Commonwealth 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. A study by Uhlaner and Drucker found that "tests developed for selection and screening

of drivers are likely to be inappropriate for public licensing."(2)
 "In the case of selection and screening, management is interested in eliminating all but the best. In the licensing process, public officials concentrate on eliminating only the more obvious misfits."(3) The authors further state that there is a "lack of evidence ... of screening out those likely to have accidents and lack of means of getting undisputed proof in terms of accidents."(4)

Levonian, Case, and Gregory studied traffic accidents and violations in relation to a number of variables. The results of the study did not show a correlation between knowledge score and recorded accidents. They did find that the person with a low knowledge score is likely to have more recorded violations than a person with a high score.(5)

There are several studies reported in the literature which deal with the knowledge and performance issue. One by J. L. Pursewell concluded in part that the relationships between written or machine test procedures and subsequent driving record are inconclusive.(6)

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 Senate Concurrent Resolution 104 (1971). The experimental program studied the reward effects of an automatic license extension for individuals with clean accident and conviction records, as well as an incentive procedure to encourage drivers with prior accident and conviction entries to avoid additions to their records. For clean record drivers, "the reward program had no influence on subsequent convictions but did have various negative effects upon subsequent collisions."(7) It was concluded that a "good driver population is not deemed to be a viable candidate for the program as implemented here."(8) "For drivers with prior entries, the incentive program had no reliable influence on subsequent convictions but did have various positive effects on subsequent collisions."(9) "The subsequent collision reduction evidenced by drivers with prior entries would seem to have important implications for the design of future driver improvement programs."(10)

A 1977 California study found that traffic safety materials were not effective in reducing six-month accident and conviction frequencies of the general driving population. In addition, the researcher found that tailoring the material for specific age and sex groups had no effect on their driving records.(11)

The California DMV also conducted a study 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 6-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.(12)

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 if renewal applicants who were administered a test that stressed knowledge of safe driving principles and recent changes in traffic laws had better subsequent driving records than applicants who were administered the standard DMV law test. The author concluded that the safe driving written test did not result in a change in collisions or convictions in the 6-month period following testing, and that the new form should not be used as a replacement for the standard law test given renewal applicants.(13)

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 and their subsequent accidents and convictions were compared with those of a control group of drivers receiving the standard 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 subsequent to testing. The author recommended that this component of the selective testing program not be implemented.(14)

The Highway Safety Research Center at the University of North Carolina and the North Carolina DMV evaluated a North Carolina law, effective June 1, 1974, which eliminated the requirement for renewal driver license applicants to take a written exam. Part of the evaluation involved a comparison of two groups of drivers of about 40,000 applicants each. To assess driver performance, the driving records of each group were monitored during the months subsequent to their assignment to study groups. "Generally the evaluation has examined ... the impact of the law on violations and accidents...."(15) 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."(16) The North Carolina results seem to indicate that, except for young drivers, applicants for a renewal drivers license do not benefit from a retesting on knowledge of driving rules.

OBJECTIVE

In this study of the effectiveness of written reexaminations the primary objective was to test the relationship between knowledge, as measured by a written test given selected applicants for a renewal license, and the number of accidents, convictions, and administrative actions resulting from subsequent driving performance. The study was designed to provide both the National Highway Traffic Safety Administration and the Commonwealth of Virginia with information as to the feasibility of implementing retesting on a statewide basis.

METHODOLOGY

Study Population

With the exception of individuals who were specifically identified by Virginia statute or DMV regulations as requiring a specialized retesting procedure, the license renewal applicants were randomly selected and assigned to four study groups from the statewide renewal population. Individuals who had to pass a written knowledge test because they had accident/conviction records which fit defined categories were not eligible for participation in this study. 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 other major offenses which required them to apply for a new license. This group is required by statute to pass a complete visual, written knowledge, and road performance test prior to relicensing. 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. Members of this group were not given any materials, written examination, or other special treatment. They did, however, receive the standard renewal notice and take the vision test as required by Virginia statute.

Applicants in experimental group I received the standard Virginia Driver's Manual at the same time they received their

renewal notice. Although this group was not tested with a written examination at the time of renewal, a notice (see Appendix C) was attached to the Driver's Manual encouraging the applicant to study the manual. Members of this group took the vision test when they applied for their license.

Experimental group II applicants received a copy of the Virginia Driver's Manual and a written test (see Appendix D) to be completed at home and returned to the examining station at the time they applied for their operator's permit. A notice (see Appendix E) from DMV asked them to study the manual and then take the test. These applicants also took the vision test at the time of renewal. If for some reason the test received by a group II applicant was lost or destroyed, the applicant could obtain another one from any examining station in the state. The applicant then completed this test and returned at a later time for license renewal.

Experimental group III applicants were mailed a copy of the Virginia Driver's Manual and a notice (see Appendix F) asking them to study the manual. The applicants were informed that a written examination would be administered at the time of application for an operator's permit. This group also took the vision test.

Each experimental group was chosen to test a specific application or treatment. Table 1 is a summary of the control and experimental test conditions which applied to each group of subjects. Experimental group I tests the adequacy and effectiveness of instructional materials alone to bring about a change in driving performance. Experimental group II tests the ability of a take-home test to effectuate a change in driving performance. Experimental group III was designed to be synonymous with the federal standards for reexamination and tests whether in-station knowledge testing can be used to improve the subsequent driving performance of individuals.

The knowledge test used for this study was designed by the Virginia DMV. Even though this examination was not tested for validity (it does possess 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 condition were not required to pass the test prior to being relicensed. Those individuals who did not

pass the in-station or the at-home test were licensed anyway and the driver history file indicated this action. A number of applicants refused to take the knowledge test. They also were licensed and this refusal to take the test was recorded on their file. Accident, conviction, and administrative action data 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 on accident and conviction rates of involvement. A 5% probability of only being involved in an accident, a 7% probability of being convicted for a traffic violation, and a 12% probability of being involved in an accident and/or being convicted for a traffic violation were used. These were the rates which occurred during 1973, the most current year prior to the development of the study proposal for which data were available. An expected reduction of 10% relative to each category (e.g., 5.0% to 4.5%) also was used in the computations.

Table 1

Test Subject Experimental Condition Summary

Condition	Experimental Group I	Experimental Group II	Experimental Group III	Control Group
Vision Test	Yes	Yes	Yes	Yes
Renewal Notice	Yes	Yes	Yes	Yes
Driver's Manual	Yes	Yes	Yes	No
Test Notice	No	Yes	Yes	No
At-Home Test	No	Yes	No	No
In-Station Test	No	No	Yes	No
Acc./Conv. Data	Yes	Yes	Yes	Yes
Administrative Actions	Yes	Yes	Yes	Yes

Sampling

The determination of sample size was computed using the formula

$$n = \frac{2 t^2 p q}{d^2},$$

where

- n = sample size,
- p = probability of occurrence,
- q = (1 - p),
- t = statistical precision as an interval value, and
- d = expected change (in percentage points).

The calculated sample sizes for the categories were 10,283 for accidents, 7,190 for convictions, and 3,969 for accidents and/or convictions. Because the largest sample size was needed for determining a reduction in the accident category, this determined the size of the study groups. Because of attrition of subjects due to factors beyond the control of the persons responsible for the study, e.g., death and moving from the state, more applicants were selected for each group than were calculated as being needed.

Each month a list of individuals was generated from the population of those persons due for renewal of their operator's license during that month. The generation of the list occurred in a systematic way with every nth individual being chosen from the computer tape listing renewal applicants. After the list had been 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 I, the third to experimental group II, etc. By this procedure 2,084 subjects were placed into each study group for each of 7 months (see Table 2).

Table 2

Sample Assignment

Months	Control Group	Experimental Group I	Experimental Group II	Experimental Group III	Monthly Total
First	2,084	2,084	2,084	2,084	8,336
Second	2,084	2,084	2,084	2,084	8,336
Third	2,084	2,084	2,084	2,084	8,336
Fourth	2,084	2,084	2,084	2,084	8,336
Fifth	2,084	2,084	2,084	2,084	8,336
Sixth	2,084	2,084	2,084	2,084	8,336
Seventh	2,084	2,084	2,084	2,084	8,336
Group Total	14,588	14,588	14,588	14,588	58,352

Research Framework

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

For four periods of 6 months each from the date an applicant renewed his operator's license, DMV files were flagged and the following data accumulated:

1. Convictions for traffic violations. (Both major* convictions and minor** convictions are included as separate categories.)
2. Accident involvement. (Because fault in an accident is not determined by DMV, the category includes all operators involved.)
3. Operators involved in an accident and who are convicted of a violation in connection with their accident involvement.
4. Driver Improvement Program administrative actions (advisory letters, group interviews, personal interviews, clinics and probations) and suspensions. For this study, suspensions were not counted for failure to pay fine, failure to file or maintain insurance, failure to attend driver improvement interviews, etc.

Comparisons between the control group and the experimental groups were carried out for the above four categories of data. For the control group and experimental group I, the total number of individuals involved were used for analysis. In experimental groups II and III, the comparisons were carried out for those who had passed, failed or refused to take the test. Because administrative actions are a direct artifact of the conviction experience of drivers, comparisons along these lines are concerned with only the total figures for each category. Accident/conviction

*Mandatory and 6-point convictions are considered as major convictions.

**Minor convictions are those with 4- or 3-point values.

comparisons were made using total figures, and where the data were available, individuals with multiple entries were also evaluated.

Figures 1 and 2 are schematic diagrams presenting the comparison frameworks that were used in seeking answers to the questions listed below. The first two questions involved the comparison of data within each of the study groups, while the remaining three questions involved the comparison of data between the various study groups.

1. Was there a difference in the subsequent driving record of those who had passed the in-station test and those who had failed or refused to take the in-station test?
2. Was there a difference in the subsequent driving record of those who had passed the at-home test and those who had failed or refused to take the at-home test?
3. Did applicants who had received only the instructional material (Driver's Manual) have a different subsequent driving record 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 at-home test have a different subsequent driving record 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 in-station test have a different subsequent driving record than applicants in the no-treatment group or those in the other groups?

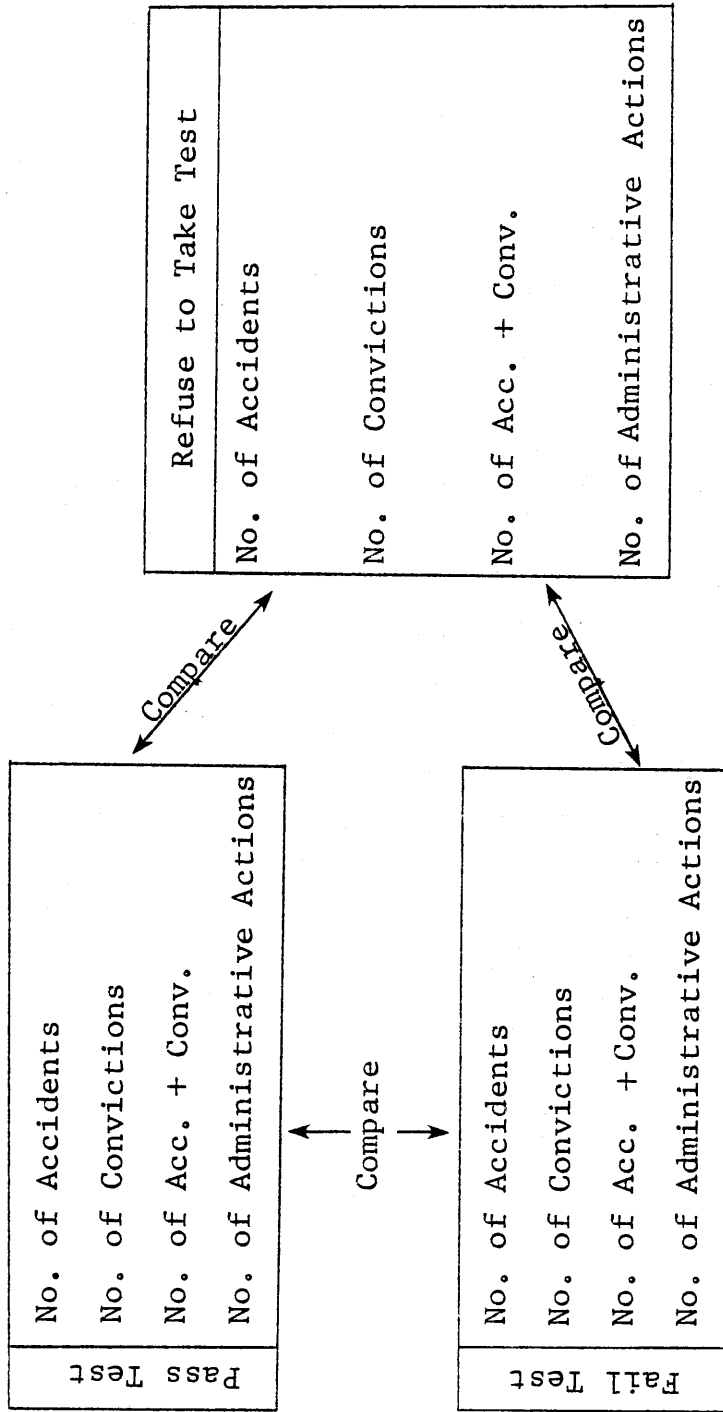


Figure 1. Framework for within group comparisons.

