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DEPARTMENT OF MOTOR VEHICLES

AB 2499: A TRAFFIC SAFETY EVALUATION OF CALIFORNIA'S TRAFFIC VIOLATOR SCHOOL MASKED CONVICTION PROGRAM

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14. ABSTRACT

The negative traffic safety impact of California's prior traffic violator school (TVS) citation dismissal policy is well documented in past departmental TVS evaluations. Using advanced inferential statistical techniques, the current study evaluated the substantive changes to California's Traffic Violator School program as required by California Assembly Bill 2499 (Chapter 599, Statutes of 2010). The program changes implemented by AB 2499 appear to be associated with a specific deterrent effect as evidenced by a reliable and statistically significant reduction in subsequent traffic crashes and convictions of those receiving a masked TVS conviction as opposed to a countable conviction. Although the results suggest that this relationship exists primarily among TVS drivers with less elevated prior records, the change in status from a TVS citation dismissal to a TVS masked conviction has reduced the negative traffic safety impact of the TVS citation dismissal policy in effect prior to the implementation of AB 2499. Several recommendations are offered to enhance the positive traffic safety impact of the TVS program by further combining its educational elements with the Department's post-license control program by way of the Negligent Operator Treatment System.

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PREFACE

This report provides information on the efficacy of California's Traffic Violator School masked conviction program. The report was prepared by the Research and Development Branch (R&D) of the California Department of Motor Vehicles. The primary purpose of reports produced by R&D is to provide administrators and legislators with useful information for formulating policy and law, informing research in the field of traffic safety, and educating the general public. The findings, opinions, and conclusions presented in this report are those of the authors and not necessarily those of the State of California.

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EXECUTIVE SUMMARY

Background

California Assembly Bill (AB) 2499 (Chapter 599, Statutes of 2010) made a number of substantial changes to the Traffic Violator School (TVS) program in California. Among these were changes to the status of citations dismissed by way of TVS attendance.

Before July 1, 2011, TVS attendance resulted in dismissal of the traffic violation by the court. The first such dismissal within any 18-month period (from violation date to violation date) was "masked" from the public driving record. A second and subsequent TVS dismissal within an 18-month period was visible on the public driving record. However, no TVS dismissal was considered a traffic conviction for purposes of assigning negligent operator points and licensing actions.

Effective July 1, 2011, TVS dismissals were redefined as TVS masked convictions. The first TVS conviction within any 18-month period is masked from the public driving record and not charged a negligent-operator point for the purpose of taking post-licensing control actions (e.g., warning letters, license probation/suspension). However, the second and subsequent TVS conviction within any 18-month period is both "unmasked" and placed on the driving record, and the driver is charged with a negligent- operator point.

The change in the law affecting the status of TVS referrals was based, in part, on several of the Department's past evaluations of the TVS dismissal policy, which was associated with a negative traffic safety impact of increased post-crash propensity for course attendees.

In addition to effecting changes to the adjudication of TVS-related traffic citations, AB 2499 implemented substantive changes to the licensing and regulation of all traffic violator schools in the State of California. Prior to the implementation of AB 2499, the Department licensed TVS programs limited to offering classroom instruction. California courts were authorized to approve other traffic safety programs, completion of which also resulted in the dismissal of a traffic citation. Prior to AB 2499, home study programs, which included internet programs, video-based DVD programs, and paper/ pencil-based correspondence courses were approved and regulated by the courts. Since the passage of AB 2499, the Department now has licensing and regulatory authority over all TVS courses, the modality of instruction, and the curriculum. Such a change has allowed the Department to implement a plan to hold all TVS providers to the same standards, to improve the quality of instruction and, hopefully, improve traffic safety as measured by reduced incidents of traffic crashes and convictions of violators referred to and completing a TVS.

The changes implemented as a result of AB 2499 restructured the TVS program from a pre-conviction diversion program into one of the Department's post license control programs. The reason for such changes is two-fold. The first is due to the masked, zero-point conviction status (versus a court dismissal of the violation) of the first TVS court reported abstract within any 18-month period. The second is due to the TVS court-reported abstract being charged one negligent-operator point (and any related interventions such as advisory letters, license probation/suspension, etc.) if a repeat TVS abstract within 18 months is reported to the Department. Therefore, the restructuring of the TVS program may now contain both general and specific deterrent effects. General deterrence may be present given that the general population of California drivers may be aware that they can only attend TVS once in any 18-month period and receive a TVS referral and conviction masking. Specific deterrence may be present given that drivers completing a TVS and receiving the masked conviction know that they will be charged a point for the next conviction within 18 months (whether or not TVS is an option).

Objectives

If one or both deterrent effects are present within the TVS masked conviction program as implemented by AB 2499, one could reasonably expect a potential decrease in traffic crashes and/or convictions in the period subsequent to TVS completion. This provides a compelling rationale to evaluate the components of AB 2499. Therefore, the present study assessed both the traffic safety impact of the TVS masked conviction policy and the relationship that the modality of TVS instruction has among drivers and their post-TVS driving record.

Methods

Three groups of subjects were selected for the study:

1 Drivers who attended a traffic violator school and had a moving (1-point) traffic conviction masked from the public driving record and, therefore, did not receive a point charged to their driving record. These drivers will be referred to as the TVS masked conviction subjects.

2 Drivers who received a 1-point moving violation charged to their driving record. These drivers will be referred to as the countable conviction subjects.

3 A sample of drivers who completed a TVS course and who are identified by their chosen modality of TVS instruction. These drivers will be referred to as the Traffic Violator School Course Completion Database (TVCC) subjects.

Inferential statistical techniques were used for the analysis of the data provided by subjects in the three groups identified above.

Propensity score matching by way of multiple logistic regression was used to statistically equate/match subjects in 1 and 2 above. Following the matching process, Poisson and negative binomial multiple regression models were constructed to assess the association of TVS with subsequent outcome or criterion measures consisting of total crashes and total citations.

Multiple logistic regression analysis was used to assess the association of subsequent driving incidents (i.e., total crashes + total citations) with the modality of instruction among subjects in group 3 above.

Results and Discussion

With the transformation of the TVS program from a pre-conviction diversion program to a post-conviction license control intervention, the current study reported a positive traffic safety impact associated with the TVS masked conviction program.

The study subjects and statistical techniques described in the previous section were employed to answer the following four study questions:

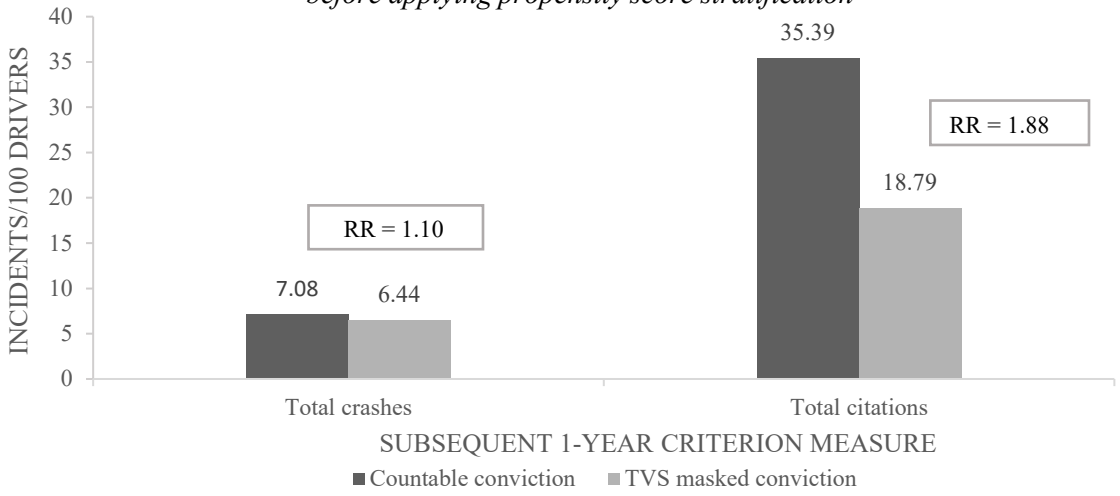
1 What are the characteristics of drivers attending TVS and receiving a masked conviction and how do they differ from those who receive a countable (1-point) traffic conviction?

- Prior to course assignment and completion, TVS drivers have characteristics associated with a lower subsequent crash propensity as compared to drivers receiving a conviction. TVS driver have better driving records and are more likely to be older and female.

2 Are TVS drivers more, less, or equally likely to be involved in subsequent traffic incidents (i.e., crashes and/or convictions) than are drivers receiving a countable (1-point) conviction?

- As would be expected due to their preexisting lower-risk characteristics, TVS attendees have a statistically significant lower rate of subsequent total crashes and total citations compared to drivers who receive a 1-point countable conviction. These relationships are illustrated in the following figure.

Comparison of treatment groups on 1-year total crashes and total citations before applying propensity score stratification



The figure shows the following:

- The 7.08 total crash rate per 100 countable conviction drivers is 1.10 times (7.08/6.44) or 10% higher than the 6.44 total crash rate per 100 TVS masked conviction drivers.

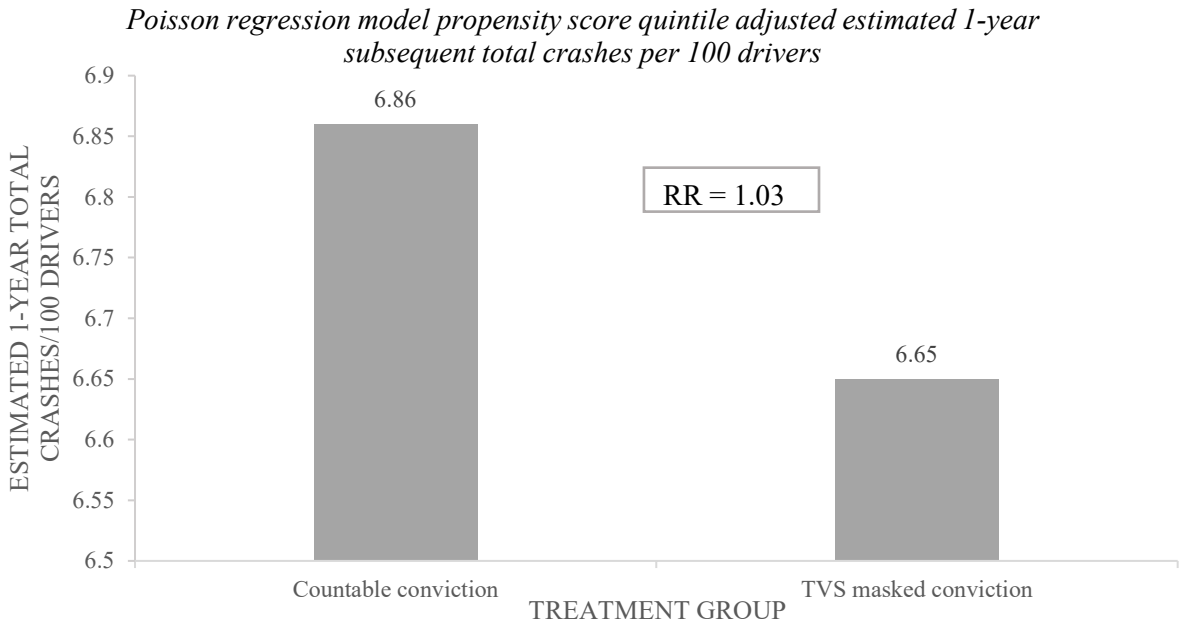
- The 35.39 total citations rate per 100 countable conviction drivers is 1.88 (35.39/18.79) or 88% higher than the 18.79 total citations rate per 100 TVS masked conviction drivers.

3. Is the law allowing violators to receive masked convictions and, thereby, avoid a countable conviction by attending and completing a TVS associated with a decrease or increase in subsequent traffic incidents, after controlling for preexisting differences between drivers receiving a masked TVS conviction and those receiving a countable conviction point?

Adjusted Subsequent Total crash outcome

- Propensity-score stratification adjustment of the observed total crash rates to control for preexisting biases (differences) between the TVS masked conviction group and the countable conviction group decreased the magnitude of the difference between their subsequent crash rates.

- As displayed in the above figure, without the adjustment, the countable conviction group had 1.10 times as many crashes as the TVS masked conviction group. As displayed in the figure below, after the adjustment, the countable conviction group had 1.03 times as many (6.86/6.65) total crashes as did the TVS masked conviction group *p* 05



- The 3% decrease in crash risk attributed to the TVS masked conviction policy results in an estimated 1,185 traffic crashes prevented annually for the approximately 900,000 drivers receiving TVS masked convictions each year. It was estimated that the economic dollars saved associated with the prevented crashes through the use of a comprehensive crash cost model was about $63 million annually.

- Although not statistically significant, there was suggestive evidence that the TVS masked conviction policy was more effective in terms of crash reduction for TVS drivers with less elevated prior driving records and biographical characteristics (e.g., gender and age distributions) predictive of lower subsequent crash expectancies. This pattern was reliably established for the total citation criterion discussed next.

Adjusted Total Citation Outcome

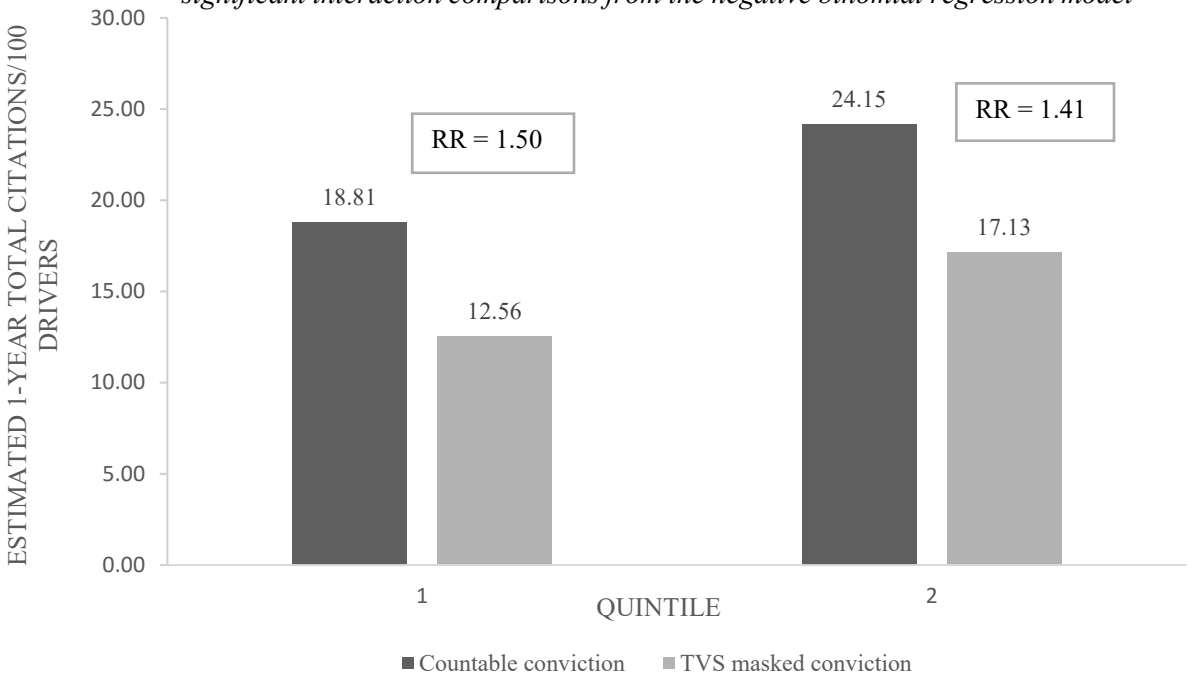
- Propensity-score stratification adjustment of the observed total citation rates to control for preexisting biases between the TVS masked conviction group decreased the magnitude of the difference between their subsequent citation rates.

- Without the adjustment, the TVS group has 46.92% fewer total citations overall than the countable conviction group.

- The appropriate model for the total citations data required a term for the propensity score stratification quintile by treatment group interaction, yielding different risk relativities within the quintiles. The results showed that the TVS masked conviction policy was effective for drivers in quintiles 1 and 2 only. These were drivers with less elevated prior driving record histories and characteristics associated with a lower subsequent risk of citations.

- As illustrated in the figure below, within quintile 1, the countable conviction drivers had 1.50 times as many (18.81/12.56) subsequent total convictions as did the TVS masked conviction subjects. Within quintile 2, the countable conviction drivers had 1.41 times as many (24.15/17.13) total convictions as did the TVS masked conviction subjects. No statistical/reliable differences were present for drivers with elevated prior driving records within quintiles 3, 4, or 5, and, therefore, these results are not displayed.