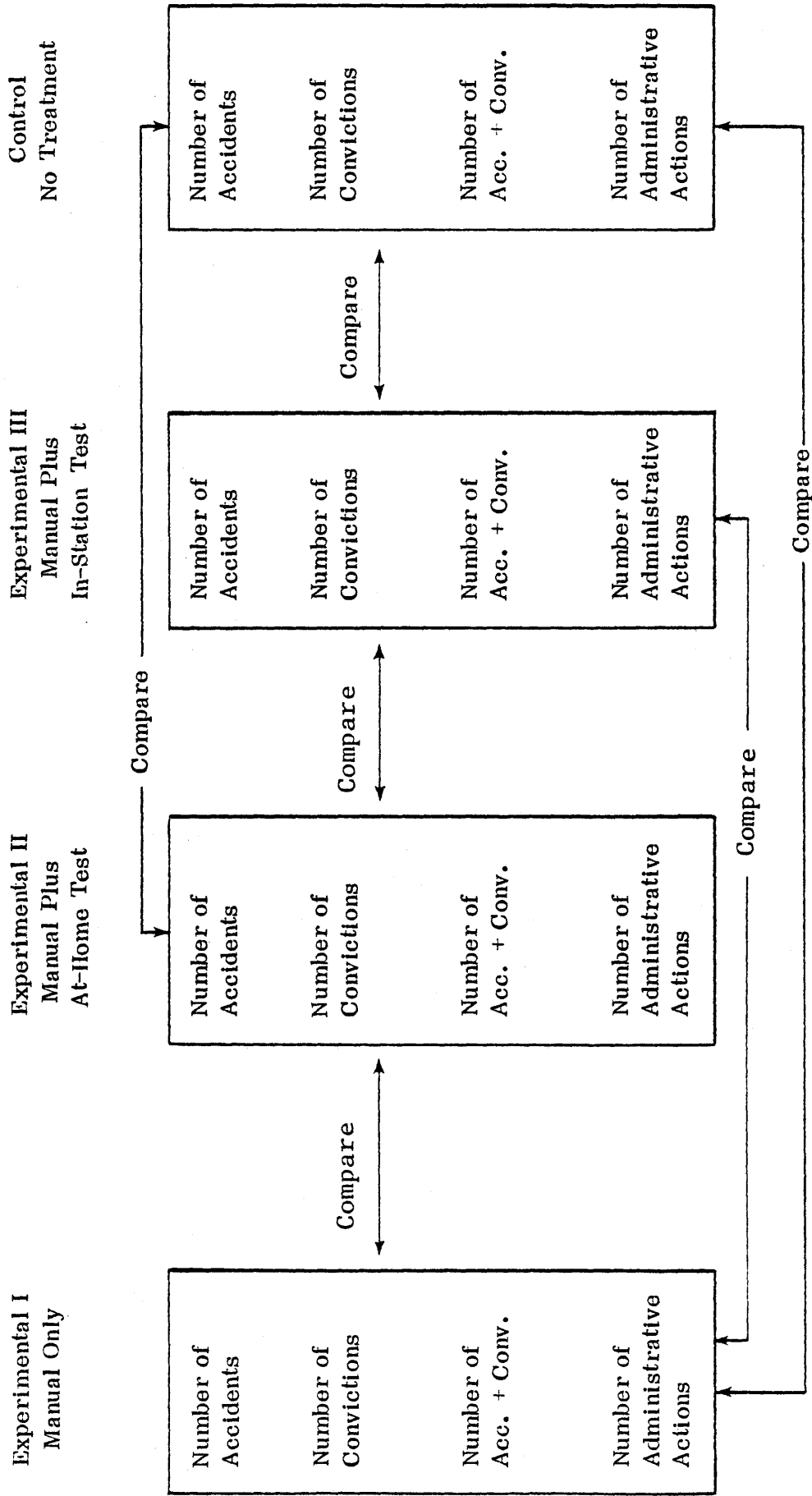


Figure 2. Framework for between group comparisons.

ANALYSIS

There were 14,588 applicants assigned to each of the study groups, but not all of them actually renewed their license within 90 days of the required date. Anyone who does not obtain a license within this time is required by statute to be retested 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 if 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. Appendix G presents the numbers and Appendix H the percentages of these entries for each of the study groups for each 6-month period of the study.

The study included three experimental groups and a control group. Two of the experimental groups, those involving the taking of a test, had three major divisions each, i.e., pass, fail, and refuse. Accident/conviction data were divided into two levels, two or more and total. The six categories of administrative actions included only figures for the totals.

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 subsequent to 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 comparisons for the 24-month data. In only a few of the comparisons carried out were statistical differences, $p \leq .05$, reached. There were 10 significant differences at the end of 6 months of vehicle operation subsequent to an applicant's having entered the study, 14 at the end of 12 months, 8 at the end of 18 months, and 11 at the end of 24 months (see Table 3).

Table 3
 Number of Comparisons and Statistically Different Results

Criterion Variable	6-Month Data		12-Month Data		18-Month Data		24-Month Data	
	Comp.	Diff.	Comp.	Diff.	Comp.	Diff.	Comp.	Diff.
Major Conviction	15	0	21	0	28	0	28	3
2 + Major Convictions	0	0	0	0	3	0	10	1
Minor Conviction	28	4	28	6	28	6	28	6
2 + Minor Convictions	6	0	10	2	15	2	21	0
Accident	28	1	28	6	28	0	28	0
2 + Accidents	6	1	6	0	21	0	28	0
Accident w/ Conviction	21	4	21	0	28	0	28	0
2 + Accidents w/Conviction	0	0	0	0	0	0	0	0
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
Totals	135	10	168	14	215	8	241	11

Conviction Data

Convictions were analyzed with respect to four main divisions of the data: 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 to the in-station knowledge test and who had either passed, failed, or refused to take the test. A second set of comparisons were computed for applicants who had been assigned to the at-home knowledge test and who had either passed, failed, or refused to take the test. A third set of comparisons, those between the various study groups and subgroups, were also carried out.

The results of the statistical analyses of the records of applicants who had incurred a major conviction on their subsequent driving records are presented in Appendix I. For the first three time periods (6, 12, and 18 months) none of the chi-square values that were computed reached statistical significance at $p \leq .05$. 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 did those who had passed the home test; that is, more of them were found to have a major conviction entry. 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% of the group had a major conviction on their driving record.

For applicants who had received two or more major convictions (see Appendix J) there were insufficient data for computations of chi-square values at the end of 6 and 12 months of vehicle operation. The data available at the end of 18 months allowed 3 comparisons and those at the end of 24 months allowed 10. The only statistical difference ($p \leq .05$) found was where more applicants who had refused the in-station test had a multiple major conviction entry on their driver files than did applicants in the control group at the end of 24 months of driving exposure. In this case less than 0.3% of the applicants had a multiple entry on their record.

Appendix K presents the results of the analyses with respect to minor conviction data. When comparisons were carried out between those who had passed, failed, or refused to take the in-station test, only in the 12-month data was there a statistical

difference in the number of applicants who had a minor conviction. More applicants who had refused to take the test had an entry on their driver history files when compared with those who had passed the test.

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

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

The results of the analyses of applicants who had received two or more minor convictions are presented in Appendix L. The data allowed the computation of 6 chi-square values at the end of 6 months, 10 at the end of 12 months, 15 at the end of 18 months, and 21 at the end of 24 months of driving subsequent to having entered the study. A statistical difference, $p \leq .05$, was not proven to exist in any of the 6- and 24- month comparisons while the same two comparisons reached significance at the end of 12 and 18 months. These two results occurred in the between group comparisons where more applicants who had passed the at-home test had a multiple minor conviction on their records than did applicants who had either passed the in-station test or who had received only the Virginia 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 which reached significance ($p \leq .05$) at the end of 6, 12, or 18 months of subsequent driving exposure. Four comparisons did reach significance at the end of 24-months' driving exposure; three of these were in the total major convictions and one in the two or more major conviction data. In only one instance did the results provide some evidence that a knowledge testing program provides a benefit. Fewer applicants in the group which had passed the in-station test had a major conviction than did applicants who had failed the in-station test (1.42% vs. 2.46%). 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 total or two or more major conviction cases.

For the total minor conviction data, where applicants who refused to take the at-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 members of the refusal group had a minor conviction than did applicants in the group to 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 Commonwealth of Virginia does not require renewal applicants to pass a knowledge test prior to relicensing. Those individuals who had refused to take the test at home may exhibit personality traits and driving behavior in need of additional study. Other than for applicants who had refused to take the home test, comparisons of total minor conviction data 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 proven to exist in the data. Knowledge testing does not appear to improve the total minor conviction experience of renewal applicants.

At the end of 6 months there were no within or between group comparisons of the two or more minor conviction data which reached statistical significance at $p \leq .05$. For both 12- and 18- month data, more of the applicants who had passed the home test had a minor conviction entry on their record as compared with 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 if within or between group multiple minor conviction differences existed. For the 21 comparisons carried out, none reached statistical significance at the level set. In the majority of cases where the chi-square could be computed, differences were not proven to exist in the number of two or more minor convictions obtained by the various study groups during all four study time periods. The taking and passing of a knowledge test, whether in-station or at-home, did not improve the subsequent driving records of study groups with respect to multiple convictions. In fact, in all instances of statistical differences, the group that had passed the home test had more driver record entries.

Accident Data

The accident data were analyzed with respect to three major divisions: all applicants who had had an accident, those who had been involved in two or more accidents, and all individuals who had been convicted of a violation in connection with their accident involvement. Each of these divisions of data was additionally split into comparisons made within each of the groups that had been assigned to take a knowledge test and comparisons made between the various study groups. The framework for comparisons were presented in Figures 1 and 2 and the divisions of data were discussed at that time (see page 19).

Appendix M presents the results of statistical analyses performed in cases of applicants who were involved in an accident. At the end of 6-months' driving exposure no differences were found in the numbers of individuals who had had an accident as compared on the basis of whether they had passed, failed, or refused to take the in-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 at-home test. When between group comparisons were carried out, in only the one case involving applicants who had refused to take the at-home test was a difference found. In the other 21 between group comparisons, statistical differences were not established.

Differences still did not occur in the in-station accident comparisons after 12 months of subsequent driving exposure. For the remainder of the 12-month data, in the six cases involving individuals who had refused to take the home test, statistical significance ($p \leq .05$) was reached, with more applicants in the refusal group having had an accident. In the remaining 19 comparisons using accident results at the end of 12 months, no statistical differences were established. In addition, none of the 28 chi-square values that were computed on total accident data for both 18- and 24-month driving exposure reached significance.

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

Of the applicants who had been involved in two or more accidents, data existed for the computation of 6 chi-square values at the end of 12 months, 21 at the end of 18 months, and 28 at the end of 24 months of driving exposure. A statistical difference, $p \leq .05$, was not proven to exist in any of these comparisons.

The results of the statistical analyses of applicants who had been convicted of a violation in connection with their accident involvement are presented in Appendix O. Of the 6-month data comparisons carried out for the in-station group, only in the case of those who had refused to take the test when compared with those who had failed the test did a statistical difference occur ($p \leq .05$). More drivers in the refusal group 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, 6-month data existed for only 1 within-group comparison. More of those who had refused to take the test had an entry of an accident combined with a conviction 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 ($p \leq .05$). One case, that of applicants who had failed the in-station test when compared with those who had passed the at-home test, is of no practical importance to an operational driver licensing program. In the other, a comparison of applicants who had refused to take the at-home test with those who had refused to take the in-station test, the at-home refusal group had the worse record.

Out of the 21 between and within group comparisons computed for 6-month data, the majority (17) did not reach statistical significance at $p \leq .05$ in the number of applicants who had an accident combined with a conviction. Although statistical differences were found in four cases, the frequency of occurrence did not exceed 1% of those applicants in any category. Because of this low frequency rate, coupled with a small numerical count (6 or fewer individuals), 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 $p \leq .05$.

Insufficient data existed for the computation of chi-square values at the end of all four time periods for 2 or more accidents with conviction. Even after two years' subsequent driving experience, multiple accident with conviction entries did not seem to be a very common occurrence among Virginia passenger vehicle operators.

Administrative Action Data

Under the Virginia Driver Improvement Program there are six levels of administrative actions: advisory letters, group interviews, personal interviews, improvement clinics, probations, and suspensions. The number of applicants receiving each of these actions was analyzed with respect to the within group and between-group categories previously discussed.

There were insufficient data at the end of the first 6 months to allow any comparative analyses for three of the administrative action criteria. The number of individuals who had received personal interviews, improvement clinics, and probations were so few 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. See Table 3 for the number of chi-square values that could be computed.

The results for the advisory letter analyses are contained in Appendix P. No differences were found in any of the comparisons performed on data at the end of 6, 12, and 18 months; and for only 1 of 21 comparisons at the end of 24 months' driving exposure. In this 1 case, more of the applicants who had passed the home test had received an advisory letter than had those who had received only a Virginia Driver's Manual.

The comparative analyses of the number of study group applicants who had had to attend a group interview are presented in Appendix Q. Results for those who had to attend a personal interview or a driver improvement clinic are contained in Appendices R and S. Data on applicants who had received a probation notice and/or had been suspended are presented in Appendices T and U. Where data existed for the computation of chi-square values in each of these administrative action areas, there were no results which were statistically significant at $p \leq .05$.

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 proven to exist at the level set for significance, $p \leq .05$.

SUMMARY

This project was carried out to determine the effectiveness of written driver knowledge tests for renewal applicants as a countermeasure for reducing accidents and/or convictions. It was

a multiphased study, with the first phase being designed to evaluate the short-term effects of this countermeasure. These short-term effects were restricted to a period of 6-months' driving exposure by each group of applicants. The second phase covered the intermediate (12- and 18-month) and long-term (24-month) effects.

The evaluation consisted of four study groups: a control, those issued a driver's manual only, those given an at-home test, and those examined at the station. In the two groups administered knowledge tests, applicants were categorized as having passed, failed, or refused to take the test. The three major categories of data were accidents, convictions, and administrative actions.

Out of 392 possible combinations of data during each time period, 135 comparisons were carried out at the end of 6 months, 168 at the end of the 12 months, 215 at the end of 18 months, and 241 at the end of 24 months. These comparisons involved the testing of differences between study groups as well as within the groups administered knowledge tests. Table 4 describes the comparisons carried out, the reasons for making the comparisons, and the results obtained based on accident, conviction, and administrative action data available on the driver history file of each study group applicant.

Table 4
Summary

Comparisons Carried Out	Reasons For Comparison
A. Control group with each of the experimental groups.	A. Did treatment reduce accidents and convictions when compared with no treatment?
B. Each experimental group with each other.	B. Was any part of the experimental program more effective than other parts?
C. Pass, fail, and refuse on each test.	C. Was the subsequent driving record and test performance related?

RESULTS

Convictions	6 Mo.	12 Mo.	18 Mo.	24 Mo.
1. Major	A. ^a ND B. ND C. ND	ND ND ND	ND ND ND	ND 2 1
2. Two or More Majors	A. ID ^c B. ID C. ID	ID ID ID	ND ND ID	1 ND ND
3. Minor	A. 1 ^d B. 2 C. 1	1 3 2	1 4 1	1 4 1
4. Two or More Minors	A. ND B. ND C. ID	ND 2 ND	ND 2 ND	ND ND ND

Table 4 (continued)

<u>Accidents</u>		<u>6 Mo.</u>	<u>12 Mo.</u>	<u>18 Mo.</u>	<u>24 Mo.</u>
1. Total	A. ^a B. C.	ND ^b 1d ND	1 3 2	ND ND ND	ND ND ND
2. Two or More	A. B. C.	1 ND ID ^c	ND ND ID	ND ND ND	ND ND ND
3. With Conviction	A. B. C.	ND 2 2	ND ND ND	ND ND ND	ND ND ND
<u>Administrative Actions</u>					
1. Advisory Letter	A. B. C.	ND ND ND	ND ND ND	ND ND ND	ND 1 ND
2. Group Interview	A. B. C.	ND ND ND	ND ND ND	ND ND ND	ND ND ND
3. Personal Interview	A. B. C.	ID ID ID	ND ND ID	ND ND ID	ND ND ID
4. Clinic	A. B. C.	ID ID ID	ID ND ID	ND ND ID	ND ND ID
5. Probation	A. B. C.	ID ID ID	ID ND ID	ND ND ID	ND ND ID
6. Suspension	A. B. C.	ND ND ID	ND ND ID	ND ND ID	ND ND ND

^aLetters refer to comparisons and reasons listed above.

^bNo difference established.

^cInsufficient data for chi-square computations.

Convictions

1. For major convictions, none of the between and within group chi-square values computed at the end of 6, 12, and 18 months reached significance at $p \leq .05$. At the end of 24 months, there were two between and one within group statistically significant differences out of the 28 comparisons carried out.
2. For two or more major convictions, there were insufficient data to compute chi-squares at the end of 6 and 12 months. At the end of 18 months there were no between or within group differences and for 24-month data there was only the one between group chi-square value at $p \leq .05$.
3. For minor conviction data, a number of statistical differences were established when comparisons were carried out between and within the study groups. Out of 28 values computed at the end of each of the study time periods, there were 4 differences at 6 months and 6 differences at the end of 12, 18, and 24 months. In all but 1 case, a greater number of applicants who had refused to take the home test had a minor conviction entry on their driving records than did those in the group to which they were compared.
4. For two or more minor convictions, none of the between or within group chi-square values computed at the end of 6 and 24 months reached statistical significance at $p \leq .05$. The same two between group chi-square computations reached significance at the end of both the 12- and 18-month periods.

Accidents

1. For the total number of applicants in each group who had had an accident at the end of 6 months there were no statistical differences between each of the comparisons of the control group with the seven experimental groups. There also were no differences at $p \leq .05$ between those who had passed, failed, or refused to take each of the knowledge tests. When 6-month comparisons were carried out between the various experimental programs, one difference involving those who had refused to take the home test was found. At the end of 12 months, 6 of the 28 comparisons were statistically different at $p \leq .05$, and in each case more of those who had refused to take the home test had an accident entry on their records than did those in the group to which they were compared. None of the 28 between or within group chi-square values reached $p \leq .05$ at the end of either 18 or 24 months.

2. For applicants who had had two or more accidents at the end of 6 months there was one statistical difference when the control group was compared with the seven experimental groups. The control group had more applicants with 2 or more accident entries on their driving records than did those in the group who had passed the in-station test. In cases where comparisons could be carried out, no differences at $p \leq .05$ were established between the various experimental groups. There were not enough data at the end of 6 months for the computation of within knowledge test group chi-square values.

For multiple accident data collected at the end of 12-, 18-, and 24-months' driving exposure, none of the between or within group chi-square values which could be computed reached significance at $p \leq .05$.

3. At the end of 6 months, no difference between the control group and each of the seven experimental groups was established for the accident with conviction data. In the other between groups comparisons, 2 chi-square values reached significance at $p \leq .05$ while 9 did not. For the within knowledge test groups, a significant difference was found in 2 cases. At the end of 12-, 18-, and 24-months' driving exposure there were no between or within group differences in the number of applicants with an accident with conviction entry on the driving records of each group.
4. There were insufficient two or more accident with conviction data at the end of all four time periods to allow the computation of any between or within group chi-square values.

Administrative Actions

1. In all cases where statistics could be computed for 6-, 12-, and 18-months' data, there were no differences in the numbers of applicants who had received an administrative action (advisory letter, group or personal interview, clinic, probation, and suspension) when the various between and within group comparisons were carried out. For 24-month data, one between group advisory letter comparison reached significance at $p \leq .05$. In all the remaining between and within group chi-square values that could be computed, none reached significance at the level set.

In summary, there were sufficient data for the computation of 759 chi-square values to test differences between various aspects of the program. Out of the 43 cases where a statistical difference at $p \leq .05$ was found, 30 involved those who refused to take the home test.

In 21 of the 22 differences found in the comparisons of minor conviction data, in all 7 differences involving accident data, and in 2 of the 4 accident with conviction statistically different results, a greater number of applicants who had refused to take the at-home test had an entry on their driver history files. From an operational point of view, the findings associated with a refusal to take the home test have no practical use under the current statutes of the Commonwealth. There is little way for a motor vehicle administrator to issue or to deny a renewal operator license based on an applicant's refusal to take the test at home.

The remaining 13 statistically different results are spread over the four time periods and among the various variables of accidents and convictions in such a way that there are no results which indicate the usefulness of a knowledge testing program to effectuate a change in the driving performance of applicants for a renewal operator's license.

ADMINISTRATIVE EVALUATION

The Driver Services Administration of the Virginia DMV had the responsibility for providing the administrative evaluation of the project. This involved a monitoring of activities and making certain administrative judgements. A research project designed as an accident/conviction reduction countermeasure must be both technically and administratively feasible before the state can commit itself to implementation on a statewide basis.

The initial criteria for conducting this study required the DMV to refuse to issue a driver's license if a renewal license applicant refused to participate. Numerous complaints were received by DMV after the September renewal notices were mailed to the licensees. The majority of complaints charged discrimination, since some applicants were required to take a written test and some were not. Several persons threatened lawsuits to prevent the DMV from requiring a written test unless all persons were required to take the written test. In addition to citizen complaints, the DMV received inquiries from members of the state legislature concerning the project.

Due to the number of complaints, the DMV made the decision not to require applicants to participate in the testing program.

Applicants who refused to participate were encouraged to reconsider after an explanation of the purpose and value of the study. If applicants still refused to participate, their statistics file was noted as "refused" and they were allowed to renew their license.

Additional problems were encountered in the September test groups with an inconsistency in the data conversion of test scores and a high percentage of renewal notices (25%) which were returned to the DMV as undeliverable. Because of the DMV's decision not to require mandatory participation in the testing program and the other problems outlined above, the decision was made by DMV and National Highway Traffic Safety Administration (NHTSA) personnel that the September test data should not be used.

Extensive changes were made in the letters which accompanied the material sent to the October test groups. Due to time constraints, the NHTSA approval of the content of the revised letters could not be obtained. After all letters to the October test groups were mailed, NHTSA personnel suggested several revisions to the letters. With the revisions required in the letters and a continuing inconsistency in data conversion, a decision was made by NHTSA and DMV personnel not to use the October 1975 data.

The project was formally revised to begin the testing phase in November 1975, and to continue through April 1976 with the months of September and October 1975 being considered as a pilot to the testing project. Concerns continued to be expressed about a significant number of renewal notices being returned undelivered and the number of persons who were refusing to participate in the testing phase. In February 1976 the DMV reemphasized to all of its driver licensing personnel the importance of this project and the absolute necessity of encouraging citizens to participate and take the written tests. An immediate drop in the number of persons who refused to take the tests was noted. Even though the number of persons taking the tests increased significantly, the increase was not quite enough to achieve a 95% degree of confidence in the results of the project. Due to the importance of the 95% degree of confidence, the testing phase was extended one month to run through May 1976.

The study required the efforts of numerous individuals at the DMV from the Commissioner's office throughout the entire organization. All the field offices in the state — 34 full-service branch offices and 86 part-time licensing stations — took an active role in giving the tests to applicants and in entering

the data into the computer files. The Central Office staff was involved in the administration of various phases of the effort, formatting and programming the data, and in the retrieval of information for the evaluators.

Separate man-hour records of costs were not kept for administrative and field service personnel because it was viewed as a part of their regular operational duties and not as a special study function. In excess of 780 man-hours were used for the programming and other allied computer functions at a cost of nearly \$31,000. This figure represents only the costs chargeable by the DMV to the project and only for the data services provided, and therefore does not represent the entire cost for carrying out this study.

Virginia's experience in this study failed to produce evidence that the cost of conducting the written testing would be offset by reductions in economic losses associated with traffic crashes. The current cost to administer an in-station written test to an original applicant is approximately \$1.00. During 1978, 723,432 persons renewed their driver's license and it is estimated that 773,000 applicants will renew during 1979; therefore, to implement this standard would require an additional appropriation of \$773,000. Cost increases of such magnitude need to be thoroughly justified in a period when government programs are subject to ever-closer scrutiny by taxpayers and the state legislatures.

In addition to the obvious increase in costs directly related to the administration of the test, other factors should be considered. If written tests are required of all citizens at renewal time, the size of the testing area in each branch office would have to be increased and either more examiners would have to be employed or more time would be required for a citizen to complete the licensing process. Finally, justification for compliance is further diminished because according to the latest preliminary figures from the National Safety Council, Virginia's ratio of deaths per 100 million miles of travel is lower than that of any of the thirteen states presently in compliance with the knowledge testing portion of the standard. Indeed, Virginia ranks in the lowest quartile, or 44th of the 50 states plus the District of Columbia.

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ACKNOWLEDGEMENTS

Thanks are expressed to Richard E. Spring, past administrator* and James L. Hazelwood, Jr., current administrator of the Driver Services Administration, Division of Motor Vehicles, and to Rosemary M. Henderson, Richard Edwards, Delbert Stein, and Joe Augeri of that office for their assistance in the retrieval of the data used in the preparation of this report, as well as their overall activity and involvement in getting the project initiated and running smoothly.

Acknowledgement also is made of the valuable role played by the examiners in each of the DMV Branch Offices. Without the cooperation and effort of these individuals it would have been impossible to conduct the study. They met the public and administered and/or collected the knowledge tests.

Also the author appreciates the efforts of Toni Thompson, who typed the several drafts of the report, and those co-workers who reviewed and commented upon the report. The report was edited by Harry Craft and the final manuscript was typed by Jean Vanderbilt and Ann McDaniel.

*Mr. Spring is currently the administrator of the Planning and Development Administration.

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APPENDIX A *

A BRIEF HISTORY OF DRIVER LICENSE TESTING IN VIRGINIA

The first requirement to successfully complete a written examination before receiving a driver's license was written into law more than forty-one years ago and became effective on July 1, 1933. Modifications to this early statute have been made on several occasions during the subsequent years. Effective July 1, 1956, persons convicted of two moving violations or having been involved in two accidents within a twelve-month period were required to successfully pass a written examination immediately, or have their driver's licenses suspended (§ 46.1-383). Effective July 1, 1968, any person convicted of more than one moving violation during the four-year period preceding the expiration of his license was required to successfully complete a written examination before his license was renewed (§ 46.1-380.1(e)). Effective January 1, 1970, § 46.1-380.1 was amended to require persons (based on age groups) to pass a vision test prior to renewing their driver's license. The same law contains the provision that effective July 1, 1975, the vision examination will be required for each operator's license renewal (four year license) and for each fourth chauffeur's license renewal (one year license).

The state's driver license testing program is currently a many-faceted program. It tries to isolate and test only those persons who have demonstrated their inability to safely operate a motor vehicle. The following shows data on reexaminations given in 1972 to 851,305 renewal applicants.

- I. 202,637, or 23.8%, received no test of any kind.
- II. 634,595, or 74.5%, received a vision test only.
- III. 10,721, or 1.3%, received a vision and written test.
- IV. 3,352, or 0.4%, received a vision, written and road test.

These are renewal applicants only and do not include those persons who received a license revocation for driving while intoxicated or other major offenses requiring them to apply for a new license at reinstatement time. This category of revocation requires a complete vision, written and road test before receiving a license. There were 14,298 such examinations given in 1972, which were in addition to the renewal group mentioned above.

* Spring, Richard E., Virginia Division of Motor Vehicles, December 1974.

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APPENDIX B *

VIRGINIA DRIVER IMPROVEMENT PROGRAM

The 1974 Virginia General Assembly enacted the Virginia Driver Improvement Act. It is believed that this Act, which became effective on January 1, 1975, is the most complete Driver Improvement Program in the country. Although the program contains no new or unique elements, we are not aware of any other state in the country whose program embraces all of these elements. Since the purpose of this program is to identify and rehabilitate dangerous drivers before they lose their licenses, a series of administrative actions has been designated for drivers who receive a certain number of points.

Advisory Letters

When a driver has accumulated at least 6 points during a 12-month period or 9 points during a 24-month period, he will receive an advisory letter from DMV. This letter will alert the driver to the fact that he has accumulated sufficient violation points that he may be in danger of losing his license if additional points are accumulated. No appearance by the driver will be required, and no further action will be taken at this point unless additional convictions are received.

Group Interviews

When a driver has accumulated at least 8 points during a 12-month period, or 12 points during a 24-month period, he will be required to attend a group interview. Groups consist of approximately 8 to 12 drivers. During the one-hour interview, a DMV Driver Improvement Analyst will review each driver's record to make sure there are no errors. He will also explain what action DMV will be required to take, and the hardships of living without a driver's license, if any additional convictions take place. Finally he will present information on safe driving and discuss ways in which each driver can avoid future violations.

Personal Interviews

When a driver has received at least 12 points during a 12-month period or 18 points during a 24-month period, he will have a personal interview with a DMV Driver Improvement Analyst. At this stage, some administrative action must be taken against the driver. Depending upon his individual record and his attitude, he will be placed on probation for a period of 3 to 12 months. The driver may:

- (1) be required to attend a Driver Improvement Clinic in addition to being placed on probation.

* From a brochure published by the Virginia Division of Motor Vehicles.

- (2) have his license suspended for up to 6 months.

Driver Improvement Clinics

Driver Improvement Clinics consist of 8 hours of classroom instruction held in 4 weekly sessions with a written examination at the end of the course. Instruction is based on the National Safety Council's Defensive Driving Course with some modifications based on local driving needs.

The purpose of this clinic is to make the driver more aware of the hazards of unsafe driving and to teach him the techniques of avoiding and preventing accidents. He is required to attend all classes in succession and pass a test to complete the course successfully.

Although the clinics are primarily for drivers who have reached a high level of point accumulation, any driver may attend the clinic voluntarily. Successful completion earns 5 safe driving points to be applied against current or future demerit points.