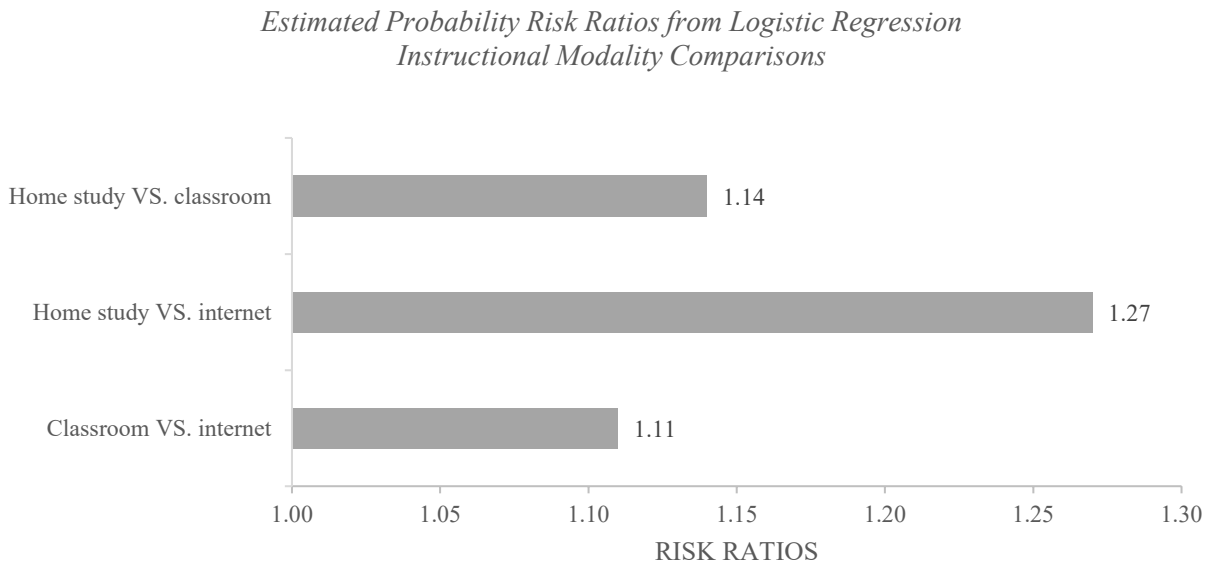
Estimated 1-year subsequent total citations per 100 drivers for statistically significant interaction comparisons from the negative binomial regression model



- A supplementary analysis on the total incidents (crashes + citations) outcome confirmed this moderating relationship between treatment group and the propensity score quintiles.

4. *Is the modality of TVS instruction completed by a referred violator related to subsequent traffic incidents?*

The following figure illustrates the probability risk ratios from the logistic regression instructional modality comparisons.



The above figure shows the significant differences between the three instructional modalities (i.e., classroom, home study, and internet) in their relationship with subsequent total incidents (i.e., total crashes + total citations). The lowest estimated probability of subsequent driving incidents was associated with the internet modality. As discussed in the body of the report, although the differences in the model estimated probability risk ratios were statistically significant, the magnitude of the estimated probabilities from which the ratios were computed were small.

Recommendations

On the basis of the results presented in this report, there exist a number of options that should be considered for potential implementation in order to increase the traffic safety impact (i.e., further reductions in crash expectancies/citation recidivism) of the TVS masked conviction program across the eligible population of TVS attendees. A number of such options are summarized below. Some of these options may require statutory changes, others may require regulatory or procedural changes initiated by DMV. Others may be

implemented using existing departmental resources and authority. All recommendations are subject to resource availability. We have therefore ordered the recommendations, roughly speaking, where those items requiring only existing departmental resources and authority come first (options #1 and #2), followed by those that would likely require additional regulatory (option #3) or statutory authority (the remaining options). These options may not be completely independent of each other, and in some cases could be implemented simultaneously. For hopefully obvious reasons, R&D recommends that for any of these options that involve substantial changes to existing policies and procedures (options #3 through #6), that they be done on a pilot basis and include an evaluation component to determine the traffic safety benefits prior to permanent implementation.

1. Continue to offer the three instructional modalities of TVS instruction to those selecting the TVS option. The results from the current study showed that while there were statistically significant differences between the subsequent driver record incidents between drivers exposed to the current instructional modalities, the differences were small and, therefore, would certainly not justify the adoption of a single mode of instruction. Since there was no control group, the observed differences could have been due to existing differences between violators selecting the mode of instruction even with the use of the covariates employed in the analyses to mitigate between-group differences.

2. California Assembly Bill 1932 (Chapter 561, Statutes of 2016) allowed violators cited while operating a motorcycle to attend a TVS with curriculum specific to the safe operation of a motorcycle. The Department should develop and initiate a data collection procedure specific to motorcycle-related TVSs with the goal of conducting an evaluation of the traffic safety impact of TVSs customized for motorcycle violators.

3. Modify the existing curriculum to amplify the relationship between repeat violations and the increased risk for subsequent crashes. Such a curriculum modification might result in further improvements in the responsiveness of TVS drivers with elevated prior records as evidenced by a decrease in subsequent crash expectancies. Alternatively, customized curriculum could be developed and administered to individuals with repeat violations (e.g., 2 or more convictions in the prior 2 years) prior to attending TVS. Such customized curricula are further elaborated upon in the following recommendations.

4. Allow commercially licensed drivers who commit a violation while operating a commercial vehicle to attend a TVS with curriculum customized for the commercially licensed violator. Under current law, commercially licensed drivers are allowed to attend TVS if the violation occurred during the

operation of a non-commercial vehicle. This recommendation would allow commercial drivers to attend a customized TVS for violations occurring during the operation of commercial vehicles. The Department's current policy is to allow an additional neg-op point for commercial drivers who reach *prima facie* neg-op status following the request and attendance at a neg-op hearing. Such a point waiver (and the resulting waiver of a NOTS probationary/suspension action) is given to commercial drivers who during the hearing produce evidence that their elevated point count is related to the higher mileage associated with driving commercially. Allowing such drivers to attend a customized TVS along with deterrent effect of potential license control actions could logically reduce the future crash expectancy and violation rates of commercially licensed drivers

5. A third recommendation would combine the educational potential of the TVS program with the experimentally proven effect of NOTS interventions in reducing subsequent crash involvement. Specifically, drivers who are eligible for NOTS Level 2 non-alcohol advisory letters (approximately 16,000 per year) would be offered the opportunity to attend TVS (with a revised curriculum designed for the repeat violator and crash involved drivers) and, thereby, avoid the point and letter associated with the Level 2 NOTS intervention. It could logically be hypothesized that Level 2 drivers are an appropriate group for such intervention. Level 2 drivers are those who are one point away from receiving a licensing action (i.e., probation/suspension) and could, therefore, benefit from a combined effect of the educational potential of TVS and the deterrent effect of potential licensing actions by way of NOTS. The National Safety Council's Attitudinal Dynamics of Driving Course could be the model upon which such customized curriculum could be developed for this group of repeat violators (National Safety Council, 2014). This intervention alternative would have the additional benefit of intervening against drivers cited as being found responsible for a crash by the reporting officer.[1] If successful, such an intervention would be hypothesized to exceed the 3% effect size (i.e., crash reduction) reported in the current study for all TVS drivers and the 8% effect size (i.e., crash reduction) reported in Gebers (2009) for the NOTS Level 2 non-alcohol advisory letter.

6. Require those completing TVS to maintain a crash/citation free record for a specified time period (e.g., 6 months, 9 months) following course completion before permanently masking the TVS-related conviction. The AB 2499 change from a TVS dismissal to a TVS masked conviction, and with any subsequent TVS within 18 months receiving a NOTS point, no doubt had a deterrent effect

[1] Under CVC § 12810(g), NOTS points are generated for responsible crashes.

on those completing TVS as evidenced by a reduction in subsequent crashes and citations. This is in stark contrast to the negative traffic safety impact of the TVS dismissal policy reported in prior departmental evaluations. Further modifying the program to require TVS attendees to maintain a clean record for a specified time period subsequent to course completion could increase the deterrent effect of the program by further reducing the crash expectancies beyond the small effect reported in the current study. If successful, such an increased deterrent effect should be observed in TVS drivers with elevated traffic safety indices due to an increased probability of receiving a licensing action (e.g., NOTS probation/suspension) in the event that the TVS masked conviction is "unmasked" and results in a neg-op point. Prior departmental programs that required post-course/training clean records to avoid further licensing interventions showed promising results (Harano & Peck, 1971; Marsh, 1978).

In moving forward, the present authors hope that the results offered in this paper will serve as a motivation to further improve the TVS program rather than being an end to itself with no further program improvements pursued. Further modifications can subsequently be pursued and implemented following appropriate evaluation.

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INTRODUCTION

Background

California Assembly Bill (AB) 2499 (Chapter 599, Statutes of 2010) made a number of substantial changes to the Traffic Violator School (TVS) program in California. Among these were changes to the status of citations dismissed by way of TVS attendance.[2]

Before July 1, 2011, TVS attendance resulted in dismissal of the traffic violation by the court. The first such dismissal within any 18-month period (from violation date to violation date) was "masked" from the public driving record. A second and subsequent TVS dismissal within an 18-month period was visible on the public driving record. However, no TVS dismissal was considered a traffic conviction for purposes of assigning negligent operator points and licensing actions.

Effective July 1, 2011, TVS dismissals were redefined as TVS masked convictions. The first TVS conviction within any 18-month period is masked from the public driving record and not charged a negligent-operator point for the purpose of taking post-licensing control actions (e.g., warning letters, license probation/suspension). However, the second and subsequent TVS conviction within any 18-month period is both "unmasked" and placed on the driving record, and the driver is charged with a negligent- operator point.[3]

The change in the law affecting the status of TVS referrals was based, in part, on several of the Department's past evaluations of the TVS dismissal policy.[4] These studies are summarized below.

In 1979, the Department published a report that evaluated the effectiveness of accredited traffic violator schools in reducing crashes and violations (Peck, Kelsey, Ratz, & Sherman, 1979). Approximately 14,000 violators cited for non-alcohol related traffic offenses were randomly assigned to attend a TVS course (treatment group) or to not attend a TVS course (control group). The results indicated that TVS

[2] AB 2499 also implemented two additional citation-related changes. The first prohibited judges from masking serious or major violations (e.g., driving under the influence, hit-and-run, reckless driving) by way of TVS attendance. The second prohibited the use of TVS masking for commercially licensed (class A and B) drivers if the violations occurred during the operation of a commercial or heavy vehicle.

[3] For a detailed description of California's Negligent Operator Treatment System, the interested reader is referred to Gebers, M. A., & Roberts, R. A. (2004). *Characteristics of negligent operators in California* (Report No. 209). Sacramento: California Department of Motor Vehicles.

[4] While most states use some kind of diversion program for traffic violators, existing evaluations of these programs are of poor quality (usually sponsored and performed by provider organizations and/or without employing a comparison or control group). In addition, the nature of different states' demerit point programs, along with their diversion or post-license control programs, are so widely varying as to make summarization somewhat difficult. Therefore, these non-California programs and evaluation results are not discussed in the present report.

attendance had no statistically significant effect on either subsequent 6-month crashes or subsequent 6-month convictions. The report concluded that although it could not be inferred that all TVS programs are ineffective in reducing crash risk, the results raised strong doubts about the efficacy of most traffic schools in reducing crash and violation risk.

These results were further substantiated by the findings of a subsequent DMV study that evaluated the effects of TVS dismissals on crash risk assessment and license control actions. Gebers, Tashima, and Marsh (1987) found that although only about 4% of the 740,000 violators who completed TVS in 1986 had two or more dismissals in a 1-year period, the data clearly showed that loss of information about the other 96% of drivers who received just one dismissal within a 1-year period reduced the validity of convictions as a predictor of future crash risk. For example, the TVS drivers who had no convictions on the public driver record had nearly 2.5 times as many crashes as a randomly sampled population of drivers with no convictions on the public driver record. It was estimated that approximately 42,000 traffic crash involvements per year in California were not predicted because of TVS dismissals. Although the lack of a "true" control group precluded finding a definitive answer regarding the effectiveness of TVS programs in reducing subsequent crash risk, the analysis indicated that a TVS dismissal was associated with a significantly higher crash risk than was a traffic conviction.

A third DMV study compared groups of drivers who completed a TVS course or who were convicted of a moving violation over a 3-year period (Peck & Gebers, 1991). The TVS group had many biographical and driver characteristics that ordinarily would be predictive of a lower subsequent crash expectancy. Despite this finding, the TVS group had significantly more (by 7.1%) crashes than did the conviction group in the subsequent 1-year period. This difference increased to 10.2% when statistically adjusted for the more favorable preexisting characteristics of the TVS group.

A 1995 departmental study (Gebers, 1995) and a 1996 study by the Automobile Club of Southern California (Bloch, 1996) examined knowledge and attitude changes and any impact upon driving performance among drivers attending a California TVS. Both studies exclusively evaluated California traffic violators exposed to a variety of TVS instructional methods and found that exposure to TVS had only a small effect in improving knowledge level of attendees. Both studies also found that driving attitudes were unchanged at the time of TVS instruction and 6 to 12 months later as well. Knowledge and attitude changes were not significantly related to method of instruction. The two studies concluded that there was no significant relationship between knowledge and subsequent crash involvement or between attitude and driver record entries.

The final departmental study of the TVS citation dismissal policy, funded by the California Office of Traffic Safety (OTS Grant #AL0523), applied methodological refinements to the 1991 DMV evaluation of the TVS dismissal policy (Gebers, 2007). This study found that the TVS group exhibited significantly more (by 10%) crashes than did a similar group of convicted drivers. The TVS group also had a higher adjusted subsequent crash rate at each prior driver record entry level. This pattern reflects a loss in both general and specific deterrence associated with the masked status of TVS dismissed citations.

In addition to effecting changes to the adjudication of TVS-related traffic citations, AB 2499 implemented substantive changes to the licensing and regulation of all traffic violator schools in the state of California. Prior to the implementation of AB 2499, the Department licensed TVS programs limited to offering classroom instruction. California courts were authorized to approve other traffic safety programs, completion of which also resulted in the dismissal of a traffic citation. Prior to AB 2499, home study programs, which included internet programs, video-based DVD programs, and paper/ pencil-based correspondence courses, were approved and regulated by the courts. Since the passage of AB 2499, the Department now has licensing and regulatory authority over all TVS courses, the modality of instruction, and the curriculum.[5] Such a change has allowed the Department to implement a plan to bring all TVS providers to the same standards designed to improve the quality of instruction and, hopefully, will result in a positive traffic safety impact as measured by reduced incidents of traffic crashes and convictions of violators referred to and completing a TVS.

The implementation of AB 2499 has resulted in a notable change in the number of licensed traffic schools and the distribution of the modality of instruction. Table 1 presents the distribution of licensed TVS (i.e., providers/owners) and modality of instruction by fiscal year (California Department of Motor Vehicles, 2015). The reader will note from the values in Table 1 that during the initial fiscal year in which AB 2499 took effect, there were 348 licensed TVS providers/owners in the state. However, by fiscal year 2014/2015, the last year for which data is publically available, there were 856 licensed TVS providers/owners in the state. An examination of the values associated with the modality of instruction shows a dramatic shift since the implementation of AB 2499. That is, during the initial fiscal year (2011/2012) in which AB 2499 took effect, classroom instruction accounted for 86% of the instructional modality, and the internet accounted for 8% of the instructional modality. However, by fiscal year 2014/2015, the classroom instruction accounted for only 20% of the modality, while the internet accounted for 53% of the instructional modality.[6]

[5] The interested reader is referred to Appendix 1 which presents the outline of required topics and standards for Department-approved TVS courses.
[6] A licensed TVS provider/owner may be licensed to offer more than one modality of instruction.