License Probation

A license probation is a trial period during which a driver's traffic record is watched closely. During this time the driver is given another chance to prove that he can be a law-abiding driver before the more serious action of license suspension or revocation is taken.

Any convictions received during a probationary period result in a driver's license suspension for a period of up to one-half of the probationary period.

License Suspension

The Driver Improvement Program provides drivers with a series of warnings, consultations and remedial learning opportunities. Drivers have been given several chances to change their unsafe driving habits as a result of:

- (1) An advisory letter at the 6-point level (9 points in 2 years).
- (2) A group interview at the 8-point level (12 points in 2 years).
- (3) A personal interview at the 12-point level (18 points in 2 years).
- (4) The Driver Improvement Clinic.
- (5) License probation.

In addition to these Division of Motor Vehicles actions, the driver has had numerous court appearances. If he still fails to respond to the program, the Division has no alternative but to suspend or revoke his license.

APPENDIX C
NOTICE TO GROUP I

VERN L. HILL, COMMISSIONER



J. C. SKELTON
FIELD SERVICES ADMINISTRATOR

R. E. SPRING
DRIVER SERVICES ADMINISTRATOR

L. F. TOWERS
VEHICLE SERVICES ADMINISTRATOR

R. P. VAN BUREN
MANAGEMENT OPERATIONS ADMINISTRATOR

COMMONWEALTH of VIRGINIA

Division of Motor Vehicles

2220 West Broad Street

MAIL ADDRESS
P. O. BOX 27412
RICHMOND, VIRGINIA 23269

Dear Motorist:

Your driver's license renewal card and a copy of the Virginia Driver's Manual are enclosed.

Please take a few minutes to study this manual since many changes have been made in the laws that cover driving during the past few years. Virginia has enjoyed a lower than average fatality rate on our highways for many years and it is our sincere hope that the few minutes spent reviewing changes in our laws will make our highways even safer. Thank you.

Sincerely,


R. E. Spring, Administrator
Driver Services Administration

RES:lmj

Enclosures

APPENDIX D*

KNOWLEDGE TEST

1. Who must agree to either a breath or an alcohol blood test in Virginia?
 - A. No one. Virginia has no way to administer such tests
 - B. Anyone appearing to be drunk
 - C. Anyone operating a vehicle in Virginia
 - D. Anyone having an accident

2. The acceleration lane on an interstate highway is used:
 - A. To allow you to make repairs to your vehicle
 - B. To allow large trucks to pass
 - C. To adjust your speed to the speed of traffic
 - D. For detours when the highway is not passable

3. When the vehicle in front of you has stopped for a stop sign and then proceeds, you should:
 - A. Continue if the way is clear
 - B. Continue at the same rate of speed
 - C. Come to a complete stop and proceed when safe
 - D. Stop only if pedestrians are coming

4. If you desire to change traffic lanes while driving on a four lane divided highway, you should:
 - A. Check for oncoming traffic
 - B. Move up close to the vehicle in front of you
 - C. Turn sharply into the desired lane
 - D. Give proper signal and change lanes when safe

5. When two vehicles approach an unmarked intersection at the same time, which vehicle has the right-of-way?
 - A. The vehicle on the left
 - B. The vehicle on the right
 - C. Neither vehicle has the right-of-way
 - D. The first vehicle to enter the intersection

6. You should signal for a turn:
 - A. In sufficient time to permit motorists to react
 - B. After slowing down for a turn
 - C. As you begin to turn your steering wheel
 - D. Only if there is oncoming traffic

*Virginia Division of Motor Vehicles, 1975.

7. If the rear of your vehicle is skidding to the left you should:
- A. Rapidly move the steering wheel back and forth
 - B. Turn your steering wheel to the left
 - C. Keep steering wheel from moving until out of the skid
 - D. Turn your steering wheel to the right
8. A flashing red traffic light at an intersection means:
- A. Proceed at the same speed
 - B. Come to a complete stop before entering or proceeding
 - C. There is detour ahead
 - D. Make a turn to the right
9. Your driving privileges can be revoked or suspended if convicted of:
- A. Driving while under the influence of alcohol
 - B. Driving while under the influence of drugs
 - C. Racing on the highway
 - D. Any of the above
10. If you are driving on a highway separated by a physical barrier or unpaved area and meet a stopped school bus loading or unloading children, you should:
- A. Proceed with caution at normal speed
 - B. Come to a complete stop
 - C. Pull over to the right and wait for the school bus to be set in motion
 - D. Turn on your headlights
11. A pedestrian has the right-of-way:
- A. Where cross walks are clearly marked
 - B. In all locations in the state
 - C. If he is blind or deaf
 - D. All of the above
12. When driving in fog or rain at night, you should use your:
- A. High beam headlights
 - B. Parking lights
 - C. Low beam headlights
 - D. Four-way flashers
13. How are highways marked when passing is not allowed in either direction:
- A. By a broken white line
 - B. By a broken yellow line
 - C. By a double solid yellow line
 - D. By a solid yellow line and a broken yellow line

14. If you exit at the wrong place on an interstate highway you should:
- A. Back onto the main interstate and continue when safe
 - B. Turn your vehicle around, stay on the shoulder, and drive back down the exit ramp
 - C. Park your vehicle on the shoulder and walk back to get a closer look at the signs
 - D. Continue until you are off the exit ramp and look for a way to reenter the interstate
15. You should drive in the right lane of a four lane highway when:
- A. Driving slower than traffic in other lanes
 - B. You are preparing to exit on the left
 - C. When you see traffic entering the highway from the right
 - D. You want to pass other vehicles on the highway
16. Turn signals are:
- A. Not required when turning at an uncontrolled intersection
 - B. Not required when turning at a traffic light
 - C. Not required when pulling into an alley or parking space
 - D. Required for all turns
17. A flashing yellow or amber traffic light at an intersection means:
- A. Stop before entering the intersection
 - B. Proceed rapidly through the intersection
 - C. Continue at normal speed because you have the right-of-way
 - D. Slow down and proceed with caution
18. When you are driving in bad weather conditions and water on the windshield reduces your visibility you should:
- A. Speed up and get off the road quickly
 - B. Increase your following distance
 - C. Drive in the lane closest to oncoming traffic
 - D. Turn your headlights on high beam
19. Before making a left turn at night, you should:
- A. Be in proper lane giving correct signal and yield to oncoming traffic and pedestrians
 - B. Sound your horn and yield to oncoming traffic
 - C. Be in proper lane and flash your headlights
 - D. Speed up and make turn quickly

NOTICE TO GROUP II

VERN L. HILL, COMMISSIONER

J. C. SKELTON
FIELD SERVICES ADMINISTRATORR. E. SPRING
DRIVER SERVICES ADMINISTRATORL. F. TOWERS
VEHICLE SERVICES ADMINISTRATORR. P. VAN BUREN
MANAGEMENT OPERATIONS ADMINISTRATOR

COMMONWEALTH of VIRGINIA

*Division of Motor Vehicles**2220 West Broad Street*MAIL ADDRESS
P. O. BOX 27412
RICHMOND, VIRGINIA 23269

Dear Motorist:

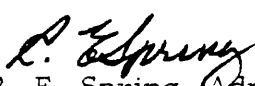
Your driver's license renewal card and a copy of the Virginia Driver's Manual are enclosed.

We are currently engaged in a study to determine how we can improve our safety record. More than one thousand persons lost their lives on Virginia highways last year due to automobile accidents. Most of these accidents occurred because someone committed a traffic violation and in most cases the people involved in these accidents had no record of prior accidents or convictions of traffic violations.

Your driving record shows no accidents or traffic violations recently and we would like you to participate with us in this study by reviewing the Driver's Manual very carefully and taking a short test when you go into our office to renew your license. You should be able to complete the test in thirty minutes or less and if you review the Driver's Manual thoroughly, you should have no problem passing this test.

Your participation in this study will assist us in developing an imposed driver licensing program and should be very helpful to you. If you have any questions concerning this study, please contact the Manager of the DMV Branch Office that is closest to you or contact me at 804-786-3063. Please remember to bring the enclosed renewal card with you when you renew your license.

Sincerely,


R. E. Spring, Administrator
Driver Services Administration

RES:lmj

Enclosures

2478

APPENDIX F
NOTICE TO GROUP III

VERN L. HILL, COMMISSIONER

J. C. SKELTON
FIELD SERVICES ADMINISTRATOR
R. E. SPRING
DRIVER SERVICES ADMINISTRATOR



L. F. TOWERS
VEHICLE SERVICES ADMINISTRATOR
R. P. VAN BUREN
MANAGEMENT OPERATIONS ADMINISTRATOR

COMMONWEALTH of VIRGINIA

Division of Motor Vehicles

2220 West Broad Street

MAIL ADDRESS
P. O. BOX 37412
RICHMOND, VIRGINIA 23269

Dear Motorist:

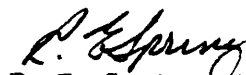
Your driver's license renewal card, a copy of the Virginia Driver's Manual and a short written test are enclosed.

We are currently engaged in a study to determine how we can improve our safety record. More than one thousand persons lost their lives on Virginia highways last year due to automobile accidents. Most of these accidents occurred because someone committed a traffic violation and in most cases the people involved in these accidents had no record of prior accidents or convictions of traffic violations.

Your driving record shows no accidents or convictions recently and we would like you to participate with us in this study by reviewing the Driver's Manual very carefully and taking the enclosed written test. When you go to our office to renew your license, one of our license examiners will review the test with you and you should be able to renew your license in less than thirty minutes.

Your participation in this study will assist us in developing an improved driver licensing program and should be very helpful to you. If you have any questions concerning this study, please contact the Manager of the DMV Branch Office that is closest to you or contact me at 804-786-3063. Please remember to bring the enclosed renewal card and the written test with you when you renew your license.

Sincerely,


R. E. Spring, Administrator
Driver Services Administration

RES:lmj

Enclosures

Appendix G-1
6-Month Data

Number of Accidents, Convictions, and Administrative Actions

Number	Category	Control Group	Experimental I (Manual Only)		Experimental II (At-Home Test)			Experimental III (In-Station Test)		
			14,588	12,066	Pass	Fail	Refuse	Pass	Fail	Refuse
Assigned		14,588	14,588		10,693	350	707	8,861	691	2,179
Renewals		12,123	12,066							
With Major Conviction	Total 2 or More	42	61	0	44	1	5	33	4	10
With Minor Conviction	Total 2 or More	418	449	20	366	17	38	286	26	85
With Accidents	Total 2 or More	327	317	19	279	8	26	222	25	50
Accident With Conviction	Total 2 or More	22	19	0	13	0	1	7	0	3
		50	48	0	37	2	6	34	6	5
		0	0		1	0	0	0	0	0
With Advisory Letters	Total	43	41		50	2	3	30	4	9
With Group Interviews	Total	42	35		33	2	5	26	1	7
With Personal Interviews	Total	2	4		4	0	1	6	0	0
With Clinics	Total	1	2		1	0	0	2	0	0
With Probation	Total	1	2		1	0	0	2	0	0
With Suspension	Total	8	12		10	1	1	11	1	1

Appendix G-2
12-Month Data
Number of Accidents, Convictions, and Administrative Actions

Category	Control Group	Experimental I (Manual Only)		Experimental II (At-Home Test)			Experimental III (In-Station Test)				
		14,588	12,066	14,588	Pass	Fail	Refuse	14,588	Pass	Fail	Refuse
Assigned	14,588										
Renewals	12,124				10,693	350	707	8,861	691	2,179	
With Major Conviction	101	112		92	4	0	9	76	8	17	
	4	1		2	0	0	0	5	0	2	
With Minor Conviction	811	799		700	22	0	67	543	43	159	
	74	59		76	0	0	1	40	4	12	
With Accidents	672	625		536	14	0	54	463	42	104	
	52	42		36	2	0	4	28	2	4	
Accident With Conviction	110	93		88	4	0	9	69	9	14	
	3	0		1	0	0	0	1	0	0	
With Advisory Letters	95	93		87	3	0	6	57	8	16	
With Group Interviews	79	64		63	3	0	6	48	2	9	
With Personal Interviews	6	10		7	1	0	1	12	1	1	
With Clinics	2	7		5	1	0	1	8	0	0	
With Probation	2	7		5	1	0	1	8	0	0	
With Suspension	19	20		15	2	0	3	18	3	2	

Appendix G-3
18-Month Data

Number of Accidents, Convictions, and Administrative Actions

Number	Category	Control Group	Experimental I (Manual Only)	Experimental II (At-Home Test)		Experimental III (In-Station Test)	
				Pass	Refuse	Pass	Refuse
Assigned		14,588	14,588	14,588			
Renewals		12,124	12,066	10,693	707	8,861	2,179
With Major Conviction	Total 2 or More	155 7	161 4	125 5	13 0	98 11	27 4
With Minor Conviction	Total 2 or More	1,135 144	1,128 115	983 139	92 5	781 84	213 23
With Accidents	Total 2 or More	925 83	902 84	788 59	64 5	664 65	157 12
Accident With Conviction	Total 2 or More	157 5	144 4	120 1	7 0	114 2	22 0
With Advisory Letters	Total	143	129	142	3	98	8
With Group Interviews	Total	112	99	90	3	69	4
With Personal Interviews	Total	17	12	16	1	16	1
With Clinics	Total	8	10	10	1	12	0
With Probation	Total	10	10	10	1	13	0
With Suspension	Total	31	26	24	3	25	4

Appendix G-4
 24-Month Data
 Number of Accidents, Convictions, and Administrative Actions

Number	Category	Control Group	Experimental I (Manual Only)	Experimental II (At-Home Test)		Experimental III (In-Station Test)	
				Pass	Refuse	Pass	Refuse
Assigned		14,588	14,588	14,588	14,588	14,588	14,588
Renewals		12,108	12,062	10,689	706	8,847	2,178
With Major Conviction	Total 2 or More	184	204	145	16	126	33
		11	15	10	0	16	6
With Minor Conviction	Total 2 or More	1,446	1,401	1,217	112	1,008	266
		229	199	195	13	140	37
With Accidents	Total 2 or More	1,222	1,211	1,063	78	872	211
		120	129	109	7	93	19
Accident With Conviction	Total 2 or More	203	193	165	11	148	28
		6	4	2	0	3	1
With Advisory Letters	Total	174	153	172	4	118	8
With Group Interviews	Total	137	122	110	6	78	4
With Personal Interviews	Total	22	13	20	1	18	2
With Clinics	Total	18	12	14	1	16	0
With Probation	Total	19	12	15	1	17	0
With Suspension	Total	43	39	27	4	35	4
							10