Table 1. Distribution of Licensed TVS and Modality of Instruction by Fiscal Year

	Fiscal Year			
	2011/2012	2012/2013	2013/2014	2014/2015
Licensed TVS	348	537	727	856
Modality of instruction				
Classroom	324 (86%)	292 (42%)	276 (26%)	257 (20%)
Home study	24 (6%)	129 (18%)	240 (23%)	354 (27%)
Internet	29 (8%)	283 (40%)	545 (51%)	704 (53%)

In the pre-AB 2499 evaluations referenced above, the reader will note that a common underlying theme is that whatever educational benefit there is to TVS was not enough to offset the negative traffic safety impact of the citation dismissal policy. That is, the pre-AB 2499 TVS dismissal policy diverted unsafe drivers out of the Negligent Operator Treatment System (NOTS) of licensing interventions. These NOTS interventions have been proven to be effective in numerous evaluations (Gebers, 2009; Gebers, Peck, Janke, & Hagge, 1993; Gebers & Roberts, 2017). Together, these studies demonstrated that the dismissal policy lacked both general and specific deterrence.

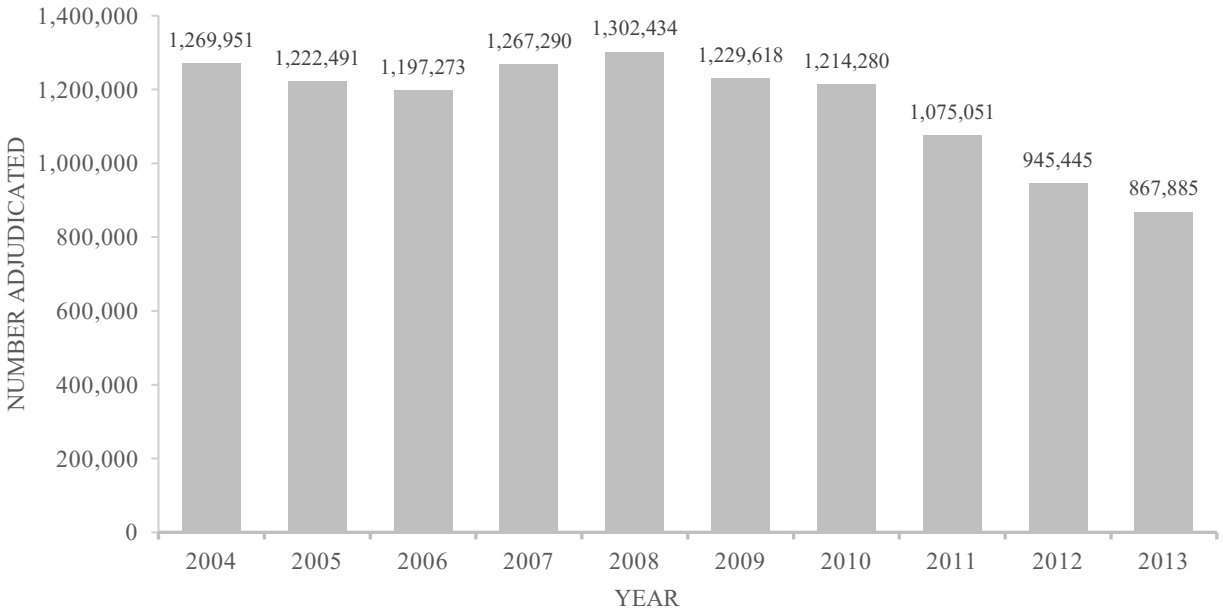
The changes implemented as a result of AB 2499 restructured the TVS program from a pre-conviction diversion program into one of the Department's post-license control programs. The r

is two-fold. The first is due to the masked, zero-point conviction status (versus a court dismissal of the violation) of the first TVS court-reported abstract within any 18-month period. The second is due to the TVS court-reported abstract being charged one negligent-operator point (and any related interventions such as advisory letters, license probation/suspension, etc.) if a repeat TVS abstract within 18 months is reported to the Department. Therefore, the restructuring of the TVS program may now contain both general and specific deterrent effects. General deterrence may be present given that the general population of California drivers may be aware that they can only attend TVS once in any 18-month period and receive a TVS referral and conviction masking. Specific deterrence may be present given that drivers completing a TVS and receiving the masked conviction know that they will be charged a point for the next conviction within 18 months (whether or not TVS is an option).

Initial, descriptive evidence that AB 2499 is resulting in changes to the TVS program is evident in Figure 1 (California Department of Motor Vehicles, 2015). This figure illustrates the number of TVS abstracts adjudicated (i.e., dismissed or masked) between 2004 and 2013. The data clearly show a drop in the volume of TVS activity. For example, during the first year of AB 2499 implementation (July 1,

2011), the total number of TVS adjudications showed an approximately 11% decrease from the previous year's (2010) total (1,075,051 versus 1,214,280, respectively). Figure 1 shows that this decreasing trend continued in 2012 (945,445 adjudications) and 2013 (867,885 adjudications) as well. Unpublished data show a similar monotonically downward trend in TVS masked convictions for 2014 (826,063 TVS masked convictions), 2015 (750,129 TVS masked convictions), and 2016 (658,225 TVS masked convictions). Whether this downward trend in TVS adjudication is accompanied by a positive traffic safety impact of TVS since the implementation of AB 2499 will be the primary focus of the remainder of this paper.

Figure 1. Number of TVS abstracts adjudicated annually, 2004 through 2013



Objectives

If one or both deterrent effects are present within the TVS masked conviction program as implemented by AB 2499, one could reasonably expect a potential decrease in traffic crashes and/or convictions in the period subsequent to TVS completion. This provides a compelling rationale to evaluate the components of AB 2499. Therefore, the present study was designed to assess both the traffic safety impact of the TVS masked conviction policy and the relationship that the modality of TVS instruction has among drivers and their post-TVS driving record.

The current study addresses the following four questions:

1 What are the characteristics of drivers attending TVS and receiving a masked conviction and how do they differ from those who receive a countable (1-point) traffic conviction?

2 Are TVS drivers more, less, or equally likely to be involved in subsequent traffic incidents (i.e., crashes and/or convictions) than are drivers receiving a countable (1-point) conviction?

3 Is the law allowing violators to receive masked convictions and, thereby, avoid a countable conviction by attending and completing a TVS associated with a decrease or increase in subsequent traffic incidents, after controlling for preexisting differences between drivers receiving a masked TVS conviction and those receiving a countable conviction point?

4 Is the modality of TVS instruction completed by a referred violator related to subsequent traffic incidents?

Despite a similarity in the themes of questions 2 and 3, they are fundamentally different in content and meaning. Question 2 refers to the use of TVS as an actuarial indicator of involvement in subsequent traffic incidents, irrespective of cause. There may be various reasons why persons opting for TVS attendance and the conviction masking could be different from persons not opting for TVS attendance. These could include a variety of reasons not directly measurable using data available to the researchers (for instance: pre-existing safety-related attitudes and behavior patterns, driving exposure, socioeconomic differences, etc.). These differences could result in TVS drivers' having lower subsequent incident rates even if TVS and its conviction masking had no causal positive or negative influence on their driving performance (reflecting an obvious self-selection bias).

In contrast, question 3 addresses whether or not any observed difference in subsequent driving behavior between the TVS masked conviction group and the countable conviction group can likely be attributed directly to the educational or motivational effects of traffic violator school attendance and the post-conviction masking. Answering this question with greater certainty requires that any preexisting differences in subsequent crash and/or conviction propensities between the two groups be eliminated or statistically controlled to the extent possible.

The following sections of this report present the methodology, results of the statistical analyses, and a discussion of the implications of the study's findings.

METHODS

This section presents an overview of the methodology used to evaluate the traffic safety impact of the TVS masked conviction program in California and the modality of instruction analysis. Therefore, this section is organized to address the design and analyses associated with the four study questions presented above. Some methodological details are reserved for the Results section because they are more understandable in the context of the findings.

Group Selection Methodology

Three groups of subjects were selected for the study. Only individuals who had a California driver's license number were included. The three groups are:

1 Drivers who attended a traffic violator school and had a moving (1-point) traffic conviction masked from the public driving record and, therefore, did not receive a point charged to their driving record. These drivers will be referred to as the TVS masked conviction subjects.

2 Drivers who received a 1-point moving violation charged to their driving record. These drivers will be referred to as the countable conviction subjects.

3 A sample of drivers who completed a TVS course and who are identified by their chosen modality of TVS instruction. These drivers will be referred to as the Traffic Violator School Course Completion Database (TVCC) subjects.

Masked TVS Conviction and Countable Conviction Subjects

Addressing questions 1 through 3 presented in the Introduction required the identification and selection of an appropriate set of "treatment" (i.e., TVS masked conviction) and "control" or comparison (i.e., countable conviction) subjects. In selecting and assigning drivers to the treatment and control/ comparison conditions, only California countable convictions and TVS masked convictions associated with one-point, safety-related moving violations (e.g., speeding, following too closely, and sign and signal violations) were considered. Two-point "major" California convictions (e.g., DUI, hit-and-run), violations occurring while operating a commercial vehicle, out-of-state convictions, failures-to-appear in court (FTAs), and crashes were bypassed as these traffic safety incidents do not qualify for TVS referral and a masked conviction.

The strategy employed in the present study involved the extraction of a systematic 10% random sample of drivers from the Department's Driver Record Master (DRM) and then involved selecting violators whose first TVS masked conviction or countable conviction occurred between July 11, 2011 and December 31, 2013.[7] To be eligible for the TVS group, the masked TVS conviction must not have been preceded during the same three-year period by a one-point conviction based on the violation date of the traffic offense. To be eligible for the countable conviction group, the one-point conviction must not have been preceded during the same three-year period by a TVS masked conviction based on violation date of the traffic offense. For example, a masked TVS conviction occurring during the subject selection process and which is followed by a countable conviction during the same period would result in the violator being assigned to the TVS masked conviction group.

It is important to note that the strategy for selecting the masked TVS conviction and countable conviction subjects introduces what is essentially a "quasi"-random process related to subject selection and assignment. That is, there is no apparent systematic bias operating in this strategy that would influence whether the first event during the subject selection/assignment period is either a TVS masked conviction or a conviction assigned a point. That is, the two events are independent. Therefore, since this quasi-random process applies to the statewide TVS and traffic conviction system run by California courts, it is permissible to estimate, given a statistically significant treatment effect, the number of incidents (e.g., crashes) attributed to or circumvented by the TVS masked conviction policy. However, since it is not possible to randomly assign individual drivers to a TVS or a conviction condition, it needs to be emphasized that such incidents attributed/circumvented are estimated predictions of such incidents and do not explicitly assume a cause and effect relationship. This topic will be a subject of further elaboration in the subsequent section discussing the analyses associated with study question 3.

If such a subject selection/assignment process is appropriate and successful, it should result in an approximately equal number of masked TVS and countable convicted group subjects. This assumption was based on *a-priori* Bayes simulations assuming (using a 3-year window) that TVS masked convictions represented approximately 20% to 25% of all (0, 1, and 2-point) court reported abstracts and 40% to 50% of all 1-point court reported abstracts. The resulting Bayes confidence interval that the probability of the first incident in the three-year period would be a masked TVS conviction ranged from 42% through 51%.

[7] Driver license numbers are issued randomly to DMV field offices and subsequently issued to drivers. The term 10% systematic random sample refers to the use of the last two terminal digits (TD) being used to identify the potential pool of study subjects. The TDs used to form the subject pool obtained from the DRM were TD 00 through TD 09 (hence a systematic 10% random sample of all drivers). July 11, 2011 was the start date for subject selection/assignment as this was the date on which violations referred to TVS were defined as TVS masked convictions.

Application of the proposed subject selection/assignment strategy was successful in that 243,634 TVS masked conviction subjects were selected and assigned (48% of the total sample size) to the study's treatment condition, and 254,590 (52% of the total sample size) subjects convicted of a one-point citation were selected and assigned to the study's control or comparison condition.

TVCC Subjects

The source of the subjects for addressing question 4 presented in the Introduction is a departmental database whose creation arose out of the implementation of AB 2499. This database is named the Traffic Violator School Course Completion Database or TVCC. The TVCC is maintained by the Department and contains course completion information at the level of the violator. The TVCC data are provided to the Department by TVS course providers. Upon a driver's completion of a TVS, the TVS providers transmit the following information to the Department:

- Driver's name
- Driver's birth date
- Driver License number
- Court of adjudication
- TVS completion date
- TVS owner/provider information
- TVS name
- TVS business license number
- Modality of instruction consisting of three types: (1) classroom; (2) home study (e.g., pen and paper, DVD); and internet.

During the data acquisition phase of this study, it was discovered that for the purposes of obtaining adequate sample sizes and pre/post course driving records, the only subjects (at the individual level) available from the TVCC database would be those completing a course during 2016.[8] Therefore, to address the fourth study question, 135,591 subjects were selected from the TVCC database. These subjects had course completion dates ranging from January 1st, 2016 through June 30th, 2016. The course completion date served as the anchor or reference date for assessing the pre/post course driving record for the analyses discussed below.

[8] Corrective measures have been undertaken to retain a longitudinal (an ongoing 36-month) record of individual subjects completing a TVS. Therefore, larger panel and cohort samples will be available for future evaluations.

Statistical Analyses

This section describes the analyses conducted to answer the four study questions posed in the Introduction section.

Analyses for questions 1, 2, and 3 involved the TVS and masked conviction subjects identified above: (1) TVS subjects whose first citation incident from July 11, 2011 through December 31, 2013 resulted in a TVS masked (non-countable) conviction, and (2) convicted subjects whose first citation incident from July 11, 2011 through December 31, 2013 resulted in a 1-point countable conviction.

Questions 1 and 2 involved comparing the TVS masked conviction subjects and the countable conviction subjects on demographic characteristics, 3-year prior driver record variables, and rate of total traffic crashes and total traffic convictions over a subsequent 1-year period. The results represent the net actuarial differences between the treatment and comparison groups, irrespective of cause and/or the presence of pre-existing inequalities or biases between the two groups.

Addressing question 3 involved a two-step process. The first step employed the use of a propensity score stratification method. The second step employed the use of an appropriate statistical technique to assess the association between a TVS masked conviction versus a countable conviction on subsequent traffic safety indices.

In the first step to address question 3, the propensity score technique was used in an attempt to reduce bias in the comparison of the masked TVS conviction and countable conviction groups. In order to have confidence in the results from a quasi-experimental design (i.e., one using intact groups without the use of random assignment) employing the use of propensity scores to reduce as much preexisting bias as possible, one should have a working knowledge of how it was used to assess the traffic safety impact of the TVS masked conviction policy.

The propensity score method is a matching strategy based on the approach described by Rosenbaum and Rubin (1983). The use of propensity score techniques has gained popularity in quasi-experimental research (Friedman & Thurman, 2012). The interested reader is referred to DeYoung, Tashima, and Masten (2005) for an application of propensity scores in a departmental study evaluating the effectiveness of ignition interlock devices in California.

In the current study evaluating the traffic safety impact of the TVS masked conviction program, propensity scores can be perceived as conditional probabilities. That is, each propensity score represents the probability that a driver was in the TVS masked conviction sample versus the countable conviction

sample. This single probability value was based on the driver's scores on a number of predictor variables or covariates.

In observational studies, like the present study, researchers have little or no control over the treatment assignment. Individuals exposed to alternate treatments (masked TVS versus countable conviction in this study) may have large differences on one or more observed variables (covariates), which can lead to biased treatment effects. Even the use of a traditional general linear model (GLM) statistical adjustment employing many covariates (analysis of covariance, or ANCOVA) is very often inadequate to eliminate this bias.

The use of the propensity score technique tends to reduce bias by creating more balance between two groups on the covariates. Implicit in its use is that there be no measured or unmeasured characteristic that predicts both treatment assignment and outcome independent of the estimated propensity score (i.e., the strongly ignorable assumption discussed by Rosenbaum and Rubin, 1983). The present study used the propensity score stratification technique outlined by D'Agostino (1998).

The first step employed logistic regression analysis (SAS PROC LOGISTIC) to model group membership (TVS masked conviction subjects coded as 1 and convicted subjects coded as 0).[9] The procedure resulted in the computation of the criterion (group membership) logit score for each subject, which served as his/her propensity score. A set of licensing, biographical, and driver record variables (e.g., license class, age, prior traffic crashes, and prior traffic convictions) served as predictors in the propensity score model. Appendix 2 provides a list of the variables assessed for the propensity score model.

As noted by Friedman and Thurman (2012), the use of a propensity score strategy for quasi-experimental designs as exists in the current study is advantageous for several reasons. One reason is that the propensity score is a composite variable as compared to a GLM (e.g., ANCOVA) approach which can require the use of numerous covariates in the outcome equation. Use of many covariates can often result in the loss of power in outcome evaluations.[10] A second reason stated by these authors is that a propensity score technique fits "nicely" into the randomization process. That is, the propensity score is computed prior to the modeling of the outcome equation (as is group assignment in a randomized experiment). Therefore, the propensity score logit can be composed of any number of meaningful

[9] The interested reader is referred to Hosmer and Lemeshow (2000) for a detailed discussion of logistic regression and to Allison (2012) for examples on using SAS for logistic regression modeling.

[10] Power in relation to statistical analyses concerns utilizing a statistical design that has the ability to detect differences between treatment/comparison groups when they actually exist. In traffic safety research, it is not uncommon for a researcher to employ at least 30 covariates when using a traditional GLM approach absent a propensity score technique. The interested reader is referred to Cohen (1988) for a detailed discussion of statistical power in behavioral science research.

covariates (main effects and interactions) without problems such as non-convergence, unequal variance/covariance matrices, and over-parameterization resulting in biased regression parameters and standard errors that can often occur in traditional GLM techniques not using the propensity score.

Following the computation of the propensity score for each TVS masked conviction and countable conviction subject, the second step in answering question 3 involved constructing models (i.e., outcome equations) for estimating the "treatment" effect of the TVS masked conviction policy. In assessing the treatment effect, two outcome measures were evaluated.

The first was the number of total crashes.[11] This outcome measure was the total number of reported crashes on record during the 12 months subsequent to the violation date associated with either the TVS masked conviction or the countable conviction. These crashes were reported by law enforcement agencies and/or drivers involved in the crashes.

The second was the number of total traffic convictions appearing on the driving record during the 12 months subsequent to the violation date associated with either the TVS masked conviction or countable conviction. One citation was counted as only one conviction if there were multiple violations (e.g., a driver is cited for speeding and failing to stop for a red light on one "ticket"). The total conviction outcome measure amounts to a count of citations reported to the Department by California courts.

Addressing study question 3 required an estimate of the subsequent crash and citation rates of the TVS masked conviction group versus that of the countable conviction group. Therefore, the appropriate analytical technique necessitated the use of a count based regression model to assess the statistical significance associated with the outcome measures.[12]

The two count regression models considered were the Poisson and negative binomial distributions.[13] To determine which was appropriate, the relationship between each criterion measure and its variance was assessed by way of the Pearson chi-square value. The decision rule applied in the current study was to utilize a Poisson regression count model for Pearson chi-square values less than 1.30 and a negative binomial count regression model for values greater than or equal to 1.30. For the total crashes criterion,

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[11] As a subsidiary analysis, at-fault crashes was also evaluated (at the request of upper Departmental management). The results of this analysis will be noted in the Results section. At-fault crashes are those police-reported crashes in which a driver is deemed as primarily responsible for the crash or contributed to the cause of the crash.

[12] A test of statistical significance allows one to determine the probability that an observed difference is due to chance alone. If this probability is sufficiently small, it is concluded that the difference is "real". Unless otherwise stated, a difference in the present study was considered to be statistically significant when the probability of a difference that large or larger (in either direction) occurring by chance was less than 1 in 20 ($p<.05$).

[13] The interested reader is referred to Kleinbaum, Kupper, and Muller (1988) for a detailed discussion of Poisson and negative binomial distributions and their respective regression modeling techniques.

the Pearson chi-square value was 1.04. Therefore, a Poisson regression with a standard error adjustment to protect against the possibility of any over dispersion was used to model the total crashes outcome. For the total convictions criterion, a Pearson chi-square value was 1.30. Therefore, negative binomial regression was used to model the total convictions outcome. SAS PROC GENMOD was used for modeling the Poisson based regression equations; SAS PROC COUNTREG was used to model the negative binomial based regression equations. [14]

As introduced above, the propensity scores of all subjects were separated into quintiles (i.e., five strata). As described in detail in the Results section, the use of propensity score quintiles allowed an assessment of the efficacy of TVS for various driver record groups. That is, drivers in quintile 1 represented those with the least deviant prior driving record. Drivers in quintile 5 represented those with the most deviant prior driving record. Therefore, assessing this quintile by treatment group interaction allowed for statistically assessing whether the TVS masked conviction policy produces a larger, smaller, or equal association with the outcome measures across groups of drivers with varying degrees of elevated prior driving record histories and/or biographical and licensing characteristics.

It is important to note that while the propensity score stratification technique used to statistically equate the groups in addressing question 3 is valuable in reducing bias, the technique cannot eliminate all bias. Using a propensity score technique in a quasi-experimental study is by no means considered superior or even equivalent to a research design employing random assignment to treatment and comparison conditions. Because it is impossible to identify and isolate all of the dimensions on which the groups differ in a manner that might affect the study results, a definitive cause and effect statement cannot be made regarding the effect of the TVS masked conviction policy on crashes and/or convictions. This topic will be further elaborated upon when discussing the data qualifications in the concluding section of this report.

The fourth and final study question becomes much more relevant if there is a positive (or even neutral) traffic safety impact associated with the masked TVS conviction policy. However, even on its own, the final study question does address whether the standard TVS curriculum as presented in Appendix 1 is more effective for one modality versus the other as assessed by the association with subsequent driving incidents.

[14] The interested reader is referred to Derby (2011) for a discussion and examples from both PROC GENMOD and PROC COUNTREG in modeling count data models.

The TVCC subjects were used to answer question four. As discussed above, these subjects completed a TVS course offering either classroom instruction, internet instruction, or home study instruction during the period from January 1st, 2016 through June 30th, 2016.

Since TVS referred drivers "select" themselves into the desired TVS instructional modality and since there is no true comparison or control group of subjects who receive no instruction, the analyses associated with study question 4 are purely correlational in nature. Therefore, multiple logistic regression analysis was used to determine if there was a statistically significant difference in the odds of the subsequent total incidents (convictions + crashes) criterion measure between the three instructional modalities.[15] In order to control for (i.e., partial-out) potential pre-existing differences between drivers selecting the different instructional modalities (e.g., "older" violators may select classroom versus internet), several covariates (identified in the Results section) were used in the logistic regression equations modeling traffic incident outcome measure (coded 0 for no subsequent incidents; coded 1 for one or more subsequent incidents).

15 The limitation of available TVCC subjects necessitated combining total crashes and total citations into a composite 6-month criterion measure. This allowed for a timely update of court reported convictions and crashes accumulated by drivers during the subsequent period. As discussed later in the report, little is lost in combining these driver record indices into a composite criterion given both the correlational nature of the analyses and the goal of TVS instruction to reduce both convictions and crashes of course completers.

RESULTS

Question 1 – What are the characteristics of drivers attending TVS and receiving a masked conviction and how do they differ from those who receive a countable (1-point) traffic conviction?

Biographical and 3-year prior driver record data were extracted for the TVS masked conviction and countable conviction groups from the Department's Driver Record Master file. Table 2 displays select biographical and prior driver record differences (per 100 drivers) between the two groups before equating the two groups by applying the propensity score stratification technique.

Table 2. Select Demographic and 3-Year Prior Driver Record Variables (Per 100 Drivers) for the TVS Masked Conviction and Countable Conviction Groups Before Propensity Score Stratification

	Treatment group means/percentages		
Covariates	TVS (N = 243,634)	Conviction (N = 254,590)	% difference
Age	40.95	38.19	7.23
% male	54.45	60.41	-9.87
% S/R action	4.44	14.24	-68.82
Total convictions	40.68	74.71	-45.55
Countable convictions	27.25	45.69	-40.36
Alcohol/drug major convictions	1.18	2.06	-42.72
Total crashes	16.17	16.29	-0.74
Police reported crashes	8.49	10.04	-15.44
Fatal /injury crashes	3.50	4.19	-16.47
TVS dismissals/masked convictions	12.97	13.71	-5.40
Responsible crashes	3.75	5.00	-25.00
Total crashes associated with DUI or reckless convictions	.15	.26	-42.31
Had been drinking crashes	.24	.41	-41.46

Note: With the exception of total crashes, all other differences are statistically significant ($p < .05$).

With the exception of prior total crashes, the masked TVS conviction and countable conviction groups differ significantly on the factors. For example, an examination of the values in Table 2 communicates the following:

- The TVS masked conviction drivers were, on average, slightly older than the countable conviction drivers (40.95 versus 38.19 years, respectively).

- The TVS masked conviction group had a lower percentage of males than did the countable conviction group (54.45% versus 60.41%, respectively).

- The TVS masked conviction drivers had, on average, directionally fewer driver record entries in the prior 3-year period as compared to the countable conviction drivers. An inspection of the values in Table 2 yields the following:

    - The TVS masked conviction drivers had 40.68 total citations per 100 drivers while the countable conviction drivers had 74.71 total citations per 100 drivers.

    - The TVS masked conviction drivers had 1.18 alcohol/drug major citations per 100 drivers while the countable conviction drivers had 2.06 alcohol/drug major citations per 100 drivers.

    - The TVS masked conviction drivers had 16.17 total crashes per 100 drivers while the countable conviction drivers had 16.29 total crashes per 100 drivers.

    - The TVS masked conviction drivers had 3.50 fatal/injury crashes per 100 drivers while the countable conviction drivers had 4.19 fatal/injury crashes per 100 drivers.

    - Among TVS masked conviction drivers, 4.44% served at least 1 day of a license suspension/revocation action during the prior 3 years. Among countable conviction drivers, 14.24% served at least 1 day of a license suspension/revocation action during the prior 3 years.

All of the prior driver record differences imply a lower pre-existing crash/citation risk for the TVS masked conviction drivers. However, it should be noted that although all (with the exception of total crashes) of the differences between the two groups were statistically significant, this does not imply that all were large or of any practical or substantive importance. For example, the simple difference in age (2.76 years) is, in all likelihood, too small to introduce meaningful bias on subsequent crash and/or citation rates.

Question 2 – Are TVS drivers more, less, or equally likely to be involved in subsequent traffic incidents (i.e., crashes and/or convictions) than are drivers receiving a countable (1-point) conviction?

Table 3 displays the 1-year subsequent total crash and total citation rates for the TVS masked conviction and countable conviction drivers. In this actuarial comparison, the mean crash and citation rates are not statistically adjusted (i.e., by propensity score stratification) for any pre-existing between group differences on any potentially biasing variables.

Table 3. Comparison of Treatment Groups on 1-Year Subsequent Total Crash and Total Citation Rates before Applying Propensity Score Stratification

Group and performance index	Total crashes per 100 drivers	Total citations per 100 drivers
A. Countable conviction	7.08	35.39
B. TVS masked conviction	6.44	18.79
C. Net difference (A-B)	0.64	16.60
D. Rate ratio (A/B)	1.10	1.88
E. Level of statistical significance	<.0001	<.0001

The values in Table 3 show that the TVS masked conviction group had a significantly lower ($p < .0001$) 1-year subsequent total crash rate. The direction of the results indicates that the TVS masked conviction group represents a lower actuarial total crash risk than does the conviction group.[16] The 7.08 total crash rate per 100 countable conviction drivers is approximately 1.10 times (7.08/6.44) or 10% higher than the 6.44 total crash rate per 100 TVS masked conviction drivers.[17]

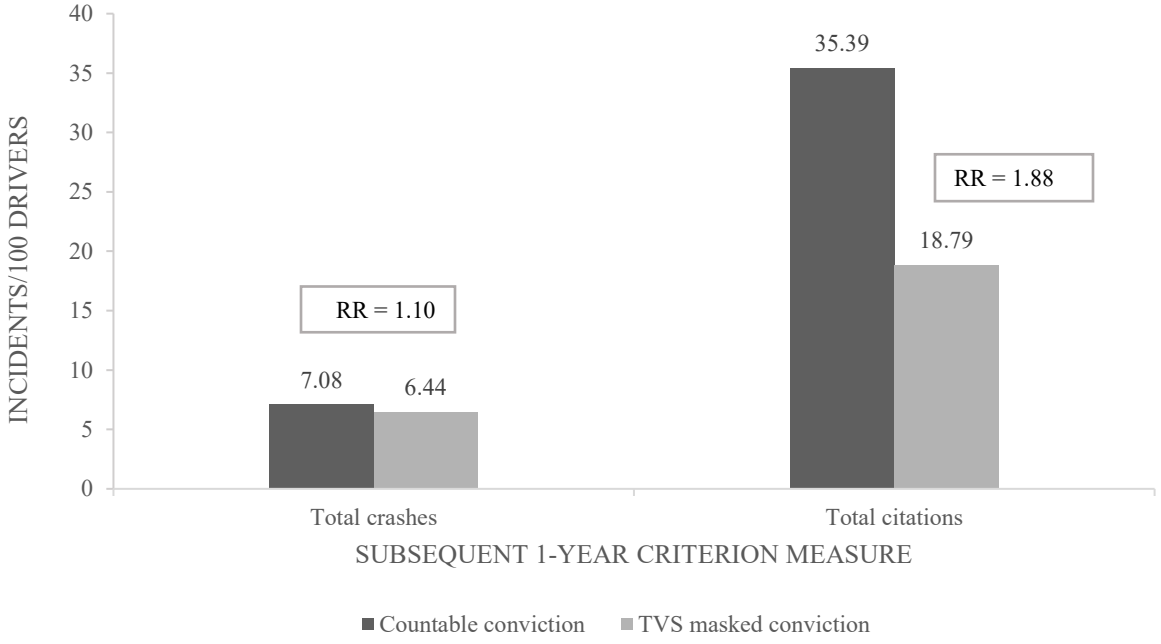
[16] To explore the possibility of a crash-reporting bias affecting the results, the number of fatal/injury crashes was calculated for each group. The number of casualty crashes forms a relatively "clean" measure because these crashes are usually much less subject to non-reporting than are property-damage-only crashes. If a reporting bias were present, one would expect these more serious crashes during the subsequent time period to be statistically significant discriminators of drivers in the two comparison groups. However, a Bayesian logistic regression analysis confirmed that the two groups did not differ on this measure. That is, the results showed that the ability of fatal/injury crashes to discriminate between drivers in the two groups was no better than chance (approximately 51%). The interested reader is referred to Patetta (2016) for a discussion of Bayesian statistical analyses.

[17] During the planning stages of this study, Departmental management expressed interest in examining at-fault crashes as a possible criterion measure. Subsequent analyses showed that the at-fault crash criterion was a heavily attenuated (accounting for approximately 30% of the total crashes for each group) and unreliable measure. The mean responsible crashes was 2.11 and 2.12 for the TVS and conviction groups, respectively. This difference was not statistically significant. If these data would have been used as the primary outcome measure for assessing a possible effect of the program on crashes, the results would have conveyed a type two experimental error, that is reporting no program effect where one existed. Therefore, the present author deemed at-fault crashes as an inferior criterion by which to assess the traffic safety impact of the TVS masked conviction program and conducted no further analyses of this outcome measure apart from its component in reported total crashes.

Table 3 also shows that the TVS masked conviction group had a significantly lower ($p < .0001$) 1-year subsequent total citation rate. The 35.39 total citations rate per 100 countable conviction drivers is 1.88 (35.39/18.79) or 88% higher than the 18.79 total citations rate per 100 TVS masked conviction drivers.

The observed means and rate ratios are graphically illustrated in Figure 2.

Figure 2. Comparison of treatment groups on 1-year total crashes and total citations before applying propensity score stratification



Although the direction of the findings from Table 3 and Figure 2 is expected due to the favorable prior 3-year record and licensing/demographic characteristics of the TVS masked conviction subjects, this actuarial comparison contains an element of bias. This bias exists because the subsequent total crash and citation rates were not adjusted for any preexisting differences between the two groups. These preexisting differences lead to the following question: *What would the expected magnitude of the difference in subsequent total crash and total citation rates be if the two groups were equivalent on the differences in the prior period?* To answer this question, the propensity score technique was used to adjust the subsequent crash and citation rates for the biases in Table 2. This question is explored in the following section.

Question 3 – Is the law allowing violators to receive masked convictions and, thereby, avoid a countable conviction by attending and completing a TVS associated with a decrease or increase in subsequent traffic incidents, after controlling for preexisting differences between drivers receiving a masked TVS conviction and those receiving a countable conviction point?

Propensity score stratification. As discussed above, the two groups displayed dissimilar "pretreatment" characteristics. Differences in these characteristics are, in part, attributed to self-selection and other selection biases that may be present within the TVS and court adjudication processes.