Appendix H-1
6-Month Data
Percent of Accidents, Convictions, and Administrative Actions

Number	Category	Control Group	Experimental I (Manual Only)		Experimental II (At-Home Test)			Experimental III (In-Station Test)		
			14,588	82.71	Pass	Fail	Refuse	Pass	Fail	Refuse
Assigned		14,588			73,229	2,339	4,84	60,74	4,73	14,93
Renewals		83.10								
With Major Conviction	Total 2 or More	0.34 0.01	0.50	—	0.41	0.28	0.70	0.37 0.01	0.57	0.45
With Minor Conviction	Total 2 or More	3.44 0.20	3.72 0.16	—	3.42 0.21	4.85	5.37 0.14	3.22 0.13	3.76 0.14	3.90 0.18
With Accidents	Total 2 or More	2.69 0.18	2.62 0.15	—	2.60 0.12	2.28	3.67 0.14	2.50 0.07	3.61	2.29 0.13
Accident With Conviction	Total 2 or More	0.41	0.39	—	0.34	0.57	0.84	0.38	0.86	0.22
With Advisory Letters	Total	0.35	0.33		0.46	0.57	0.42	0.33	0.57	0.41
With Group Interviews	Total	0.34	0.29		0.30	0.57	0.70	0.29	0.14	0.32
With Personal Interviews	Total	0.01	0.03		0.03	—	0.14	0.06	—	—
With Clinics	Total	—	0.01		—	—	—	0.02	—	—
With Probation	Total	—	0.01		—	—	—	0.02	—	—
With Suspension	Total	0.06	0.09		0.09	0.28	0.14	0.12	0.14	0.04

Appendix H-2
 12-Month Data
 Percent of Accidents, Convictions, and Administrative Actions

Number	Category	Control Group	Experimental I (Manual Only)	Experimental II (At-Home Test)			Experimental III (In-Station Test)		
				Pass	Fail	Refuse	Pass	Fail	Refuse
Assigned		14,588	14,588	14,588			14,588		
Renewals		83.10	82.71	73.29	2.39	4.84	60.74	4.73	14.93
With Major Conviction	Total 2 or More	0.83 0.03	0.92 —	0.86 0.01	1.14 —	1.27 —	0.85 0.05	1.15 —	0.78 0.09
With Minor Conviction	Total 2 or More	6.68 0.61	6.62 0.48	6.54 0.71	6.28 —	9.47 0.14	6.12 0.45	6.22 0.57	7.29 0.55
With Accidents	Total 2 or More	5.54 0.42	5.17 0.34	5.01 0.33	4.00 0.57	7.63 0.56	5.22 0.31	6.07 0.28	4.77 0.18
Accident With Conviction	Total 2 or More	0.90 0.02	0.77 —	0.82 —	1.14 —	1.27 —	0.77 0.01	1.30 —	0.64 —
With Advisory Letters	Total	0.78	0.77	0.81	0.85	0.84	0.64	1.15	0.73
With Group Interviews	Total	0.65	0.53	0.58	0.85	0.84	0.54	0.28	0.41
With Personal Interviews	Total	0.04	0.08	0.06	0.28	0.14	0.13	0.14	0.04
With Clinics	Total	0.01	0.05	0.04	0.28	0.14	0.09	—	—
With Probation	Total	0.01	0.05	0.04	0.28	0.14	0.09	—	—
With Suspension	Total	0.15	0.16	0.14	0.57	0.42	0.20	0.43	0.09

Appendix H-3
18-Month Data
Percent of Accidents, Convictions, and Administrative Actions

Number	Category	Control Group	Experimental I (Manual Only)		Experimental II (At-Home Test)			Experimental III (In-Station Test)		
			Pass	Fail	Pass	Fail	Refuse	Pass	Fail	Refuse
Assigned		14,588	14,588		14,588			14,588		
Renewals		83.10	82.71		73.29	2.39	4.84	60.74	4.73	14.93
With Major Conviction	Total 2 or More	1.27 0.05	1.33 0.03		1.16 0.04	1.71 —	1.83 —	1.10 0.12	1.88 —	1.23 0.18
With Minor Conviction	Total 2 or More	9.36 1.18	9.34 0.95		9.19 1.29	9.71 0.28	13.01 0.70	8.81 0.94	8.68 0.57	9.77 1.05
With Accidents	Total 2 or More	7.62 0.68	7.47 0.69		7.36 0.55	7.71 0.85	9.05 0.70	7.49 0.73	9.11 1.15	7.20 0.55
Accident With Conviction	Total 2 or More	1.29 0.04	1.19 0.03		1.12 —	2.00 —	1.41 —	1.28 0.02	1.44 —	1.00 —
With Advisory Letters	Total	1.17	1.06		1.32	0.85	1.27	1.10	1.15	1.00
With Group Interviews	Total	0.92	0.82		0.84	0.85	1.13	0.77	0.57	0.68
With Personal Interviews	Total	0.14	0.09		0.14	0.28	0.14	0.18	0.14	0.09
With Clinics	Total	0.06	0.08		0.09	0.28	0.14	0.13	—	0.04
With Probation	Total	0.08	0.08		0.09	0.28	0.14	0.14	—	0.04
With Suspension	Total	0.25	0.21		0.22	0.85	0.42	0.28	0.57	0.27

Appendix II-4
 24-Month Data
 Percent of Accidents, Convictions, and Administrative Actions

Number	Category	Control Group	Experimental I (Manual Only)	Experimental II (At-Home Test)			Experimental III (In-Station Test)		
				Pass	Fail	Refuse	Pass	Fail	Refuse
Assigned		14,588	14,588	14,588			14,588		
Renewals		82.99	82.68	73.27	2.39	4.83	60.64	4.72	14.93
With Major Conviction	Total 2 or More	1.51 0.09	1.69 0.12	1.35 0.09	2.57 —	2.26 —	1.42 0.18	2.46 —	1.51 0.27
With Minor Conviction	Total 2 or More	11.94 1.89	11.61 1.64	11.38 1.82	12.03 1.14	15.86 1.84	11.39 1.58	10.15 0.87	12.21 1.69
With Accidents	Total 2 or More	10.09 0.99	10.03 1.06	9.94 1.01	8.59 1.43	11.04 0.99	9.85 1.05	10.88 1.45	9.68 0.87
Accident With Conviction	Total 2 or More	1.67 0.04	1.60 0.03	1.54 0.01	2.29 —	1.55 —	1.67 0.03	1.59 —	1.28 0.04
With Advisory Letters	Total	1.43	1.26	1.60	1.14	1.69	1.33	1.16	1.23
With Group Interviews	Total	1.13	1.01	1.02	1.71	1.55	0.88	0.58	0.82
With Personal Interviews	Total	0.18	0.10	0.18	0.28	0.14	0.20	0.29	0.13
With Clinics	Total	0.14	0.09	0.13	0.28	0.14	0.18	—	0.09
With Probation	Total	0.15	0.09	0.14	0.28	0.14	0.19	—	0.09
With Suspension	Total	0.35	0.32	0.25	1.14	0.42	0.39	0.58	0.45

APPENDIX I

Data for Major Convictions

Comparison Performed	6-Month Data		12-Month Data	
	Chi-Square	Probability	Chi-Square	Probability
Between Group Comparisons				
Control vs. Pass Station	0.10	0.75	0.014	0.903
Control vs. Fail Station	ID ^a	—	0.478	0.503
Control vs. Refuse Station	0.65	0.57	0.015	0.898
Control vs. Pass Home	0.64	0.57	0.023	0.874
Control vs. Fail Home	ID	—	ID	—
Control vs. Refuse Home	2.38	0.12	1.048	0.307
Control vs. Manual	3.61	0.054	0.523	0.523
Pass Station vs. Pass Home	0.19	0.67	0.003	0.953
Pass Station vs. Fail Home	ID	—	ID	—
Pass Station vs. Refuse Home	1.86	0.17	0.854	0.642
Pass Station vs. Manual	2.03	0.15	0.212	0.651
Fail Station vs. Pass Home	ID	—	0.362	0.555
Fail Station vs. Fail Home	ID	—	ID	—
Fail Station vs. Refuse Home	ID	—	0.002	0.961
Fail Station vs. Manual	ID	—	0.164	0.688
Refuse Station vs. Pass Home	0.10	0.75	0.590	0.803
Refuse Station vs. Fail Home	ID	—	ID	—
Refuse Station vs. Refuse Home	0.64	0.57	0.953	0.669
Refuse Station vs. Manual	0.08	0.77	0.301	0.590
Manual vs. Pass Home	1.09	0.30	0.222	0.643
Manual vs. Fail Home	ID	—	ID	—
Manual vs. Refuse Home	0.53	0.53	0.518	0.521
In-Station Group Comparisons				
Pass vs. Fail	ID	—	0.363	0.554
Pass vs. Refuse	0.34	0.57	0.050	0.818
Fail vs. Refuse	ID	—	0.484	0.506
At-Home Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	1.36	0.24	0.859	0.643
Fail vs. Refuse	ID	—	ID	—

^aInsufficient data for computing chi-square.

^bStatistically significant beyond the 0.05 level.

Comparison Performed	18-Month Data		24-Month Data	
	Chi-Square	Probability	Chi-Square	Probability
Between Group Comparisons				
Control vs. Pass Station	1.138	0.286	0.257	0.618
Control vs. Fail Station	1.400	0.235	3.199	0.070
Control vs. Refuse Station	0.002	0.961	0.006	0.935
Control vs. Pass Home	0.475	0.502	0.950	0.669
Control vs. Fail Home	0.223	0.642	1.849	0.171
Control vs. Refuse Home	1.218	0.269	1.959	0.158
Control vs. Manual	0.106	0.744	1.021	0.314
Pass Station vs. Pass Home	0.119	0.730	0.116	0.733
Pass Station vs. Fail Home	0.638	0.570	2.348	0.122
Pass Station vs. Refuse Home	2.460	0.113	2.617	0.102
Pass Station vs. Manual	1.997	0.154	2.174	0.137
Fail Station vs. Pass Home	2.188	0.135	4.927	0.025 ^b
Fail Station vs. Fail Home	0.003	0.955	0.010	0.916
Fail Station vs. Refuse Home	0.999	0.682	0.005	0.942
Fail Station vs. Manual	1.075	0.300	1.872	0.168
Refuse Station vs. Pass Home	0.028	0.862	0.228	0.639
Refuse Station vs. Fail Home	0.224	0.641	1.482	0.221
Refuse Station vs. Refuse Home	0.019	0.884	1.379	0.239
Refuse Station vs. Manual	0.066	0.793	0.250	0.623
Manual vs. Pass Home	1.119	0.290	3.985	0.043 ^b
Manual vs. Fail Home	0.139	0.711	1.102	0.294
Manual vs. Refuse Home	0.917	0.660	0.985	0.678
In-Station Group Comparisons				
Pass vs. Fail	2.714	0.096	4.029	0.042 ^b
Pass vs. Refuse	0.171	0.683	0.048	0.822
Fail vs. Refuse	1.142	0.285	2.242	0.131
At-Home Group Comparisons				
Pass vs. Fail	0.457	0.506	2.835	0.088
Pass vs. Refuse	1.959	0.158	3.309	0.066
Fail vs. Refuse	0.011	0.915	0.009	0.918

APPENDIX J

Data for Two or More Major Convictions

Comparison Performed	6-Month Data		12-Month Data	
	Chi-Square	Probability	Chi-Square	Probability
Between Group Comparisons				
Control vs. Pass Station	ID ^a	—	ID	—
Control vs. Fail Station	ID	—	ID	—
Control vs. Refuse Station	ID	—	ID	—
Control vs. Pass Home	ID	—	ID	—
Control vs. Fail Home	ID	—	ID	—
Control vs. Refuse Home	ID	—	ID	—
Control vs. Manual	ID	—	ID	—
Pass Station vs. Pass Home	ID	—	ID	—
Pass Station vs. Fail Home	ID	—	ID	—
Pass Station vs. Refuse Home	ID	—	ID	—
Pass Station vs. Manual	ID	—	ID	—
Fail Station vs. Pass Home	ID	—	ID	—
Fail Station vs. Fail Home	ID	—	ID	—
Fail Station vs. Refuse Home	ID	—	ID	—
Fail Station vs. Manual	ID	—	ID	—
Refuse Station vs. Pass Home	ID	—	ID	—
Refuse Station vs. Fail Home	ID	—	ID	—
Refuse Station vs. Refuse Home	ID	—	ID	—
Refuse Station vs. Manual	ID	—	ID	—
Manual vs. Pass Home	ID	—	ID	—
Manual vs. Fail Home	ID	—	ID	—
Manual vs. Refuse Home	ID	—	ID	—
In-Station Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	ID	—	ID	—
Fail vs. Refuse	ID	—	ID	—
At-Home Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	ID	—	ID	—
Fail vs. Refuse	ID	—	ID	—

^aInsufficient data for computing chi-square.

^bStatistically significant beyond the 0.05 level.