To statistically equate the two groups on the potentially biasing preexisting differences, the propensity score stratification technique described in the Methods section was applied to the masked TVS conviction group and the countable conviction group drivers.[18] Table 4 presents the mean propensity scores and sample sizes for the five quintiles formed by the propensity score stratification. The similarity of the mean propensity scores in each quintile indicates that the propensity score technique was successful in statistically equating the two groups within each quintile on the scalar summary (logit) of all potentially biasing pretreatment characteristics for which data are available.[19]

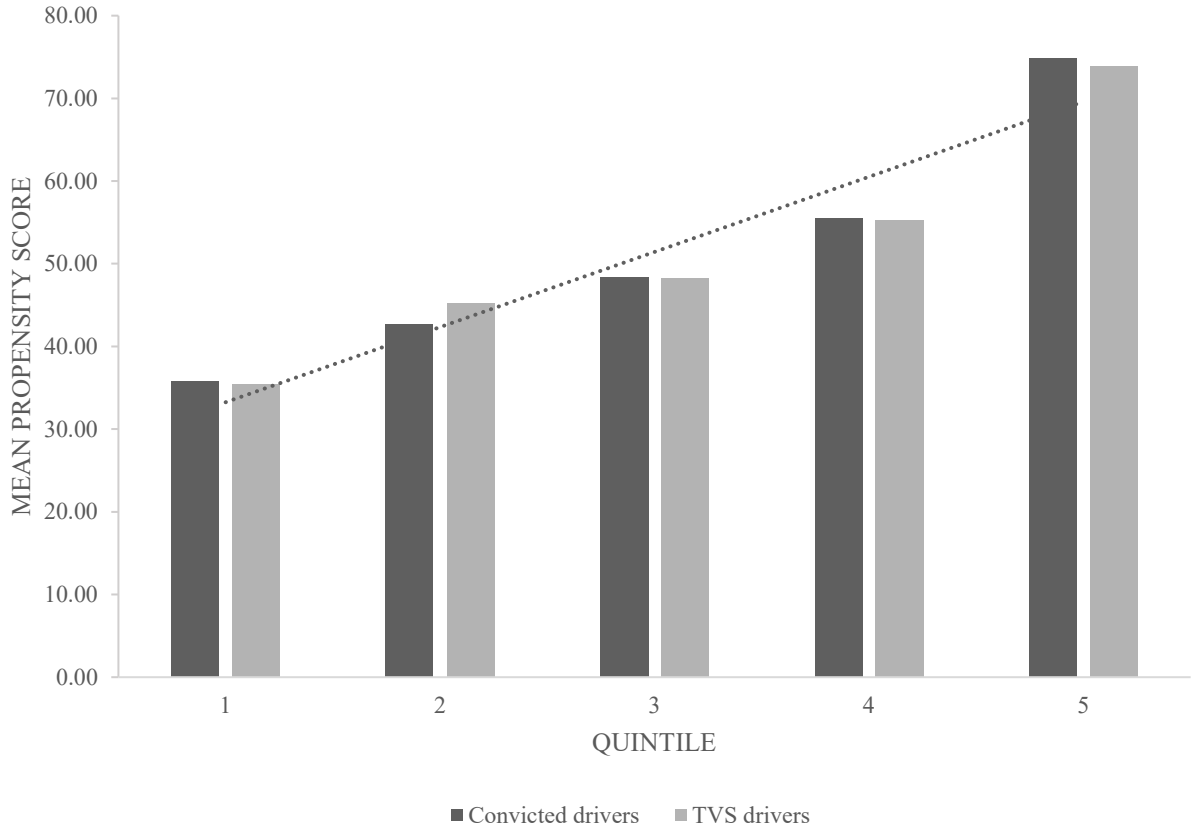
Table 4. Mean Propensity Scores by quintile and group

Quintile and treatment group	Mean propensity score	Sample size
Quintile 1		
TVS drivers	35.44	64,616
Convicted drivers	35.78	34,361
Quintile 2		
TVS drivers	45.27	57,580
Convicted drivers	42.68	41,403
Quintile 3		
TVS drivers	48.19	51,003
Convicted drivers	48.33	47,975
Quintile 4		
TVS drivers	55.24	42,981
Convicted drivers	55.56	55,998
Quintile 5		
TVS drivers	73.90	25,969
Convicted drivers	74.78	73,011

[18] As noted in the prior section, the assessed covariates are presented in Appendix 2.
[19] This would also include unmeasured factors that are correlated with the discriminating variables included in the propensity score model.

Figure 3 illustrates the mean propensity score by quintile and group.

Figure 3. Mean propensity scores by quintile and group



The monotonic (upward) trend line in the figure illustrates that the quintile approach was successful in forming stratification or matching groups of increasingly elevated driver record histories. Therefore, the formation of the quintiles allows for adjusting or subtracting out the measured confounding factors potentially biasing the simple or actuarial comparisons between the TVS masked conviction and countable conviction groups.

To further assess and demonstrate for the reader the adequacy of the propensity score stratification technique in reducing bias at the individual covariate level, the TVS masked conviction group and countable conviction group drivers were compared on each of the pretreatment characteristics after adjusting for their propensity score quintile. This was accomplished by use of a general linear model (GLM). Each GLM in the present analyses included the main effects of propensity score quintile (coded as 1 through 5) and treatment (coded as 1 for the TVS masked conviction subjects and 0 for the countable conviction subjects) and the quintile by treatment interaction.[20] The results indicate that the background characteristics which

[20] The interested reader is referred to Orelien (2001) for fitting GLMs with SAS.

were significantly different between the two groups prior to stratification were either non-significantly different or only marginally significantly different after adjustment for the propensity score quintile. For example, Table 5 illustrate the bias reduction for a sub-set of covariates whose initial bias was greater than 20%. As observed from the table, each of the covariates had a bias reduction of over 50% after stratification on the propensity score.

*Table 5.*Percent Reduction in Bias (Difference between Treatment Group Means) for a Sub-set of Covariates with Initial Bias Greater Than 20 Percent

Variable	Initial bias	Bias after adjustment for propensity score strata	% of bias reduction
% S/R action	9.80	2.80	71.43
Total convictions	34.03	6.74	80.19
Countable convictions	18.44	2.83	84.65
Neg-Op points	21.49	4.31	79.94
Days on S/R action	40.55	12.70	68.68
Days on probation	2.32	0.69	70.26
Reckless driving convictions	0.17	0.01	94.12
S/R actions due to neg-op violations	0.75	0.29	61.33
S/R actions due to FR violations	0.54	0.25	53.70
S/R actions due to proof failure	0.35	0.13	62.86
S/R actions due to other reasons	8.31	3.63	56.32

Note. The percent of bias reduction equals the absolute value of 100(1-(ba/bi)), where ba and bi are the differences in covariate mean (or percentage) after stratification and initially, respectively.

Adjusted subsequent total crashes.

Following the computation of the propensity scores, several options existed to estimate the impact of the TVS masked conviction policy on subsequent total crash rates. One was to estimate the treatment effects separately within each propensity score quintile and then combine the quintile estimates into an overall estimate of the TVS masked conviction treatment effect. An alternative approach would involve incorporating into the outcome equation the propensity score itself (not strata) as a covariate and use group membership (TVS vs conviction) as the treatment or independent variable.

As briefly introduced in the Methods section, it was decided to estimate the Poisson regression models by using the propensity score quintile approach. Specifically, the treatment effect (i.e., TVS masked conviction versus countable conviction) was adjusted by including terms for the strata produced by the propensity scores. The strata were scaled as presented in the above Figure 3 so that drivers in propensity score quintile 1 represented those with the least deviant prior driving record while drivers in propensity score quintile 5

represented those with the most deviant prior driving record.[21] Cross-product terms were computed between the treatment effect and strata to test for the presence of a treatment by propensity score stratification interaction or moderated effect.[22] If statistically significant, such an interaction might yield an indication as to whether the TVS masked conviction policy results in a larger or smaller association with the total crash outcome across groups of drivers with differing degrees of elevated prior driving record history and biographical/licensing characteristics. The lack of such a statistically significant interaction would imply that the quintile-adjusted effect of the TVS masked conviction policy was consistent (i.e., on average, equally effective or ineffective) across the marginal distribution of the propensity score quintile.

The initial equation consisted of the fully saturated Poisson regression model. This model consisted of the propensity score quintile, the treatment effect (TVS masked conviction versus countable conviction), and the propensity score quintile by treatment effect interaction. The results indicated that the interaction effect term was not statistically significant ($p = 0.104$) according to the decision rules adopted *a-priori* for the analyses.[23] This implies that the TVS treatment effect was statistically consistent across the marginal distributions of the propensity score quintile. Therefore, the second step necessitated the computation of a main effect model assessing the association of subsequent traffic crashes with the TVS masked conviction program. It is noted, however, that the magnitude and direction of the interaction effect (had it been borderline statistically significant using a more relaxed criterion of .10 *a-priori*) implied that the positive effect of the TVS masked conviction policy existed among drivers with the least elevated (i.e., within earlier quintiles) prior records. This topic in context with the findings reported in the next section analyzing the total citations criterion will be elaborated upon in the concluding section of the report.

Table 6 summarizes the Poisson model regressing subsequent 1-year total crashes against the propensity score quintile and treatment group.[24]

[21] The interested reader is referred to Appendix 3 for a table showing the marginal biographical/licensing characteristics and prior driving record of the propensity score quintiles.
[22] For a detailed discussion of the computation and interpretation of interaction and moderating effects in regression analysis, the interested reader is referred to Aiken and West (1991).
[23] Since this was not the appropriate model to describe the data, the related tabulation is not presented.
[24] A likelihood ratio chi-square test was conducted between the interaction model and the main effect model displayed in Table 6. This test was not statistically significant ($p > .05$), thereby formally confirming the appropriateness of the main effect model containing the propensity score quintile and treatment effect on the basis of the decision rule adopted for the study analyses.

Table 6. Summary of Poisson Model Regressing 1-Year Total Crashes against Propensity Score Quintile Indicators and Treatment Group

Source	Parameter estimate	Standard error	Wald chi-square	*P*
Constant	-2.5185	0.0142	31,351.70	<.0001
Propensity score quintile (referent = quintile 5)			460.60	<.0001
Quintile 1	-0.3032	0.0180	284.81	<.0001
Quintile 2	-0.3018	0.0178	288.87	<.0001
Quintile 3	-0.2481	0.0173	204.76	<.0001
Quintile 4	-0.1390	0.0167	69.37	<.0001
Group (referent = TVS masked conviction)	0.0310	0.0116	7.11	0.0077

Likelihood ratio chi-square for model = 10,143.16, $p < .05$.

The chi-square test statistic associated with the propensity score quintile indicates that the propensity score quintile was statistically significant in reducing bias from the treatment effect term in the equation (Wald chi-square = 460.60, $p < .05$).[25] As expected, the direction and magnitude of the quintile regression parameters indicates a monotonic increasing trend in subsequent total crash risk from quintile 1 through quintile 5. That is, quintile 1 consisted of TVS and convicted drivers with the least elevated prior records (and, expectedly, the lowest relative subsequent total crash risk), while quintile 5 consisted of TVS and convicted drivers with the most elevated prior records (and, expectedly, the highest relative subsequent total crash risk).

The term of primary interest in Table 6 is the parameter estimate associated with group. The related values reveal the treatment effect (i.e., TVS masked conviction versus countable conviction) and a test of its statistical significance after adjusting for the bias (i.e., subtracting out the composite multivariate differences between the two groups in licensing/biographical characteristics and prior driver record) removed by the propensity score quintiles. In other words, the parameter estimate allows for asking and answering the following question: With all else being equal, is TVS attendance associated with a reduction or increase in subsequent total crash risk as modeled by these data?

[25] The only way to assess the degree of bias and to remove the bias in order to make true cause/effect conclusions about a treatment effect would be to replicate this study using random assignment to the treatment conditions. Obviously, this is not possible in the "real world" operational environment in which the TVS program operates.

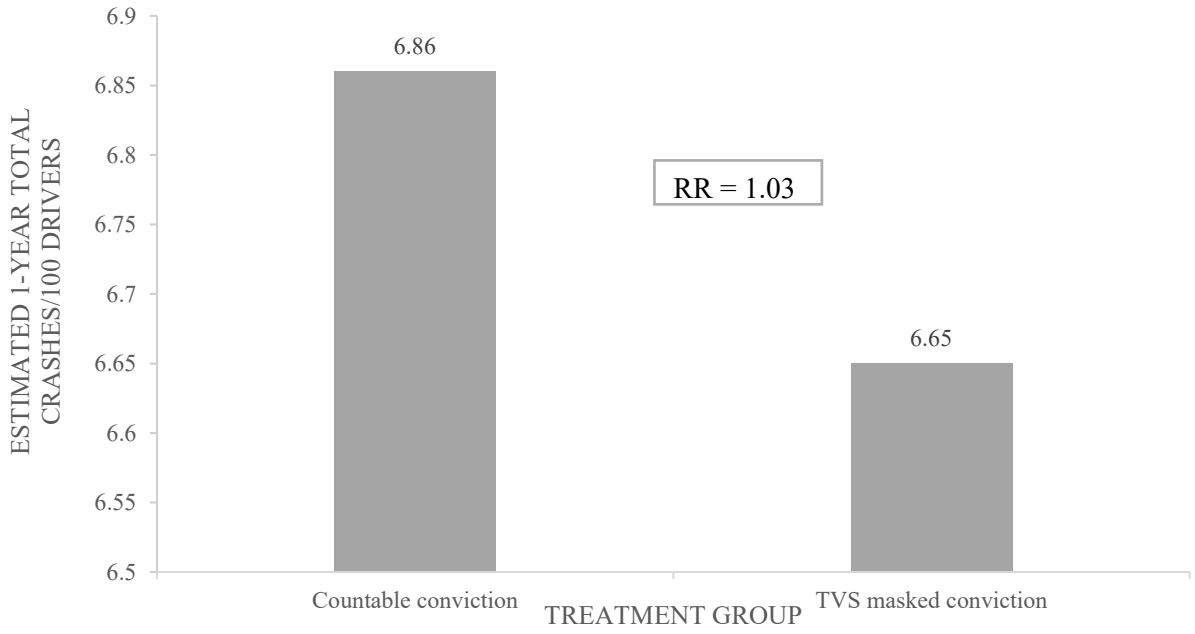
The term for group was scaled so that a positive value indicates a positive effect (i.e., fewer crashes) associated with the TVS masked conviction group. As displayed in Table 6, the group parameter estimate of 0.0310 was statistically significant (p = 0.0077). This result implies that the TVS masked conviction group, on average, had a reliably (statistically significant) lower 1-year subsequent total crash rate than the countable conviction group.

Using the parameter estimates from Table 6, quintile adjusted 1-year subsequent total crash rates were estimated for the TVS masked conviction and countable conviction groups. The results are presented in Table 7 and illustrated in Figure 4.

Table 7. Poisson Regression Model Propensity Score Quintile Adjusted Estimated 1-Year Subsequent Total Crashes Per 100 Drivers

Intervention group	Estimated 1-year total crash rate/100 drivers	Relative risk ratio
Countable conviction	6.86	1.03
TVS masked conviction	6.65	

Figure 4. Poisson regression model propensity score quintile adjusted estimated 1-year subsequent total crashes per 100 drivers



As displayed in the table and figure, the quintile adjusted 1-year estimated total crash rate for the countable conviction group was 6.86 per 100 drivers. The quintile adjusted 1-year total crash rate for the TVS masked conviction group was 6.65 per 100 drivers. The relative risk ratio in the final column of Table 7 and

illustrated in Figure 4 implies that the subsequent total crash rate of the countable conviction group was 1.03 times higher (6.86/6.65) than that of the TVS masked conviction group. Alternatively, one can also phrase the relationship by stating that the TVS masked conviction group had a subsequent total crash rate that was 3% lower [((6.86-6.65)/6.65)*100] than the subsequent total crash rate of the countable conviction group.

While the 3% effect size reported above for the TVS masked conviction policy may seem small, such an effect size becomes quite meaningful when considering that the ultimate goal of any driver improvement or educational program such as TVS is to prevent crashes. By using the detected and statistically significant effect size of 3%, it is possible to estimate the total crash savings potentially attributed to the TVS masked conviction policy. Table 8 provides such an estimate.

Table 8. Estimated Number of Attributed Total Crash Involvements and Economic Costs Saved by the TVS Masked Conviction Policy

Effect size (per driver) (A)	-0.002094868
Annual number of TVS masked convictions (B)	900,000
Estimated Number of attributed total crashes saved by the TVS masked conviction program (A*B)	1,885
Cost of total crashes saved by the TVS masked conviction program*	$62,683,790

*Obtained by multiplying the estimated value of 1,885 crash involvements saved by the unit cost of $33,254 per crash.

These figures were obtained by multiplying the estimated number of attributed crash involvements saved for the TVS masked conviction group (the difference between 0.0665 and 0.0686 rounded to 9 decimal places) by the approximate annualized volume of drivers receiving a masked TVS conviction (900,000) during the study period. As shown in Table 8, it is estimated that approximately 1,885 total crashes per year are saved and/or prevented by the TVS masked conviction program.

An estimate of the cost savings of the attributed total crash involvements prevented each year by the masked TVS conviction program is provided in the final column entry of Table 8. The average total crash cost of $33,254 used to derive the estimate was obtained by multiplying the California Department of Transportation's (Caltrans) estimates of the unit costs (in 2012 dollars) of fatal, injury, and property-damage-only crashes by the proportion of each crash type among the TVS population (California Department of Transportation, n.d.). The Caltrans cost model reflects the direct and indirect costs

incurred by the involved individuals and the larger society.[26] Multiplying the $33,254 value by the estimated number of attributed crash involvements saved (1,885) by the TVS masked conviction program yields an estimated gross economic costs savings of $62,683,790.

One caveat, as noted above, related to these crash and economic savings estimates is that they are derived from a quasi-experimental design rather than from one employing random assignment. Therefore, the possibility exists that these estimates could be unstable and inaccurate if the propensity score model excluded potentially biasing factors not related to the ones included in the propensity score model. In order to account for this possible instability, 95% confidence intervals were calculated for the parameter estimates presented in Table 8. Lower and upper estimates of total crashes saved were computed from the intervals. The estimated values of attributed crashes saved ranged from a low of 645 total crashes to a high of 4,580 total crashes.

As a confirmatory procedure, a Poisson Bayesian analysis was conducted on the total crash outcome. This Bayesian analysis produced a probability value (based on posterior density plots) of .99 that the parameter estimate for the TVS masked conviction policy would be a positive one in 10,000 independent samples (of the same size) of TVS masked conviction and countable conviction subjects – indicating a probable positive effect related to TVS. The potential problems associated with drawing conclusions from such a quasi-experimental design will be further discussed in the concluding section of the report.

Adjusted subsequent total citations.

As was the case with the total crashes criterion, the propensity score stratification technique was applied in the program assessment involving the total citations outcome measure.

Since the Poisson regression assumption of equal mean and variance was violated ($p < .01$) for the total citations outcome, negative binomial regression was utilized.

The fully saturated model was deemed the best for fitting the subsequent 1-year total citations criterion. This model consisted of the propensity score quintile, the treatment effect (TVS masked conviction versus countable conviction), and the propensity score quintile by treatment effect interaction. Table 9 shows the summary of the negative binomial model regressing 1-year subsequent total citations against the propensity score quintile indicators, treatment group, and the propensity score quintile by treatment group interaction.

[26] For a discussion of crash cost and benefit cost analysis as applicable to California data, the interested reader is referred to Peck & Healey (1995-96, winter).

Table 9. Summary of Negative Binomial Model Regressing 1-Year Total Citations Against Propensity Score Quintile Indicators, Treatment Group, and Propensity Score Quintile Indicators by Treatment Interaction

Source	Parameter estimate	Standard error	Wald chi-square	*P*
Constant	-2.0746	0.0117	31,696	<.0001
Propensity score quintile (referent = quintile 1)			5182.43	<.0001
Quintile 2	0.1892	0.0163	135.41	<.0001
Quintile 3	0.3692	0.0161	525.12	<.0001
Quintile 4	0.5963	0.016	1384.99	<.0001
Quintile 5	1.0807	0.0165	4303.55	<.0001
Group (referent = TVS masked conviction)	0.4039	0.0177	520.68	<.0001
Propensity score quintile X group (referent = quintile 1 X group)			13.11	0.0107
Quintile 2 X group	0.0607	0.0237	6.57	0.0104
Quintile 3 X group	0.027	0.023	1.38	0.2404
Quintile 4 X group	-0.0062	0.0224	0.08	0.7802
Quintile 5 X group	0.0027	0.022	0.02	0.9015

Likelihood ratio chi-square for model = 75,001.24 , $p < .0001$

The term of primary interest in the table is the statistically significant ($p = 0.0107$) interaction between propensity score quintile and treatment group.[27] This statistically significant interaction indicates that the magnitude of the treatment effect (the association with traffic citations) varies (in direction, magnitude, and/or statistical significance) as a function of the propensity score strata. As a result, the appropriate focus of interest is the difference between the masked TVS conviction and the countable conviction treatment groups within the propensity score quintiles. The tests of statistical significance from Table 9 (and additional confirmatory within-strata negative binomial models applying a Bonferroni procedure to correct for familywise alpha inflation – not shown) confirmed that a statistically significant ($p < .05$) difference

[27] A common error made by researchers is to interpret a treatment main effect term from an interaction model as representing the overall treatment effect. However, unlike a main effects model, this term no longer represents the marginal effect of treatment across the propensity score quintiles. In the present case, the main effect term of group (0.4039) is the log of the rate ratio between the two treatment groups for the referent quintile group 1 within the interaction model.

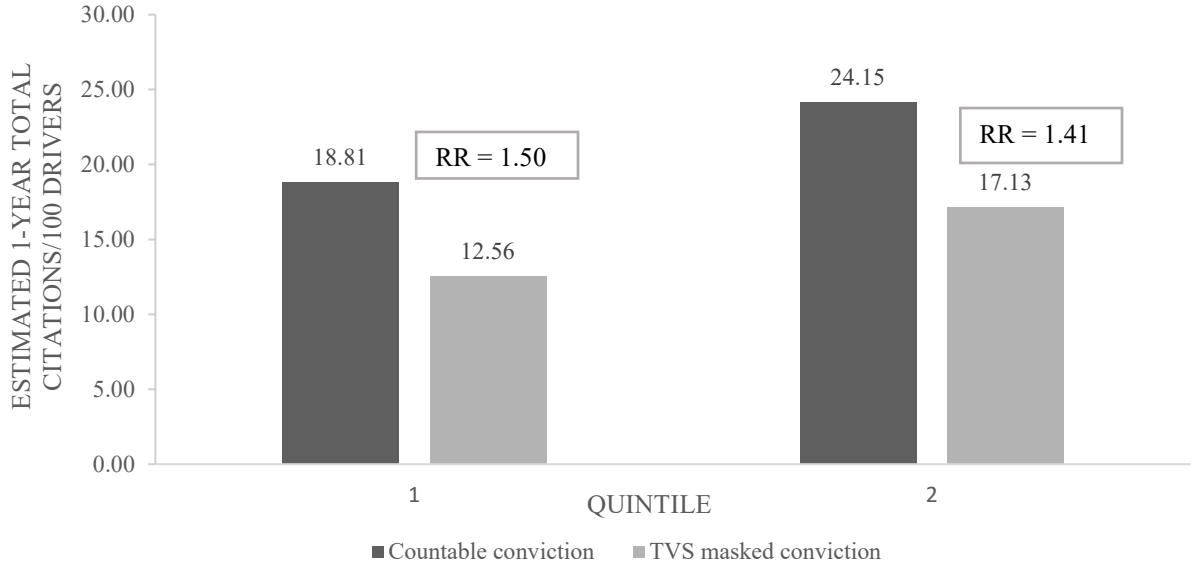
existed between the two treatment groups within propensity score strata 1 and 2 only.[28] As discussed above, these two quintiles represented drivers with the least elevated prior driving records (i.e., quintile 1 contained the "cleanest" prior record violators while quintile 5 contained the "dirtiest" or most elevated prior driving record violators).

Using the parameters from Table 9, the estimated subsequent 1-year total citations per 100 drivers and relative risk ratios were computed for the TVS masked conviction and countable conviction groups for propensity score quintile strata 1 and 2.[29] The results are presented in Table 10 and illustrated in Figure 5.

Table 10. Negative Binomial Regression Model of Estimated 1-Year Subsequent Total Citations Per 100 Drivers by Statistically Significant Propensity Score Quintile by Intervention Group Interaction Effects

Quintile	Intervention group	Estimated 1-year total citation rate/100 drivers	Relative risk ratio
1	Countable conviction	18.81	
	TVS masked conviction	12.56	1.50
2	Countable conviction	24.15	
	TVS masked conviction	17.13	1.41

Figure 5. Estimated 1-year subsequent total citations per 100 drivers for statistically significant interaction comparisons from the negative binomial regression model



[28] The interested reader is referred to Aiken and West (1991) and to Huitema (1980) for a discussion of the use of the Bonferroni procedure for testing and interpreting interactions produced from a multiple regression model.
[29] The estimated means for strata 3, 4, and 5 are not provided as the comparisons were not statistically significant and/or reliable. This is confirmed by the fact the 95% confidence intervals (not shown for the sake of brevity) contain the value of 0, indicating the very real possibility that the differences between the two groups within each of these the strata could be zero—i.e., further validating the statistically non-significant results.

The statistically significant interaction comparisons displayed in Table 10 and Figure 5 show that within quintiles 1 and 2, drivers within the countable conviction groups had higher subsequent 1-year total citations than drivers within the TVS masked conviction group.

Specifically, within quintile 1, the estimated 1-year total citation rate per 100 drivers for the countable conviction group is 1.50 times, or 50%, higher than that of the TVS masked conviction subjects (18.81 versus 12.56, respectively). Alternatively, this relationship could be phrased as the TVS masked conviction subjects having on average 33.23% fewer [((12.56-18.81)/18.81)*100] subsequent total citations than do the countable conviction subjects.

For quintile 2, Table 10 shows that the estimated 1-year total citation rate per 100 drivers for the countable conviction group is 1.41 times, or 41%, higher than that of the TVS masked conviction subjects (24.15 versus 17.13, respectively). This association, alternatively, could be stated as the TVS masked conviction subjects having on average 29.07% [((17.13-24.15)/24.15)*100] fewer subsequent total citations than do the countable conviction subjects.

Although not presented due to the spurious (i.e., part/whole) relationship and very similar estimates reported for the total citations criterion, an analysis of the total incidents (crashes + citations) criterion replicated the interaction effects between treatment and propensity score quintile for the citations outcome. That is, the statistically reliable/significant association (but one that is reduced in magnitude) was found in favor of the TVS masked conviction group for drivers in quintiles 1 and 2 but was not present for drivers in quintiles 3 through 5. As discussed in the concluding section of this report, the presence of such a treatment by propensity score quintile for the total incidents outcome further substantiates that the "effectiveness" of the TVS masked conviction program exists primarily among drivers with less elevated prior records. This finding replicated after imposing additional (i.e., Bonferroni) constraints on the probability values and confidence intervals associated with the subsequent total incidents' treatment by propensity score quintile interaction parameter estimates.

By establishing a positive traffic safety association between the TVS masked conviction group for subsequent total crash involvement and total citations (at least for TVS drivers with less elevated prior driving records), the next logical focus shifts to the association of the offered classroom modalities and subsequent driver performance among those completing TVS. This relationship is examined in the next section.

Question 4 – Is the modality of TVS instruction completed by a referred violator related to subsequent traffic incidents?

As presented in the methods section, three instructional modalities are offered to the TVS attendee. The modalities present the same curriculum and require the same effort and commitment of time.[30] These three modalities consist of classroom instruction, home study, and internet. Table 11 displays the sample size, biographical and licensing characteristics, and prior 3-year driver record indices for the three TVS instructional modalities.[31]

Table 11. Licensing /Biographical Characteristics and Prior Driver Record Indices by Modality of TVS Instruction for the 6 Month Sample with January 1st through June 30th 2016 Course Completion Dates

Variable	Classroom (n = 18,387)	Home study (n = 2,813)	Internet (n = 114,391)
Biographical and licensing			
% Class A/B commercial license	0.36	0.64	0.30
% Male	59.62	56.95	56.43
% Attachment 23 present	5.45	3.38	3.32
% Original licensees	17.09	9.42	11.29
Mean age	47.57	49.32	39.10
Prior 3-year			
% suspended revoked	4.17	4.83	4.79
Total citations/100 drivers	138.07	139.57	142.24
Countable citations/100 drivers	127.42	128.62	131.77
Major alcohol/drug citations/100 drivers	1.06	1.00	1.07
Total crashes/100 drivers	19.45	22.93	17.85
CHP/police reported crashes/100 drivers	11.70	13.15	10.14
Fatal/injury crashes/100 drivers	5.56	6.15	4.52
Negligent-Operator points/100 drivers	27.09	28.08	29.55
TVS masked convictions/100 drivers	107.43	107.86	108.68
Countable crashes/100 drivers	5.75	6.22	5.06

Note: An attachment 23 indicates that a driver had at some point two or more assigned driver license numbers that were combined into a new driver's license that resulted in only one record being present for that driver.

[30] See Appendix 1 for the TVS curriculum and the allocation of time for each topic covered by the instructional modality.

[31] Prior and subsequent records presented in this section are indexed to the date the violator successfully completed TVS instruction.

Although most of the indices presented in Table 11 are fairly equivalent in magnitude, there are some obvious differences which could introduce bias in the comparison of the subsequent driving incident criterion unless properly controlled. For example, a selective examination of Table 11 shows the following:

- The percentage of original licensees (i.e., not renewals) is 17.09% for those selecting classroom instruction; 9.42% for those selecting home study instruction; and 11.29% for those selecting internet instruction;

- The mean age is 47.57 years for those selecting classroom instruction; 49.32 years for those selecting home study instruction; and 39.10 years for those selecting internet instruction;

- The total citations rate per 100 drivers was 138.07 for those selecting classroom instruction; 139.57 for those selecting home study instruction; and 142.24 for those selecting internet instruction; and

- The total crash rate per 100 drivers was 19.45 for those selecting classroom instruction; 22.93 for those selecting home study; and 17.85 for those selecting internet.

Considering that the observed differences in the measured covariates could introduce bias into the instructional modality analysis, the authors decided to employ the licensing/biographical and prior 3-year driver record indices as covariates. The covariates were assessed individually and in groups to assess their ability to discriminate between subjects within the three instructional modalities and to predict the subsequent 6-month driving incidents criterion. The analyses revealed that the covariates as a complete set outperformed models containing the intercept only, single covariate usage, and various covariate sets. Therefore, the complete set of variables presented in Table 11 were used as covariates in the logistic regression model assessing the relationship between instructional modality and the driving incident outcome.

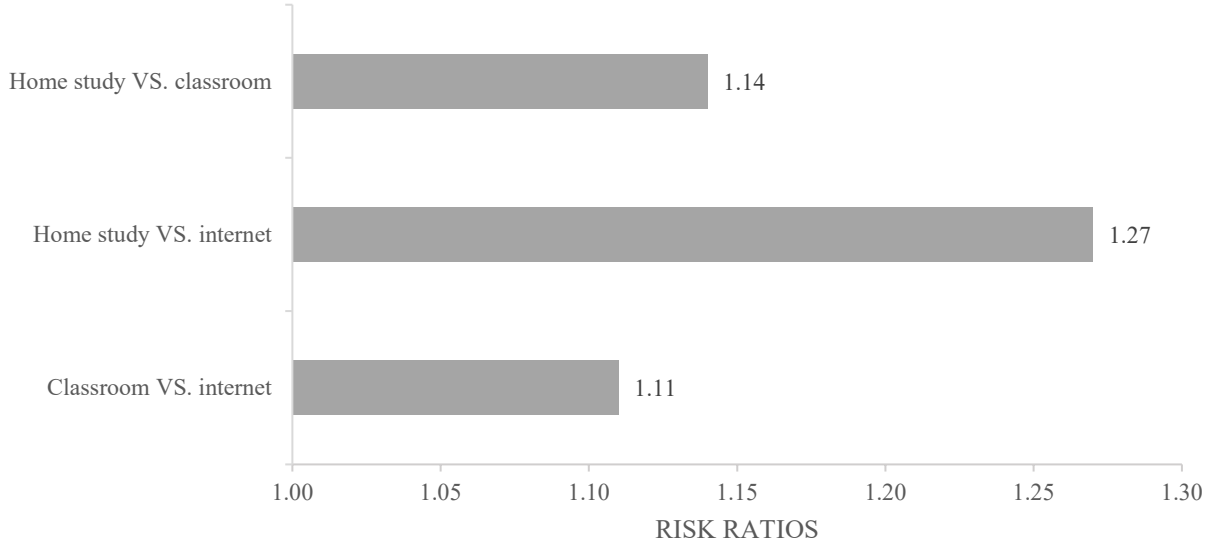
Table 12 presents the estimated probability risk ratios and tests of statistical significance obtained from the logistic model regressing subsequent 6-month total incidents against the covariate set and the modality of instruction. Figure 6 illustrates the estimated probability risk ratios presented in Table 12.