Comparison Performed	18-Month Data		24-Month Data	
	Chi-Square	Probability	Chi-Square	Probability
Between Group Comparisons				
Control vs. Pass Station	1.901	0.165	2.540	0.107
Control vs. Fail Station	ID ^a	—	ID	—
Control vs. Refuse Station	ID	—	3.839	0.047 ^b
Control vs. Pass Home	0.005	0.940	0.024	0.871
Control vs. Fail Home	ID	—	ID	—
Control vs. Refuse Home	ID	—	ID	—
Control vs. Manual	ID	—	0.362	0.555
Pass Station vs. Pass Home	2.656	0.099	2.156	0.138
Pass Station vs. Fail Home	ID	—	ID	—
Pass Station vs. Refuse Home	ID	—	ID	—
Pass Station vs. Manual	ID	—	0.736	0.604
Fail Station vs. Pass Home	ID	—	ID	—
Fail Station vs. Fail Home	ID	—	ID	—
Fail Station vs. Refuse Home	ID	—	ID	—
Fail Station vs. Manual	ID	—	ID	—
Refuse Station vs. Pass Home	ID	—	3.466	0.059
Refuse Station vs. Fail Home	ID	—	ID	—
Refuse Station vs. Refuse Home	ID	—	ID	—
Refuse Station vs. Manual	ID	—	1.908	0.164
Manual vs. Pass Home	ID	—	0.257	0.619
Manual vs. Fail Home	ID	—	ID	—
Manual vs. Refuse Home	ID	—	ID	—
In-Station Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	ID	—	0.382	0.544
Fail vs. Refuse	ID	—	ID	—
At-Home Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	ID	—	ID	—
Fail vs. Refuse	ID	—	ID	—

APPENDIX K

Data for Minor Convictions

Comparison Performed	6-Month Data		12-Month Data	
	Chi-Square	Probability	Chi-Square	Probability
Between Group Comparisons				
Control vs. Pass Station	0.77	0.62	2.579	0.104
Control vs. Fail Station	0.19	0.66	0.160	0.692
Control vs. Refuse Station	1.12	0.29	0.985	0.678
Control vs. Pass Home	0.01	0.91	0.165	0.688
Control vs. Fail Home	1.12	0.29	0.036	0.844
Control vs. Refuse Home	7.24	0.007 ^b	7.711	0.006 ^b
Control vs. Manual	1.31	0.25	0.034	0.848
Pass Station vs. Pass Home	0.57	0.54	1.355	0.243
Pass Station vs. Fail Home	2.81	0.09	0.00005	0.990
Pass Station vs. Refuse Home	9.23	0.003 ^b	11.746	0.001 ^b
Pass Station vs. Manual	3.67	0.052	1.995	0.154
Fail Station vs. Pass Home	0.23	0.64	0.065	0.795
Fail Station vs. Fail Home	0.70	0.59	0.009	0.921
Fail Station vs. Refuse Home	2.08	0.15	4.665	0.029 ^b
Fail Station vs. Manual	0.003	0.95	0.110	0.739
Refuse Station vs. Pass Home	1.22	0.27	1.519	0.216
Refuse Station vs. Fail Home	0.71	0.60	0.324	0.576
Refuse Station vs. Refuse Home	2.84	0.09	3.218	0.069
Refuse Station vs. Manual	0.17	0.69	1.235	0.266
Manual vs. Pass Home	1.46	0.23	0.041	0.834
Manual vs. Fail Home	1.22	0.27	0.019	0.883
Manual vs. Refuse Home	4.98	0.02 ^b	8.166	0.005 ^b
In-Station Group Comparisons				
Pass vs. Fail	0.58	0.55	0.0003	0.983 ^b
Pass vs. Refuse	2.44	0.11	3.819	0.048 ^b
Fail vs. Refuse	0.03	0.86	0.768	0.615
At-Home Group Comparisons				
Pass vs. Fail	2.08	0.15	0.007	0.931 ^b
Pass vs. Refuse	7.39	0.007 ^b	8.613	0.004 ^b
Fail vs. Refuse	0.13	0.72	2.691	0.097

^aInsufficient data for computing chi-square.

^bStatistically significant beyond the 0.05 level.

Comparison Performed	18-Month Data		24-Month Data	
	Chi-Square	Probability	Chi-Square	Probability
Between Group Comparisons				
Control vs. Pass Station	1.786	0.178	1.437	0.229
Control vs. Fail Station	0.280	0.603	1.817	0.174
Control vs. Refuse Station	0.323	0.577	0.104	0.746
Control vs. Pass Home	0.172	0.681	1.654	0.196
Control vs. Fail Home	0.017	0.892	0.001	0.973
Control vs. Refuse Home	9.880	0.002 ^b	9.242	0.003 ^b
Control vs. Manual	0.0002	0.987	0.593	0.552
Pass Station vs. Pass Home	0.803	0.626	0.00002	0.992
Pass Station vs. Fail Home	0.236	0.633	0.080	0.774
Pass Station vs. Refuse Home	13.420	0.0005 ^b	12.196	0.0008 ^b
Pass Station vs. Manual	1.698	0.190	0.224	0.642
Fail Station vs. Pass Home	0.146	0.704	0.851	0.641
Fail Station vs. Fail Home	0.188	0.669	0.662	0.579
Fail Station vs. Refuse Home	6.321	0.012 ^b	9.505	0.003 ^b
Fail Station vs. Manual	0.268	0.611	1.214	0.270
Refuse Station vs. Pass Home	0.661	0.578	1.135	0.287
Refuse Station vs. Fail Home	0.004	0.950	0.00004	0.991
Refuse Station vs. Refuse Home	5.583	0.017 ^b	5.924	0.014 ^b
Refuse Station vs. Manual	0.345	0.564	0.582	0.548
Manual vs. Pass Home	0.145	0.705	0.271	0.609
Manual vs. Fail Home	0.019	0.885	0.024	0.870
Manual vs. Refuse Home	9.959	0.002 ^b	11.125	0.001 ^b
In-Station Group Comparisons				
Pass vs. Fail	0.002	0.961	0.852	0.641
Pass vs. Refuse	1.857	0.170	1.069	0.302
Fail vs. Refuse	0.606	0.557	1.939	0.160
At-Home Group Comparisons				
Pass vs. Fail	0.057	0.807	0.084	0.769
Pass vs. Refuse	10.887	0.001 ^b	12.462	0.0008 ^b
Fail vs. Refuse	2.122	0.142	2.449	0.114

APPENDIX L

Data for Two or More Minor Convictions

Comparison Performed	6-Month Data		12-Month Data	
	Chi-Square	Probability	Chi-Square	Probability
Between Group Comparisons				
Control vs. Pass Station	1.47	0.22	2.174	0.137
Control vs. Fail Station	ID ^a	—	ID	—
Control vs. Refuse Station	ID	—	0.025	0.869
Control vs. Pass Home	0.02	0.88	0.703	0.593
Control vs. Fail Home	ID	—	ID	—
Control vs. Refuse Home	ID	—	ID	—
Control vs. Manual	0.52	0.52	1.407	0.234
Pass Station vs. Pass Home	1.73	0.19	5.137	0.022 ^b
Pass Station vs. Fail Home	ID	—	ID	—
Pass Station vs. Refuse Home	ID	—	ID	—
Pass Station vs. Manual	0.32	0.58	0.098	0.753
Fail Station vs. Pass Home	ID	—	ID	—
Fail Station vs. Fail Home	ID	—	ID	—
Fail Station vs. Refuse Home	ID	—	ID	—
Fail Station vs. Manual	ID	—	ID	—
Refuse Station vs. Pass Home	ID	—	0.425	0.522
Refuse Station vs. Fail Home	ID	—	ID	—
Refuse Station vs. Refuse Home	ID	—	ID	—
Refuse Station vs. Manual	ID	—	0.054	0.812
Manual vs. Pass Home	0.71	0.60	4.284	0.036 ^b
Manual vs. Fail Home	ID	—	ID	—
Manual vs. Refuse Home	ID	—	ID	—
In-Station Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	ID	—	0.217	0.646
Fail vs. Refuse	ID	—	ID	—
At-Home Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	ID	—	ID	—
Fail vs. Refuse	ID	—	ID	—

^aInsufficient data for computing chi-square.

^bStatistically significant beyond the 0.05 level.

Comparison Performed	18-Month Data		24-Month Data	
	Chi-Square	Probability	Chi-Square	Probability
Between Group Comparisons				
Control vs. Pass Station	2.601	0.103	2.731	0.095
Control vs. Fail Station	ID ^a	—	3.310	0.066
Control vs. Refuse Station	0.155	0.696	0.247	0.626
Control vs. Pass Home	0.461	0.505	0.145	0.705
Control vs. Fail Home	ID	—	ID	—
Control vs. Refuse Home	0.758	0.612	0.006	0.934
Control vs. Manual	2.862	0.087	1.921	0.162
Pass Station vs. Pass Home	5.031	0.024 ^b	1.480	0.222
Pass Station vs. Fail Home	ID	—	ID	—
Pass Station vs. Refuse Home	0.106	0.744	0.287	0.599
Pass Station vs. Manual	0.00004	0.991	0.117	0.733
Fail Station vs. Pass Home	ID	—	2.897	0.085
Fail Station vs. Fail Home	ID	—	ID	—
Fail Station vs. Refuse Home	ID	—	2.107	0.143
Fail Station vs. Manual	ID	—	2.092	0.144
Refuse Station vs. Pass Home	0.619	0.562	0.064	0.769
Refuse Station vs. Fail Home	ID	—	ID	—
Refuse Station vs. Refuse Home	0.265	0.613	0.044	0.828
Refuse Station vs. Manual	0.120	0.730	0.012	0.910
Manual vs. Pass Home	5.663	0.017 ^b	0.832	0.635
Manual vs. Fail Home	ID	—	ID	—
Manual vs. Refuse Home	0.128	0.722	0.157	0.695
In-Station Group Comparisons				
Pass vs. Fail	ID	—	1.743	0.184
Pass vs. Refuse	0.142	0.708	0.112	0.738
Fail vs. Refuse	ID	—	1.998	0.154
At-Home Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	1.159	0.282	0.004	0.949
Fail vs. Refuse	ID	—	ID	—

APPENDIX M

Data for Accidents

Comparison Performed	6-Month Data		12-Month Data	
	Chi-Square	Probability	Chi-Square	Probability
Between Group Comparisons				
Control vs. Pass Station	0.74	0.61	0.948	0.668
Control vs. Fail Station	2.07	0.15	0.262	0.615
Control vs. Refuse Station	1.17	0.28	1.986	0.155
Control vs. Pass Home	0.17	0.68	3.079	0.076
Control vs. Fail Home	0.22	0.64	1.275	0.258
Control vs. Refuse Home	2.40	0.12	5.108	0.023 ^b
Control vs. Manual	0.12	0.74	1.499	0.219
Pass Station vs. Pass Home	0.21	0.65	0.409	0.530
Pass Station vs. Fail Home	0.07	0.79	0.795	0.624
Pass Station vs. Refuse Home	3.56	0.056	6.992	0.008 ^b
Pass Station vs. Manual	0.30	0.59	0.013	0.905
Fail Station vs. Pass Home	2.54	0.11	1.316	0.250
Fail Station vs. Fail Home	1.34	0.25	1.584	0.206
Fail Station vs. Refuse Home	0.004	0.95	1.097	0.295
Fail Station vs. Manual	2.46	0.11	0.891	0.652
Refuse Station vs. Pass Home	0.72	0.60	0.172	0.681
Refuse Station vs. Fail Home	0.0001	0.99	0.250	0.623
Refuse Station vs. Refuse Home	3.98	0.04 ^b	7.923	0.005 ^b
Refuse Station vs. Manual	0.81	0.63	0.549	0.534
Manual vs. Pass Home	0.007	0.93	0.294	0.595
Manual vs. Fail Home	0.16	0.70	0.743	0.607
Manual vs. Refuse Home	2.82	0.09	7.563	0.006 ^b
In-Station Group Comparisons				
Pass vs. Fail	3.15	0.07	0.769	0.615
Pass vs. Refuse	0.32	0.58	0.644	0.572
Fail vs. Refuse	3.61	0.054	1.591	0.205
At-Home Group Comparisons				
Pass vs. Fail	0.14	0.71	0.536	0.529
Pass vs. Refuse	2.91	0.09	8.786	0.003 ^b
Fail vs. Refuse	1.46	0.23	4.560	0.031 ^b

^aInsufficient data for computing chi-square.

^bStatistically significant beyond the 0.05 level.

Comparison Performed	18-Month Data		24-Month Data	
	Chi-Square	Probability	Chi-Square	Probability
Between Group Comparisons				
Control vs. Pass Station	0.117	0.733	0.291	0.597
Control vs. Fail Station	1.830	0.173	0.367	0.552
Control vs. Refuse Station	0.417	0.526	0.292	0.596
Control vs. Pass Home	0.517	0.521	0.121	0.728
Control vs. Fail Home	0.002	0.964	0.683	0.586
Control vs. Refuse Home	1.706	0.189	0.568	0.542
Control vs. Manual	0.184	0.672	0.013	0.905
Pass Station vs. Pass Home	0.091	0.760	0.033	0.850
Pass Station vs. Fail Home	0.003	0.959	0.469	0.501
Pass Station vs. Refuse Home	2.047	0.149	0.908	0.657
Pass Station vs. Manual	0.0005	0.980	0.171	0.682
Fail Station vs. Pass Home	2.620	0.102	0.536	0.529
Fail Station vs. Fail Home	0.415	0.527	1.095	0.296
Fail Station vs. Refuse Home	0.003	0.958	0.0001	0.987
Fail Station vs. Manual	2.290	0.126	0.425	0.522
Refuse Station vs. Pass Home	0.050	0.819	0.107	0.743
Refuse Station vs. Fail Home	0.053	0.813	0.299	0.592
Refuse Station vs. Refuse Home	2.321	0.124	0.949	0.668
Refuse Station vs. Manual	0.159	0.693	0.217	0.647
Manual vs. Pass Home	0.078	0.777	0.047	0.823
Manual vs. Fail Home	0.004	0.947	0.633	0.568
Manual vs. Refuse Home	2.155	0.138	0.640	0.570
In-Station Group Comparisons				
Pass vs. Fail	2.178	0.136	0.646	0.573
Pass vs. Refuse	0.171	0.682	0.039	0.838
Fail vs. Refuse	2.447	0.114	0.708	0.595
At-Home Group Comparisons				
Pass vs. Fail	0.019	0.884	0.546	0.533
Pass vs. Refuse	2.478	0.112	0.777	0.618
Fail vs. Refuse	0.376	0.547	1.273	0.258

APPENDIX N

Data for Two or More Accidents

Comparison Performed	6-Month Data		12-Month Data	
	Chi-Square	Probability	Chi-Square	Probability
Between Group Comparisons				
Control vs. Pass Station	3.90	0.046 ^b	1.457	0.225
Control vs. Fail Station	ID ^a	—	ID	—
Control vs. Refuse Station	ID	—	ID	—
Control vs. Pass Home	1.33	0.25	1.074	0.301
Control vs. Fail Home	ID	—	ID	—
Control vs. Refuse Home	ID	—	ID	—
Control vs. Manual	0.21	0.65	0.849	0.640
Pass Station vs. Pass Home	0.86	0.64	0.014	0.903
Pass Station vs. Fail Home	ID	—	ID	—
Pass Station vs. Refuse Home	ID	—	ID	—
Pass Station vs. Manual	2.54	0.11	0.074	0.782
Fail Station vs. Pass Home	ID	—	ID	—
Fail Station vs. Fail Home	ID	—	ID	—
Fail Station vs. Refuse Home	ID	—	ID	—
Fail Station vs. Manual	ID	—	ID	—
Refuse Station vs. Pass Home	ID	—	ID	—
Refuse Station vs. Fail Home	ID	—	ID	—
Refuse Station vs. Refuse Home	ID	—	ID	—
Refuse Station vs. Manual	ID	—	ID	—
Manual vs. Pass Home	0.52	0.52	0.002	0.966
Manual vs. Fail Home	ID	—	ID	—
Manual vs. Refuse Home	ID	—	ID	—
In-Station Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	ID	—	ID	—
Fail vs. Refuse	ID	—	ID	—
At-Home Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	ID	—	ID	—
Fail vs. Refuse	ID	—	ID	—

^aInsufficient data for computing chi-square.