Table 12. Estimated Probability Risk Ratios Obtained from Logistic Regression Model Regressing Subsequent 6-Month Total Incidents Against Covariates and Instructional Modality for Violators Completing A TVS Between January 1st, 2016 and June 30th, 2016

Instructional modality comparison	Estimated probability risk ratio	*p*
Classroom VS. internet	1.11	0.0237
Home study VS. internet	1.27	<.0001
Home study VS. classroom	1.14	<.0001

Note: Likelihood ratio chi-square for the complete model = 2,446.16, *P* <.0001
Wald chi-square for the instructional modality effect estimate = 32.9318, p <.0001

Figure 6. Estimated Probability Risk Ratios from Logistic Regression Instructional Modality Comparisons



The entries in Table 12 indicate that the full model (i.e., intercept, covariates, and instructional modality) was a statistically significant predictor of driving incidents (Likelihood ratio chi square = 2,446.16, *p* < .0001). Table 12 also indicates that after adjusting for the potential bias associated with the covariate differences, there was one or more statistically significant difference between instructional modalities and subsequent involvement (as measured by probabilities) in driving incidents (Wald chi-square = 32.9318; p < .0001).

Follow-up tests of the differences in estimated probabilities indicated that statistically significant differences existed between the three instructional modalities and that the lowest estimated probability of subsequent driving incidents was associated with the internet modality. That is, Table 12 and the Figure 6 yield the following estimated probability risk ratios:

- The estimated probability of subsequent 6-month driving incidents associated with classroom instruction was 1.11 (or 11%) higher than that associated with internet instruction ($p < .0237$);

- The estimated probability of subsequent 6-month driving incidents associated with home study instruction was 1.27 (or 27%) higher than that associated with internet instruction ($p < .0001$);

- The estimated probability of subsequent 6-month driving incidents associated with home study instruction was 1.14 (or 14%) higher than that associated with classroom instruction ($p < .0001$).

Although the differences in the model estimated probability risk ratios are statistically significant, the magnitudes of the estimated probabilities from which the ratios were computed are small. That is, the estimated probabilities for accumulating subsequent driving incidents in the 6 months subsequent to course completion are 0.0886, 0.0985, and 0.1126 for internet, classroom, and home study instruction, respectively.

DISCUSSION

Conclusions

Using advanced inferential statistical techniques, this study evaluated the substantive changes to California's Traffic Violator School program as required by California Assembly Bill 2499 (Chapter 599, Statutes of 2010). As presented in the prior section of this report, the program changes implemented by AB 2499 appear to be associated with a specific deterrent effect as evidenced by a reliable and statistically significant reduction in subsequent traffic crashes and convictions of those receiving a masked TVS conviction as opposed to a countable conviction. Although the results suggest that this relationship exists primarily among TVS drivers with less elevated prior records, the change in status from a TVS citation dismissal to a TVS masked conviction has reduced the negative traffic safety impact of the TVS citation dismissal policy in effect prior to the implementation of AB 2499. The negative traffic safety impact of the prior citation dismissal policy is well documented in past departmental TVS evaluations (e.g., Gebers, 2010;

Gebers, Tashima, & Marsh, 1987; Peck & Gebers, 1991). The following conclusions are warranted by the study findings:

1. Prior to treatment assignment, TVS attendees who receive a masked conviction have characteristics associated with lower subsequent crash and citation expectancies compared to drivers who receive a 1-point countable conviction.

2. As would be expected due to their preexisting lower-risk characteristics, TVS attendees have a statistically significant lower rate of subsequent total crashes and total citations compared to drivers who receive a 1-point countable conviction.

3. Propensity-score stratification adjustment of the observed total crash rates to control for preexisting biases between the TVS masked conviction group and the countable conviction group decreased the magnitude of the difference between their subsequent crash rates. Without the adjustment, the countable conviction group had 1.10 times as many crashes as the TVS masked conviction group. After the adjustment, the countable conviction group had 1.03 times as many total crashes as did the TVS masked conviction group.

4. The 3% decrease in crash risk attributed to the TVS masked conviction policy results in an estimated 1,885 traffic crashes prevented annually for the approximately 900,000 drivers receiving TVS masked convictions each year. It was estimated that the economic dollars saved associated with the prevented crashes through the use of a comprehensive crash cost model was about $63 million annually.

5. Although significant, there was suggestive evidence that the TVS masked conviction policy was more effective in terms of crash reduction for TVS drivers with less elevated prior driving records and biographical characteristics predictive of lower subsequent crash expectancies. This pattern was reliably established for the total citation and total incidents criteria discussed next.

6. Propensity-score stratification adjustment of the observed total citation rates to control for preexisting biases between the TVS masked conviction group decreased the magnitude of the difference between their subsequent citation rates. Without the adjustment, the TVS group has 46.92% fewer total citations overall than the countable conviction group. The appropriate model for the total citations data required a term for the propensity score stratification quintile by treatment

group interaction, yielding different risk relativities within the quintiles. The results showed that the TVS masked conviction policy was effective for drivers in quintiles 1 and 2 only. These were drivers with less elevated prior driving record histories and characteristic associated with a lower subsequent risk of citations. Within quintile 1, TVS attendees had 33.23% fewer subsequent total citations than did the countable conviction subjects. Within quintile 2, TVS attendees had on average 29.07% fewer subsequent total citations than did the countable conviction subjects. No statistical/reliable differences were present for drivers with elevated prior driving records within quintiles 3, 4, or 5. A supplementary analysis on the total incidents (crashes + citations) outcome confirmed this moderating relationship between treatment group and the propensity score quintiles.

7. The covariate adjusted logistic regression analysis yielded statistically significant differences between the three instructional modalities (i.e., classroom, home study, and internet) in their relationship with subsequent total incidents. It was reported that the lowest estimated probability of subsequent driving incidents was associated with the internet modality. Although the differences in the model estimated probability risk ratios were statistically significant, the magnitude of the estimated probabilities from which the ratios were computed as presented in the prior section were small.

As stated above, the present study employed advanced statistical and methodological techniques to evaluate the TVS masked conviction policy as implemented under AB 2499. However, as with any study employing a quasi-experimental design in which assignment to treatment is not random, it is essential to discuss and evaluate the potential threats to the internal validity of the study. Before doing so, it is instructive, however, to examine which of the above conclusions are subject to alternative explanations or bias.

Conclusions 1, 2, and 7 follow directly from the data. Their validity relies solely on the reliability and precision of the sampling.

Conclusions 3, 4, 5, and 6 involve inferences of causality that the differences in the adjusted crash and citation rates found in the primary and supplementary analyses were likely the result of type of treatment (i.e., TVS masked conviction versus countable conviction). These inferences require that the influence of any important preexisting differences between the TVS and conviction groups be adequately and statistically controlled in the analyses. It is certainly possible to question this assumption by invoking the possibility of the existence of one or more latent, uncontrolled variables that represent some factor that influenced subsequent crash risk and citations but on which the two groups still differed after the propensity score stratification adjustment. For example, annual mileage and other aspects of exposure related to

subsequent driving performance were not available for use in calculating the propensity score. The exclusion of variables raises the possibility that not controlling for possible differences between groups on these variables biased the findings against one of the groups. Such an effect might occur, for example, if the countable conviction group drove more miles in the subsequent period than did the TVS group. However, if the "treatment" effect of a masked TVS conviction or a countable conviction caused drivers in one of the two groups to drive fewer (or more) miles, it would be inappropriate to adjust subsequent crashes and/or citations for the differences in mileage. Doing so would incorrectly "wash-out" a valid treatment effect. Unfortunately, given available data, it is not possible to determine whether this bias exists in these analyses nor, if it exists, the magnitude and direction of the bias.

Another uncontrolled factor warranting acknowledgement is insurance status. Data regarding insurance is not available on the driver record, and therefore cannot be included in the present study. That said, on the basis of logical principles, it is likely that the TVS masked conviction group (at least in the strata with less elevated driver record histories and characteristics associated with a lower propensity for future crashes and citations) consisted of a higher incidence of insured drivers than did the countable conviction group. Avoiding increased insurance premiums associated with receiving a conviction for a traffic violation is presumably the primary reason someone would enroll in TVS. Therefore, persons who do not have insurance may be somewhat less likely to attend TVS, there being no direct monetary incentive for doing so. This potential source of bias, if it exists, would therefore favor the TVS group, given that being uninsured has been showed to be associated with increased crash risk (Harano, McBride, & Peck, 1973; Peck & Kuan, 1983). However, this potential source of bias was controlled to some extent in the present study through the use of statewide violators (i.e., spreading the bias equally over the entire statewide marginal) as the sampling base for both groups, and through assessing the contribution of geographic residential indicator variables when computing the propensity score quintiles.

Given the above study design qualifications, it is important to note that for such potential biases to threaten the validity of the results reported in the present study, one would have to empirically identify for the study data an unmeasured variable(s). Such an unmeasured variable(s) would have to account for the relationship between treatment/comparison group assignment and the outcome measures completely unrelated to the variables used to create the propensity score quintiles – an unlikely scenario. Therefore, due to the quasi-experimental nature of this study, the results do not prove a positive or negative causal impact of the AB 2499 TVS masked conviction policy. Instead, the results illustrate relationships between the TVS program changes implemented by way of AB 2499 and subsequent total crashes, citations, and incidents that are suggestive of its effect on traffic safety.

While past TVS studies (e.g., Peck, et. al. , 1979) have found mixed results (e.g., one group with a higher post crash rate but a lower post citation rate), the present study was consistent in that the TVS masked conviction group was associated with lower counts of both subsequent crashes and citations. While total crashes represents the ultimate safety criterion by which to assess the value of a traffic safety program due to their inherent societal costs associated with fatalities/injures and property damage, total citations represents an additional criterion worthy of examination. This criterion is especially relevant to educational programs such as TVS whose goal is to reduce both the crash propensity and citation recidivism of treated drivers. The obvious rationale is that since individuals with elevated counts of citations tend to have elevated counts of crashes, a program that reduces citations should be accompanied by a crash reduction as well. The larger effects found for total citations relative to crashes are consistent with prior studies (e.g., Gebers, 2009) employing a rigorous experimental design and are due, primarily, to the greater frequency of citations relative to drivers in the specific driver sub-groups under investigation.

The novel finding, however, in the current study was that there was statistical evidence that the effectiveness of the TVS masked conviction policy varies according to the type of TVS driver "treated."

While suggestive for the traffic crash outcome measure, the results from both the total citations criterion and the supplementary analyses of the total incidents criterion clearly indicated that the TVS masked conviction policy yielded its most positive outcomes among specific driver subtypes. That is, the positive outcomes were evident within quintiles consisting of drivers with less elevated prior record indices and biographical characteristics that are predictive of fewer subsequent driver record entries. The favorable outcomes associated with a TVS masked conviction were clearly evident among drivers in quintiles 1 and 2. Drivers in these two quintiles represent approximately 40% (or about 360,000) of the 900,000 drivers annually receiving a masked TVS conviction. Drivers in quintiles 1 and 2 consist of drivers who are on average 49.67 and 41.42 years of age, are 36.93% and 52.56% male, and exhibit an average 3-year prior total incidents rate of 124.66 and 133.18 per 100 drivers, respectively. This is in contrast to the less favorable outcomes associated with TVS drivers in quintiles 3, 4, and 5 with elevated prior driver records and characteristics associated with higher subsequent driver record entries. These three quintiles consist of drivers who are on average 37.75, 35.39, and 33.89 years of age, are 59.54%, 65.15%, and 74.15% male, and exhibit an average 3-year prior total incidents rate of 145.27, 176.82, and 270.82 per 100, respectively.[32]

This pattern of results indicates that greater attention could be given to further motivate the TVS attendee to drive more safely. That is, what should be rewarded in association with TVS attendance is the outcome

[32] These numbers are interpolated from the data presented in Tables 2 and Appendix 2 and by adding to the numbers the critical incident leading to assignment to the TVS masked conviction or the countable conviction groups.

(safe driving) and not merely attending TVS and receiving a masked non-countable conviction once in every 18 months. While the authors believe that the intent of AB 2499 TVS policy revisions was to introduce a more rigorous traffic safety program than what was present in the pre AB 2499 TVS diversion era, this effort could be enhanced when one considers the proven efficacy of the NOTS program.

As discussed earlier in this report, the NOTS program is a post-license control system administered by the Department. Violators accumulating NOTS points are "treated" with increasing levels of intervention ranging from lower-level advisory letters for drivers with the fewest negligent operator points to license probation, suspension, and revocation for drivers with the highest number of negligent operator points (Gebers & Roberts, 2004).

Prior study results have shown that the NOTS program with intervention levels of greater intensity than the TVS masked citation dismissal policy are much more effective in reducing subsequent crashes and citations among drivers with elevated prior driving records and biographical characteristics. For example, relative to TVS drivers in quintiles 4 and 5 detailed above, NOTS drivers in Levels 1 through 3 have much worse prior 3-year total incidents per 100 drivers (325.13, 463.44, and 525.11, respectively) (Gebers, 2016).[33] However, despite the more favorable preexisting characteristics and larger number of treated drivers associated with TVS relative to NOTS (900,000 versus 188,000, respectively), NOTS is more efficient in terms of crash prevention. In other words, the ratio of crashes prevented to drivers treated by NOTS is approximately 3 times greater than the ratio associated with the TVS program.[34] This would clearly imply that the TVS program could be modified to incorporate a behavioral paradigm that, if successful, might achieve a greater reduction in crash expectancy (and total driver record incidents overall) than observed in the present study across the full spectrum of the TVS eligible population.

The final question addressed in this study focused on the relationship between the three offered TVS instructional modalities and subsequent driving incidents. It was reported that statistically significant ($p < .0001$) differences existed between the classroom, home study, and internet instructional modalities. The lowest estimated probability of subsequent driving incidents was associated with the internet modality. However, it was demonstrated that the magnitude of the estimated probabilities of subsequent driving incidents for the three instructional modalities was small.

[33] Drivers in NOTS tended to be younger and more male relative to TVS drivers as well. For example, the data from Gebers (2016) showed NOTS Level 3 drivers (those receiving probation/suspension) to be on average 30.31 years of age and comprising of 77.71% males.

[34] For NOTS, the ratio is 1,300 crashes prevented to 188,000 treated drivers, annually, or .00691. For TVS, the ratio is 1,900 crashes prevented to 900,000 treated drivers, annually, or .0021. The ratio of ratios is simply .00691/.0021 or 2.699, which is 3.29 or rounded to 3 in the above paragraph.

Recommendations

The primary focus of the present study was on the substantive changes mandated to the TVS program in California as required by AB 2499. Results from this study demonstrated that redefining TVS from a pre-conviction diversion program resulting in a TVS citation dismissal into one of the Department's post-license control programs resulting in a TVS masked conviction has promising traffic safety implications. These implications were evident by reduced incidents of subsequent crashes and citations of those attending TVS. As presented in the Results section and discussed in the preceding paragraphs, the reduced incidents occurred primarily among drivers with less elevated prior driving records and with characteristics predictive of better post driving records. The trend would indicate that the most positive outcome associated with TVS occurs among drivers below or approaching NOTS Level 1 status (not exceeding 2 prior incidents per driver within a 12-month period).

Accordingly, there exists a number of options that should be considered for potential implementation in order to increase the traffic safety impact (i.e., further reductions in crash expectancies/citation recidivism) of the TVS masked conviction program across the eligible population of TVS attendees. A number of such options are summarized below. Some of these options may require statutory changes, others may require regulatory or procedural changes initiated by DMV. Others may be implemented using existing departmental resources and authority. All recommendations are of course subject to resource availability. We have therefore ordered the recommendations, roughly speaking, where those items requiring only existing departmental resources and authority come first (options #1 and #2), followed by those that would likely require additional regulatory (options #3) or statutory authority (the remaining options). These options may not be completely independent of each other, and in some cases could be implemented simultaneously. For hopefully obvious reasons, R&D recommends that options that involve substantial changes to existing policies and procedures (options #3 through #6) be done on a pilot basis and include an evaluation component to determine the traffic safety benefits prior to permanent implementation.