^bStatistically significant beyond the 0.05 level.

Comparison Performed	18-Month Data		24-Month Data	
	Chi-Square	Probability	Chi-Square	Probability
Between Group Comparisons				
Control vs. Pass Station	0.104	0.746	0.112	0.737
Control vs. Fail Station	1.532	0.213	0.977	0.676
Control vs. Refuse Station	0.331	0.572	0.172	0.682
Control vs. Pass Home	1.433	0.229	0.018	0.888
Control vs. Fail Home	ID	—	0.249	0.624
Control vs. Refuse Home	0.017	0.890	0.028	0.861
Control vs. Manual	0.0004	0.982	0.279	0.604
Pass Station vs. Pass Home	2.252	0.130	0.019	0.887
Pass Station vs. Fail Home	ID	—	0.143	0.707
Pass Station vs. Refuse Home	0.036	0.844	0.006	0.935
Pass Station vs. Manual	0.054	0.811	0.005	0.940
Fail Station vs. Pass Home	3.225	0.069	0.816	0.630
Fail Station vs. Fail Home	ID	—	0.042	0.832
Fail Station vs. Refuse Home	0.350	0.562	0.275	0.607
Fail Station vs. Manual	1.436	0.229	0.587	0.550
Refuse Station vs. Pass Home	0.022	0.878	0.269	0.611
Refuse Station vs. Fail Home	ID	—	0.449	0.510
Refuse Station vs. Refuse Home	0.050	0.818	0.009	0.924
Refuse Station vs. Manual	0.392	0.539	0.529	0.526
Manual vs. Pass Home	1.664	0.194	0.094	0.757
Manual vs. Fail Home	ID	—	0.118	0.731
Manual vs. Refuse Home	0.027	0.865	0.0006	0.979
In-Station Group Comparisons				
Pass vs. Fail	1.084	0.298	0.654	0.575
Pass vs. Refuse	0.607	0.558	0.392	0.539
Fail vs. Refuse	2.078	0.146	1.263	0.260
At-Home Group Comparisons				
Pass vs. Fail	ID	—	0.195	0.663
Pass vs. Refuse	0.096	0.755	0.024	0.872
Fail vs. Refuse	ID	—	0.075	0.781

APPENDIX O

Data for Accidents With Conviction

Comparison Performed	6-Month Data		12-Month Data	
	Chi-Square	Probability	Chi-Square	Probability
Between Group Comparisons				
Control vs. Pass Station	0.11	0.74	0.855	0.642
Control vs. Fail Station	3.12	0.07	0.722	0.600
Control vs. Refuse Station	1.61	0.20	1.215	0.270
Control vs. Pass Home	0.66	0.58	0.377	0.547
Control vs. Fail Home	ID ^a	—	ID	—
Control vs. Refuse Home	2.93	0.08	0.615	0.561
Control vs. Manual	0.32	0.85	1.196	0.274
Pass Station vs. Pass Home	0.19	0.67	0.070	0.787
Pass Station vs. Fail Home	ID	—	ID	—
Pass Station vs. Refuse Home	3.40	0.06	1.414	0.233
Pass Station vs. Manual	0.03	0.87	0.0002	0.985
Fail Station vs. Pass Home	4.71	0.03 ^b	1.244	0.264
Fail Station vs. Fail Home	ID	—	ID	—
Fail Station vs. Refuse Home	0.002	0.97	0.035	0.845
Fail Station vs. Manual	3.43	0.06	1.707	0.188
Refuse Station vs. Pass Home	0.76	0.61	0.538	0.530
Refuse Station vs. Fail Home	ID	—	ID	—
Refuse Station vs. Refuse Home	5.39	0.02 ^b	1.946	0.160
Refuse Station vs. Manual	1.41	0.23	0.253	0.621
Manual vs. Pass Home	0.41	0.53	0.135	0.714
Manual vs. Fail Home	ID	—	ID	—
Manual vs. Refuse Home	3.23	0.07	1.540	0.212
In-Station Group Comparisons				
Pass vs. Fail	3.61	0.054	1.573	0.207
Pass vs. Refuse	1.18	0.28	0.271	0.609
Fail vs. Refuse	5.61	0.02 ^b	2.104	0.143
At-Home Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	4.46	0.03 ^b	1.103	0.294
Fail vs. Refuse	ID	—	ID	—

^aInsufficient data for computing chi-square.

^bStatistically significant beyond the 0.05 level.

Comparison Performed	18-Month Data		24-Month Data	
	Chi-Square	Probability	Chi-Square	Probability
Between Group Comparisons				
Control vs. Pass Station	0.00007	0.989	0.001	0.972
Control vs. Fail Station	0.029	0.859	0.00004	0.991
Control vs. Refuse Station	0.997	0.681	1.537	0.213
Control vs. Pass Home	1.273	0.258	0.551	0.535
Control vs. Fail Home	0.817	0.630	0.447	0.511
Control vs. Refuse Home	0.010	0.916	0.008	0.927
Control vs. Manual	0.428	0.520	0.175	0.680
Pass Station vs. Pass Home	0.972	0.675	0.434	0.517
Pass Station vs. Fail Home	0.829	0.634	0.446	0.512
Pass Station vs. Refuse Home	0.014	0.903	0.006	0.937
Pass Station vs. Manual	0.291	0.596	0.126	0.723
Fail Station vs. Pass Home	0.353	0.560	0.003	0.959
Fail Station vs. Fail Home	0.165	0.688	0.297	0.593
Fail Station vs. Refuse Home	0.030	0.856	0.025	0.870
Fail Station vs. Manual	0.172	0.682	0.022	0.876
Refuse Station vs. Pass Home	0.120	0.730	0.650	0.574
Refuse Station vs. Fail Home	1.809	0.175	1.513	0.216
Refuse Station vs. Refuse Home	0.471	0.500	0.128	0.722
Refuse Station vs. Manual	0.394	0.538	0.997	0.681
Manual vs. Pass Home	0.192	0.665	0.083	0.771
Manual vs. Fail Home	1.232	0.266	0.632	0.567
Manual vs. Refuse Home	0.120	0.730	0.005	0.944
In-Station Group Comparisons				
Pass vs. Fail	0.034	0.848	0.00001	0.993
Pass vs. Refuse	0.886	0.651	1.431	0.230
Fail vs. Refuse	0.557	0.538	0.181	0.674
At-Home Group Comparisons				
Pass vs. Fail	1.590	0.205	0.790	0.622
Pass vs. Refuse	0.276	0.606	0.016	0.894
Fail vs. Refuse	0.205	0.656	0.357	0.557

APPENDIX P

Data for Advisory Letters

Comparison Performed	6-Month Data		12-Month Data	
	Chi-Square	Probability	Chi-Square	Probability
Between Group Comparisons				
Control vs. Pass Station	0.04	0.84	1.213	0.270
Control vs. Fail Station	ID ^a	—	0.727	0.601
Control vs. Refuse Station	0.17	0.68	0.012	0.910
Control vs. Pass Home	1.78	0.18	0.032	0.851
Control vs. Fail Home	ID	—	ID	—
Control vs. Refuse Home	ID	—	0.0008	0.976
Control vs. Manual	0.04	0.84	0.002	0.967
Pass Station vs. Pass Home	1.98	0.16	1.698	0.190
Pass Station vs. Fail Home	ID	—	ID	—
Pass Station vs. Refuse Home	ID	—	0.167	0.686
Pass Station vs. Manual	0.0002	0.99	0.995	0.681
Fail Station vs. Pass Home	ID	—	0.560	0.540
Fail Station vs. Fail Home	ID	—	ID	—
Fail Station vs. Refuse Home	ID	—	0.097	0.754
Fail Station vs. Manual	ID	—	0.802	0.626
Refuse Station vs. Pass Home	0.12	0.73	0.061	0.801
Refuse Station vs. Fail Home	ID	—	ID	—
Refuse Station vs. Refuse Home	ID	—	0.003	0.955
Refuse Station vs. Manual	0.28	0.60	0.002	0.962
Manual vs. Pass Home	2.33	0.12	0.084	0.770
Manual vs. Fail Home	ID	—	ID	—
Manual vs. Refuse Home	ID	—	0.00008	0.989
In-Station Group Comparisons				
Pass vs. Fail	ID	—	1.807	0.176
Pass vs. Refuse	0.28	0.61	0.104	0.746
Fail vs. Refuse	ID	—	0.681	0.585
At-Home Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	ID	—	0.013	0.904
Fail vs. Refuse	ID	—	ID	—

^aInsufficient data for computing chi-square.

^bStatistically significant beyond the 0.05 level.

Comparison Performed	18-Month Data		24-Month Data	
	Chi-Square	Probability	Chi-Square	Probability
Between Group Comparisons				
Control vs. Pass Station	0.183	0.673	0.315	0.582
Control vs. Fail Station	0.017	0.892	0.178	0.677
Control vs. Refuse Station	0.330	0.573	0.374	0.548
Control vs. Pass Home	0.899	0.655	0.980	0.677
Control vs. Fail Home	ID ^a	—	ID	—
Control vs. Refuse Home	0.002	0.963	0.157	0.694
Control vs. Manual	0.567	0.542	1.131	0.288
Pass Station vs. Pass Home	1.791	0.178	2.255	0.129
Pass Station vs. Fail Home	ID	—	ID	—
Pass Station vs. Refuse Home	0.049	0.820	0.393	0.538
Pass Station vs. Manual	0.035	0.846	0.119	0.730
Fail Station vs. Pass Home	0.043	0.830	0.552	0.536
Fail Station vs. Fail Home	ID	—	ID	—
Fail Station vs. Refuse Home	0.002	0.961	0.371	0.550
Fail Station vs. Manual	0.0009	0.975	0.004	0.945
Refuse Station vs. Pass Home	1.216	0.270	1.346	0.245
Refuse Station vs. Fail Home	ID	—	ID	—
Refuse Station vs. Refuse Home	0.145	0.706	0.517	0.521
Refuse Station vs. Manual	0.018	0.887	0.00093	0.992
Manual vs. Pass Home	3.012	0.079	4.303	0.036 ^b
Manual vs. Fail Home	ID	—	ID	—
Manual vs. Refuse Home	0.104	0.746	0.641	0.571
In-Station Group Comparisons				
Pass vs. Fail	0.004	0.948	0.042	0.833
Pass vs. Refuse	0.075	0.781	0.056	0.809
Fail vs. Refuse	0.014	0.901	0.001	0.969
At-Home Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	0.002	0.962	0.0008	0.976
Fail vs. Refuse	ID	—	ID	—

APPENDIX Q

Data for Group Interviews

Comparison Performed	6-Month Data		12-Month Data	
	Chi-Square	Probability	Chi-Square	Probability
Between Group Comparisons				
Control vs. Pass Station	0.45	0.51	0.853	0.641
Control vs. Fail Station	ID ^a	—	ID	—
Control vs. Refuse Station	0.03	0.85	1.351	0.244
Control vs. Pass Home	0.25	0.63	0.264	0.614
Control vs. Fail Home	ID	—	ID	—
Control vs. Refuse Home	2.38	0.12	0.152	0.699
Control vs. Manual	0.61	0.56	1.312	0.251
Pass Station vs. Pass Home	0.04	0.84	0.118	0.731
Pass Station vs. Fail Home	ID	—	ID	—
Pass Station vs. Refuse Home	3.47	0.06	0.620	0.563
Pass Station vs. Manual	0.002	0.96	0.0002	0.985
Fail Station vs. Pass Home	ID	—	ID	—
Fail Station vs. Fail Home	ID	—	ID	—
Fail Station vs. Refuse Home	ID	—	ID	—
Fail Station vs. Manual	ID	—	ID	—
Refuse Station vs. Pass Home	0.01	0.92	0.718	0.598
Refuse Station vs. Fail Home	ID	—	ID	—
Refuse Station vs. Refuse Home	1.92	0.16	1.207	0.271
Refuse Station vs. Manual	0.06	0.80	0.295	0.594
Manual vs. Pass Home	0.07	0.79	0.255	0.620
Manual vs. Fail Home	ID	—	ID	—
Manual vs. Refuse Home	3.72	0.051	0.726	0.601
In-Station Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	0.05	0.83	0.341	0.567
Fail vs. Refuse	ID	—	ID	—
At-Home Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	3.17	0.07	0.374	0.549
Fail vs. Refuse	ID	—	ID	—

^aInsufficient data for computing chi-square.

^bStatistically significant beyond the 0.05 level.

Comparison Performed	18-Month Data		24-Month Data	
	Chi-Square	Probability	Chi-Square	Probability
Between Group Comparisons				
Control vs. Pass Station	1.096	0.295	2.841	0.088
Control vs. Fail Station	ID ^a	—	ID	—
Control vs. Refuse Station	0.911	0.658	1.30	0.253
Control vs. Pass Home	0.348	0.563	0.453	0.508
Control vs. Fail Home	ID	—	0.559	0.538
Control vs. Refuse Home	0.127	0.722	0.70	0.592
Control vs. Manual	0.632	0.567	0.696	0.591
Pass Station vs. Pass Home	0.167	0.686	0.935	0.665
Pass Station vs. Fail Home	ID	—	1.707	0.188
Pass Station vs. Refuse Home	0.627	0.565	2.483	0.111
Pass Station vs. Manual	0.066	0.794	0.760	0.612
Fail Station vs. Pass Home	ID	—	ID	—
Fail Station vs. Fail Home	ID	—	ID	—
Fail Station vs. Refuse Home	ID	—	ID	—
Fail Station vs. Manual	ID	—	ID	—
Refuse Station vs. Pass Home	0.353	0.560	0.551	0.535
Refuse Station vs. Fail Home	ID	—	1.638	0.198
Refuse Station vs. Refuse Home	0.825	0.633	2.122	0.142
Refuse Station vs. Manual	0.256	0.619	0.462	0.504
Manual vs. Pass Home	0.011	0.915	0.004	0.947
Manual vs. Fail Home	ID	—	1.010	0.316
Manual vs. Refuse Home	0.449	0.510	1.398	0.235
In-Station Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	0.038	0.764	0.014	0.902
Fail vs. Refuse	ID	—	ID	—
At-Home Group Comparisons				
Pass vs. Fail	ID	—	0.924	0.662
Pass vs. Refuse	0.358	0.557	1.259	0.261
Fail vs. Refuse	ID	—	0.005	0.945

APPENDIX R

Data for Personal Interviews

Comparison Performed	6-Month Data		12-Month Data	
	Chi-Square	Probability	Chi-Square	Probability
Between Group Comparisons				
Control vs. Pass Station	ID ^a	—	3.466	0.060
Control vs. Fail Station	ID	—	ID	—
Control vs. Refuse Station	ID	—	ID	—
Control vs. Pass Home	ID	—	0.051	0.816
Control vs. Fail Home	ID	—	ID	—
Control vs. Refuse Home	ID	—	ID	—
Control vs. Manual	ID	—	0.577	0.546
Pass Station vs. Pass Home	ID	—	1.776	0.180
Pass Station vs. Fail Home	ID	—	ID	—
Pass Station vs. Refuse Home	ID	—	ID	—
Pass Station vs. Manual	ID	—	0.890	0.652
Fail Station vs. Pass Home	ID	—	ID	—
Fail Station vs. Fail Home	ID	—	ID	—
Fail Station vs. Refuse Home	ID	—	ID	—
Fail Station vs. Manual	ID	—	ID	—
Refuse Station vs. Pass Home	ID	—	ID	—
Refuse Station vs. Fail Home	ID	—	ID	—
Refuse Station vs. Refuse Home	ID	—	ID	—
Refuse Station vs. Manual	ID	—	ID	—
Manual vs. Pass Home	ID	—	0.056	0.808
Manual vs. Fail Home	ID	—	ID	—
Manual vs. Refuse Home	ID	—	ID	—
In-Station Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	ID	—	ID	—
Fail vs. Refuse	ID	—	ID	—
At-Home Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	ID	—	ID	—
Fail vs. Refuse	ID	—	ID	—

^aInsufficient data for computing chi-square.

^bStatistically significant beyond the 0.05 level.

Comparison Performed	18-Month Data		24-Month Data	
	Chi-Square	Probability	Chi-Square	Probability
Between Group Comparisons				
Control vs. Pass Station	0.305	0.588	0.038	0.839
Control vs. Fail Station	ID ^a	—	ID	—
Control vs. Refuse Station	ID	—	ID	—
Control vs. Pass Home	0.0001	0.987	0.004	0.951
Control vs. Fail Home	ID	—	ID	—
Control vs. Refuse Home	ID	—	ID	—
Control vs. Manual	0.533	0.528	1.795	0.177
Pass Station vs. Pass Home	0.126	0.723	0.009	0.922
Pass Station vs. Fail Home	ID	—	ID	—
Pass Station vs. Refuse Home	ID	—	ID	—
Pass Station vs. Manual	1.945	0.160	2.534	0.108
Fail Station vs. Pass Home	ID	—	ID	—
Fail Station vs. Fail Home	ID	—	ID	—
Fail Station vs. Refuse Home	ID	—	ID	—
Fail Station vs. Manual	ID	—	ID	—
Refuse Station vs. Pass Home	ID	—	ID	—
Refuse Station vs. Fail Home	ID	—	ID	—
Refuse Station vs. Refuse Home	ID	—	ID	—
Refuse Station vs. Manual	ID	—	ID	—
Manual vs. Pass Home	0.789	0.622	1.939	0.160
Manual vs. Fail Home	ID	—	ID	—
Manual vs. Refuse Home	ID	—	ID	—
In-Station Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	ID	—	ID	—
Fail vs. Refuse	ID	—	ID	—
At-Home Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	ID	—	ID	—
Fail vs. Refuse	ID	—	ID	—

APPENDIX S

Data for Improvement Clinics

Comparison Performed	6-Month Data		12-Month Data	
	Chi-Square	Probability	Chi-Square	Probability
Between Group Comparisons				
Control vs. Pass Station	ID ^a	—	ID	—
Control vs. Fail Station	ID	—	ID	—
Control vs. Refuse Station	ID	—	ID	—
Control vs. Pass Home	ID	—	ID	—
Control vs. Fail Home	ID	—	ID	—
Control vs. Refuse Home	ID	—	ID	—
Control vs. Manual	ID	—	ID	—
Pass Station vs. Pass Home	ID	—	0.804	0.627
Pass Station vs. Fail Home	ID	—	ID	—
Pass Station vs. Refuse Home	ID	—	ID	—
Pass Station vs. Manual	ID	—	0.361	0.556
Fail Station vs. Pass Home	ID	—	ID	—
Fail Station vs. Fail Home	ID	—	ID	—
Fail Station vs. Refuse Home	ID	—	ID	—
Fail Station vs. Manual	ID	—	ID	—
Refuse Station vs. Pass Home	ID	—	ID	—
Refuse Station vs. Fail Home	ID	—	ID	—
Refuse Station vs. Refuse Home	ID	—	ID	—
Refuse Station vs. Manual	ID	—	ID	—
Manual vs. Pass Home	ID	—	0.006	0.934
Manual vs. Fail Home	ID	—	ID	—
Manual vs. Refuse Home	ID	—	ID	—
In-Station Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	ID	—	ID	—
Fail vs. Refuse	ID	—	ID	—
At-Home Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	ID	—	ID	—
Fail vs. Refuse	ID	—	ID	—

^aInsufficient data for computing chi-square.

^bStatistically significant beyond the 0.05 level.

Comparison Performed	18-Month Data		24-Month Data	
	Chi-Square	Probability	Chi-Square	Probability

Between Group Comparisons

Control vs. Pass Station	1.915	0.163	0.158	0.694
Control vs. Fail Station	ID	—	ID	—
Control vs. Refuse Station	ID	—	ID	—
Control vs. Pass Home	0.253	0.621	0.032	0.853
Control vs. Fail Home	ID	—	ID	—
Control vs. Refuse Home	ID	—	ID	—
Control vs. Manual	0.060	0.801	0.813	0.629
Pass Station vs. Pass Home	0.430	0.519	0.492	0.510
Pass Station vs. Fail Home	ID	—	ID	—
Pass Station vs. Refuse Home	ID	—	ID	—
Pass Station vs. Manual	0.890	0.652	1.949	0.159
Fail Station vs. Pass Home	ID	—	ID	—
Fail Station vs. Fail Home	ID	—	ID	—
Fail Station vs. Refuse Home	ID	—	ID	—
Fail Station vs. Manual	ID	—	ID	—
Refuse Station vs. Pass Home	ID	—	ID	—
Refuse Station vs. Fail Home	ID	—	ID	—
Refuse Station vs. Refuse Home	ID	—	ID	—
Refuse Station vs. Manual	ID	—	ID	—
Manual vs. Pass Home	0.002	0.962	0.254	0.620
Manual vs. Fail Home	ID	—	ID	—
Manual vs. Refuse Home	ID	—	ID	—

In-Station Group Comparisons

Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	ID	—	ID	—
Fail vs. Refuse	ID	—	ID	—

At-Home Group Comparisons

Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	ID	—	ID	—
Fail vs. Refuse	ID	—	ID	—

APPENDIX T

Data for Probations

Comparison Performed	6-Month Data		12-Month Data	
	Chi-Square	Probability	Chi-Square	Probability
Between Group Comparisons				
Control vs. Pass Station	ID ^a	—	ID	—
Control vs. Fail Station	ID	—	ID	—
Control vs. Refuse Station	ID	—	ID	—
Control vs. Pass Home	ID	—	ID	—
Control vs. Fail Home	ID	—	ID	—
Control vs. Refuse Home	ID	—	ID	—
Control vs. Manual	ID	—	ID	—
Pass Station vs. Pass Home	ID	—	0.804	0.627
Pass Station vs. Fail Home	ID	—	ID	—
Pass Station vs. Refuse Home	ID	—	ID	—
Pass Station vs. Manual	ID	—	0.361	0.556
Fail Station vs. Pass Home	ID	—	ID	—
Fail Station vs. Fail Home	ID	—	ID	—
Fail Station vs. Refuse Home	ID	—	ID	—
Fail Station vs. Manual	ID	—	ID	—
Refuse Station vs. Pass Home	ID	—	ID	—
Refuse Station vs. Fail Home	ID	—	ID	—
Refuse Station vs. Refuse Home	ID	—	ID	—
Refuse Station vs. Manual	ID	—	ID	—
Manual vs. Pass Home	ID	—	0.006	0.934
Manual vs. Fail Home	ID	—	ID	—
Manual vs. Refuse Home	ID	—	ID	—
In-Station Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	ID	—	ID	—
Fail vs. Refuse	ID	—	ID	—
At-Home Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	ID	—	ID	—
Fail vs. Refuse	ID	—	ID	—

^aInsufficient data for computing chi-square.

^bStatistically significant beyond the 0.05 level.

Comparison Performed	18-Month Data		24-Month Data	
	Chi-Square	Probability	Chi-Square	Probability
Between Group Comparisons				
Control vs. Pass Station	1.387	0.237	0.192	0.666
Control vs. Fail Station	ID	—	ID	—
Control vs. Refuse Station	ID	—	ID	—
Control vs. Pass Home	0.003	0.953	0.023	0.874
Control vs. Fail Home	ID	—	ID	—
Control vs. Refuse Home	ID	—	ID	—
Control vs. Manual	0.045	0.826	1.137	0.286
Pass Station vs. Pass Home	0.758	0.612	0.508	0.517
Pass Station vs. Fail Home	ID	—	ID	—
Pass Station vs. Refuse Home	ID	—	ID	—
Pass Station vs. Manual	1.359	0.242	2.523	0.108
Fail Station vs. Pass Home	ID	—	ID	—
Fail Station vs. Fail Home	ID	—	ID	—
Fail Station vs. Refuse Home	ID	—	ID	—
Fail Station vs. Manual	ID	—	ID	—
Refuse Station vs. Pass Home	ID	—	ID	—
Refuse Station vs. Fail Home	ID	—	ID	—
Refuse Station vs. Refuse Home	ID	—	ID	—
Refuse Station vs. Manual	ID	—	ID	—
Manual vs. Pass Home	0.002	0.962	0.489	0.508
Manual vs. Fail Home	ID	—	ID	—
Manual vs. Refuse Home	ID	—	ID	—
In-Station Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	ID	—	ID	—
Fail vs. Refuse	ID	—	ID	—
At-Home Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	ID	—	ID	—
Fail vs. Refuse	ID	—	ID	—

APPENDIX U

Data for Suspensions

Comparison Performed	6-Month Data		12-Month Data	
	Chi-Square	Probability	Chi-Square	Probability
Between Group Comparisons				
Control vs. Pass Station	1.91	0.16	0.391	0.539
Control vs. Fail Station	ID ^a	—	ID	—
Control vs. Refuse Station	ID	—	ID	—
Control vs. Pass Home	0.55	0.53	0.022	0.876
Control vs. Fail Home	ID	—	ID	—
Control vs. Refuse Home	ID	—	ID	—
Control vs. Manual	0.82	0.63	0.0002	0.985
Pass Station vs. Pass Home	0.42	0.52	0.794	0.623
Pass Station vs. Fail Home	ID	—	ID	—
Pass Station vs. Refuse Home	ID	—	ID	—
Pass Station vs. Manual	0.28	0.60	0.215	0.648
Fail Station vs. Pass Home	ID	—	ID	—
Fail Station vs. Fail Home	ID	—	ID	—
Fail Station vs. Refuse Home	ID	—	ID	—
Fail Station vs. Manual	ID	—	ID	—
Refuse Station vs. Pass Home	ID	—	ID	—
Refuse Station vs. Fail Home	ID	—	ID	—
Refuse Station vs. Refuse Home	ID	—	ID	—
Refuse Station vs. Manual	ID	—	ID	—
Manual vs. Pass Home	0.02	0.88	0.102	0.748
Manual vs. Fail Home	ID	—	ID	—
Manual vs. Refuse Home	ID	—	ID	—
In-Station Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	ID	—	ID	—
Fail vs. Refuse	ID	—	ID	—
At-Home Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	ID	—	ID	—
Fail vs. Refuse	ID	—	ID	—

^aInsufficient data for computing chi-square.

^bStatistically significant beyond the 0.05 level.

Comparison Performed	18-Month Data		24-Month Data	
	Chi-Square	Probability	Chi-Square	Probability
Between Group Comparisons				
Control vs. Pass Station	0.053	0.812	0.129	0.721
Control vs. Fail Station	ID	—	ID	—
Control vs. Refuse Station	0.004	0.949	0.292	0.596
Control vs. Pass Home	0.119	0.730	1.619	0.201
Control vs. Fail Home	ID	—	ID	—
Control vs. Refuse Home	ID	—	ID	—
Control vs. Manual	0.262	0.615	0.098	0.753
Pass Station vs. Pass Home	0.435	0.517	2.675	0.098
Pass Station vs. Fail Home	ID	—	ID	—
Pass Station vs. Refuse Home	ID	—	ID	—
Pass Station vs. Manual	0.680	0.585	0.560	0.539
Fail Station vs. Pass Home	ID	—	ID	—
Fail Station vs. Fail Home	ID	—	ID	—
Fail Station vs. Refuse Home	ID	—	ID	—
Fail Station vs. Manual	ID	—	ID	—
Refuse Station vs. Pass Home	0.042	0.832	2.003	0.153
Refuse Station vs. Fail Home	ID	—	ID	—
Refuse Station vs. Refuse Home	ID	—	ID	—
Refuse Station vs. Manual	0.089	0.764	0.630	0.566
Manual vs. Pass Home	0.0000050	0.993	0.746	0.608
Manual vs. Fail Home	ID	—	ID	—
Manual vs. Refuse Home	ID	—	ID	—
In-Station Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	0.030	0.858	0.052	0.815
Fail vs. Refuse	ID	—	ID	—
At-Home Group Comparisons				
Pass vs. Fail	ID	—	ID	—
Pass vs. Refuse	ID	—	ID	—
Fail vs. Refuse	ID	—	ID	—