1. Continue to offer the three instructional modalities of TVS instruction to those selecting the TVS option. The results from the current study showed that while there were statistically significant differences between the subsequent driver record incidents between drivers exposed to the current instructional modalities, the differences were small and, therefore, would certainly not justify the adoption of a single mode of instruction. Since there was no control group, the observed differences could have been due to existing differences between violators selecting the mode of instruction even with the use of the covariates employed in the analyses to mitigate between-group differences.

2. California Assembly Bill 1932 (Chapter 561, Statutes of 2016) allowed violators cited while operating a motorcycle to attend a TVS with curriculum specific to the safe operation of a motorcycle. The Department should develop and initiate a data collection procedure specific to motorcycle-related TVSs with the goal of conducting an evaluation of the traffic safety impact of TVSs customized for motorcycle violators.

3. Modify the existing curriculum to amplify the relationship between repeat violations and the increased risk for subsequent crashes. Such a curriculum modification might result in further improvements in the responsiveness of TVS drivers with elevated prior records as evidenced by a decrease in subsequent crash expectancies. Alternatively, customized curriculum could be developed and administered to individuals with repeat violations (e.g., 2 or more convictions in the prior 2 years) prior to attending TVS. Such customized curricula are further elaborated upon in the following recommendations.

4. Allow commercially licensed drivers who commit a violation while operating a commercial vehicle to attend a TVS with curriculum customized for the commercially licensed violator. Under current law, commercially licensed drivers are allowed to attend TVS if the violation occurred during the operation of a non-commercial vehicle. This recommendation would allow commercial drivers to attend a customized TVS for violations occurring during the operation of commercial vehicles. The Department's current policy is to allow for waiving an additional neg-op point for commercial drivers who reach *prima facie* neg-op status, following a request for, and attendance at, a neg-op hearing. Such a point waiver (and the resulting waiver of a NOTS probationary/suspension action) is given to commercial drivers who during the hearing produce evidence that their elevated point count is related to the higher mileage associated with driving commercially. Allowing such drivers to attend a customized TVS along with deterrent effect of potential license control actions could logically reduce the future crash expectancy and violation rates of commercially licensed drivers

5. A third recommendation would combine the educational potential of the TVS program with the experimentally proven effect of NOTS interventions in reducing subsequent crash involvement. Specifically, drivers who are eligible for NOTS Level 2 non-alcohol advisory letters (approximately 16,000 per year) would be offered the opportunity to attend TVS (with a revised curriculum designed for the repeat violator and crash-involved drivers) and, thereby, avoid the point and letter associated with the Level 2 NOTS intervention. It could logically be hypothesized that Level 2 drivers are an appropriate group for such intervention. Level 2 drivers are those who are

one point away from receiving a licensing action (i.e., probation/suspension) and could, therefore, benefit from a combined effect of the educational potential of TVS and the deterrent effect of potential licensing actions by way of NOTS. The National Safety Council's Attitudinal Dynamics of Driving Course could be the model upon which such customized curriculum could be developed for this group of repeat violators (National Safety Council, 2014). This intervention alternative would have the additional benefit of intervening against drivers cited as being found responsible for a crash by the reporting officer.[35] If successful, such an intervention would be hypothesized to exceed the 3% effect size (i.e., crash reduction) reported in the current study for all TVS drivers and the 8% effect size (i.e., crash reduction) reported in Gebers (2009) for the NOTS Level 2 non-alcohol advisory letter.

6. Require those completing TVS to maintain a crash/citation free record for a specified time period (e.g., 6 months, 9 months) following course completion before permanently masking the TVS-related conviction. The AB 2499 change from a TVS dismissal to a TVS masked conviction and with any subsequent TVS within 18 month receiving a NOTS point no doubt had a deterrent effect on those completing TVS as evidenced by a reduction in post crashes and citations. This is in stark contrast to the negative traffic safety impact of the TVS dismissal policy reported in prior Departmental evaluations. Further modifying the program to require TVS attendees to maintain a clean record for a specified time period subsequent to course completion could increase the deterrent effect of the program by further reducing the crash expectancies beyond the small effect reported in the current study. If successful, such an increased deterrent effect should be observed in TVS drivers with elevated traffic safety indices due to an increased probability of receiving a licensing action (e.g., NOTS probation/suspension) in the event that the TVS masked conviction is "unmasked" and results in a neg-op point. Prior departmental programs that required post course/training clean records to avoid further licensing interventions showed promising results (Harano & Peck, 1971; Marsh, 1978).

The present study offers statistical evidence that the changes in the TVS program as required by AB 2499 reduced the negative traffic safety impact of the preexisting TVS citation dismissal policy. The AB 2499 change in the TVS abstract status from a simple pre-adjudication abstract dismissal to a masked conviction under the condition that a second or subsequent TVS in 18 months would result in a point produced a

[35] As mentioned earlier in the report, NOTS points are generated for responsible crashes as well and not just for traffic convictions.

specific deterrent effect. This effect was evidenced by a measured reduction in subsequent driving incidents especially among drivers with less elevated prior driver record histories.

In moving forward, the present authors hope that these results will serve as a motivation to further improve the TVS program rather than being an end to itself with no further program improvements pursued. Since the TVS program resides within the regulatory influence of the Department following AB 2499, enhancements to the program may be more easily initiated from within the Department with input from stakeholders such as judges, course providers, educators, and law enforcement. Further modifications can subsequently be pursued and implemented following appropriate evaluation.

Such an evaluation component has been in existence for another of the Department's post-licensing control systems. That is, the Negligent Operator Treatment System or NOTS has had an evaluation component in place since the 1970s (NOTES and ENOTES). As a result of successive evaluations, NOTS has undergone numerous changes over the past decades resulting in an increased positive safety impact among drivers receiving the system's interventions (Gebers, 2009). If NOTS is used as a model for further TVS evaluations and program enhancements, it is anticipated that a TVS program utilizing both educational and post license control interventions will result in future increases in program efficacy.

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APPENDIX 1

OUTLINE OF REQUIRED TOPICS AND STANDARDS FOR DMV APPROVED TVS

A Public Service Agency

OUTLINE OF REQUIRED TOPICS AND STANDARDS FOR STATE OF CALIFORNIA, DEPARTMENT OF MOTOR VEHICLES APPROVED TRAFFIC VIOLATOR SCHOOL COURSE

PURPOSE AND OBJECTIVES

The goal of the Traffic Violator School Program is to ultimately:

Reduce traffic collision involvement
Reduce traffic law violations
Reemphasize the responsibilities associated with operating a motor vehicle

The traffic violator school shall create, through a structured learning atmosphere, an understanding of motor vehicle operation essential to violation and collision-free driving, operator responsibility, and licensing requirements.

COURSE

Each course must provide a minimum of 340 minutes of time for classroom instruction or a 42,500 word count for non-classroom instruction expressly devoted to traffic safety and provide a minimum of 60 minutes for completion of the required final test. Time/text alloted for class registration, issuance of a course completion receipt, and any lunch or break periods shall not count toward the time/word count requirement. It should be balanced so as to provide a good overview of the subject matter pertinent to the Traffic Violator School Program.

OUTLINE OF COURSE MATERIAL

Each course submitted for department approval shall provide sufficient detail and content to allow the department to adequately review for course context, method of instruction, and compliance with the minimum amount of instruction time.

Test:
A post lesson test shall be given for each course. The test shall be designed to include questions related to at least eight of the topic areas listed on page 3 (I-XI). It shall include at least one question on each of the following subjects: defensive driving, driver distractions, right-of-way, and operator responsibility. The post lesson examination shall be graded and a passing score shall be 70% or more. It may be an open book test. Students shall not correct their own test. The test shall consist of a minimum of 25 questions. All answers shall be sufficiently plausible to cause the student to consider them and shall not be off topic. Should a student score less than 70%, one additional test may be administered but shall not be the same test. If the student should fail to score 70% or more on the second attempt, they may re-enroll in another Traffic Violator School class. The test shall not be incorporated throughout the lesson but will be completed following the instruction portion. The violator must be given the opportunity to answer all test questions within a 60 minute period.

Internet and Home Study:
When the testing format allows, the test questions shall be randomized. Paper based examinations shall be copyright protected.

Evaluations:
The school shall provide a course evaluation to the attendees as a condition for student program completion. Completion time of the evaluation shall not exceed 5 minutes. The evaluation form design shall be provided by the department. While it is preferred the student completes this form, a student expressing reservations about filling it out, need only enter his/her name on the form to satisfy this requirement. Instructors shall not discourage completion of, tamper with, or withhold the evaluation form before or after it has been completed by the student. The evaluations shall be forwarded quarterly to the department with the statistical information.

Statistical Information:
By the thirtieth day of April, July, October and January, the school shall report to the department, the total number of violators who attended for each modality, the total number of violators who failed to complete the course for each modality, the total number of violators not passing the first test for each modality, the total number of violators not passing a second test for each modality for the previous quarter. This report shall be on the TVS Statistical Report, OL 850, and shall be forwarded to the department with the student evaluation forms.

Requirements for Individual Modalities:
For regulations related to individual modalities, please refer to the California Code of Regulations: Title 13, Division 1, Chapter 1, Article 4.7, Section 345.30 et al.

COURSE LENGTH GUIDELINES

While the time/word count for each topic area is recommended, a curriculum may have somewhat different time frames for topic areas provided that the total time/word count meets the minimum requirements.

The following topic and sub-topic areas are shown with the recommended guidelines for instruction.

		CLASSROOM	OTHER MODALITIES
	Topic Area	**Recommended Time**	**Recommended Word Count and Percentage of Instruction**
i.	Introduction (Course Objectives/Requirements)	5 minutes	725 / 1.70%
I.	Recent Changes/Reasons for Traffic Laws	20 minutes	2500 / 5.88%
II.	Careless Driving and its Consequences	20 minutes	2500 / 5.88%
III.	Operator Responsibilities	45 minutes	5825 / 13.70%
IV.	Rights and Responsibilities of a Pedestrian	5 minutes	650 / 1.52%
V.	Driving Maneuvers	30 minutes	3850 / 9.05%
VI.	Defensive Driving	55 minutes	6975 / 16.41%
VII.	Collision Avoidance	40 minutes	5100 / 12.00%
VIII.	Road Rage/Aggressive Driving and Avoiding It	20 minutes	2500 / 5.88%
IX.	Driver Distractions	30 minutes	3750 / 8.82%
X.	The Vehicle	20 minutes	2500 / 5.88%
XI.	The Road	45 minutes	5625 / 13.23%
XII.	Course Evaluation	5 minutes	N/A / .05%
	TOTAL TIME	**340 MINUTES**	**42,500 / 100%**
	Time Allowed for Post Lesson Examination	60 minutes	

TVS courses shall include instruction on each topic and sub-topic area. All topic and sub-topic areas are to be thoroughly covered in each course submitted for approval.

CURRICULUM

i. INTRODUCTION

A. COURSE OBJECTIVES

1. Reduce traffic collision involvement
2. Reduce traffic law violations
3. Reemphasize the responsibilities associated with operating a vehicle

B. COURSE REQUIREMENTS

1. Attend (all of the) class
2. Participate/be mentally present
3. Pass final examination
4. Complete the DMV course evaluation form

I. RECENT CHANGES/REASONS FOR TRAFFIC LAWS

A. RECENT CHANGES AND THE REASONING BEHIND THEM

1. Recently passed/changed traffic related laws
2. Changes to technology
3. Changes in driving techniques

B. REASONS FOR TRAFFIC LAWS

1. Safety
2. Common understanding
3. Keeping order and movement in traffic

II. CARELESS DRIVING AND ITS CONSEQUENCES

A. DAMAGE TO OR LOSS OF VEHICLE
B. INJURY OR DEATH TO YOU, PASSENGERS, AND/OR OTHERS
C. POSSIBLE AUTO INSURANCE INCREASE
D. FINANCIAL IMPACT/LEGAL ACTIONS/DMV ACTIONS
E. IMPACT ON QUALITY OF LIFE
F. CONTRIBUTING FACTORS CAN CAUSE COLLISIONS
G. EXPLANATION OF NEGLIGENT OPERATOR TREATMENT SYSTEM (NOTS)
H. DUI AND ITS ADDITIONAL IMPACT (NOTE: TOUCH ON TOPIC--NO ONE IS ATTENDING DUE TO A DUI CONVICTION)

1. Emotional
2. Financial cost to offender over 10 year period
3. Added restrictions or loss of privileges
4. On the victims and victim's family
5. On society

III. OPERATOR RESPONSIBILITIES

A. KNOWING WHEN NOT TO DRIVE

1. Personal concerns

a. Tired
b. Feeling overly emotional
c. Inability to focus on driving
d. Poor vision
e. Medicated/alcohol level

2. Exterior concerns

    a. Conditions are beyond driving ability (self-regulating driver)
    b. Vehicle meeting requirements
    c. Driver license/vehicle registration/liability insurance is not valid or current

B. COMMUNICATION
C. BEING COURTEOUS
D. KNOWING AND CORRECTLY APPLYING RULES OF THE ROAD
E. IDENTIFYING AND RESPONDING TO HAZARDS
F. CHILD ENDANGERMENT

1. Checking around vehicle prior to entering and leaving
2. Leaving young children in vehicle unattended

    a. Temperature of a vehicle on a hot day
    b. Releasing brake/shifting to neutral
    c. Properly securing children in vehicle as well as heavy items

G. POOR DRIVING CONDITIONS (SUCH AS DOWNPOUR, SLIPPERY ROADS, ETC)
H. RIGHTS AND DUTIES

1. Pedestrian related to traffic laws/traffic safety
2. Drivers related to pedestrians, bicycles, and motorcycles

IV. RIGHTS AND RESPONSIBILITIES OF A PEDESTRIAN

A. CROSS AT INTERSECTIONS AND DESIGNATED CROSSWALKS
B. USING THE SHOULDER OF THE ROAD, FACING TRAFFIC WHEN NO SIDEWALK IS PROVIDED
C. PEDESTRIANS WITH WHITE CANES OR SEEING EYE DOGS ALWAYS HAVE THE RIGHT OF WAY

V. DRIVING MANEUVERS

A. BACKING
B. LANE CHANGE
C. PASSING
D. RECOVERING FROM HYDROPLANING
E. RECOVERING FROM FISH-TAILING
F. RETURNING TO ROAD FROM UNEVEN SURFACE

VI. DEFENSIVE DRIVING

A. PLANNING TRIPS

1. Packing: first aid kit, flashlight, blanket, navigation aid, warm clothing, etc. in vehicle
2. Checking road conditions/construction (heavy congestion, collisions, chains required, etc.)
3. Inspect or have someone else inspect your vehicle for safety before taking a long trip
4. Allowing extra travel time

B. AVOIDING PROBLEMS ON THE ROAD

1. Maintaining a safe following distance

    a. Three second and three second plus rule
    b. Allowing more space behind motorcycles

2. Avoid driving in the blind spots of other vehicles
3. Planning for an evasive action (e.g., sudden stop ahead or sudden lane change ahead)
4. Driving with your headlights on during the day to increase your vehicle's visibility
5. Avoiding lane changes near intersections
6. Scanning for hazards

a. For parked vehicles moving into traffic
b. At intersections for vehicles taking your right-of-way
c. Before making lane changes (ahead and blind area)
d. Covering the brake as you approach an intersection or recognize hazard ahead
e. Inattentive driver or erratic driving

7. Enhancing driving with aids

a. Use of sunglasses
b. Use of auto designed water repellant on windshield
c. Using convex and/or panoramic mirrors
d. Using an audible back-up warning device

8. Knowing when to give up your right of way

VII. COLLISION AVOIDANCE

A. STATISTICS FOR THE MOST RECENT YEAR REPORTED (PLEASE IDENTIFY YOUR SOURCES)

1. California percentages and numbers by

a. Type of violation
b. Time of day
c. Age groups
d. Gender

2. National percentages and numbers by

a. Type of violation
b. Time of day
c. Age groups
d. Gender

B. COMMON CAUSES OF COLLISIONS

1. Unsafe speed
2. Driving on the wrong side of the road
3. Improper turns
4. Violating right-of-way rules
5. Violating stop signals and signs
6. Driver distractions (discussed in more depth later)

VIII. ROAD RAGE/AGGRESSIVE DRIVING AND AVOIDING IT

A. HOW TO HANDLE ANOTHER DRIVER EXHIBITING ROAD RAGE/BEING AGGRESSIVE
B. KEEPING YOUR OWN EMOTIONS IN CHECK

IX. DRIVER DISTRACTIONS

A. DOING OTHER THINGS

1. Eating
2. Hygiene
3. Electronic devices (cell phones/text devices, navigation devices/dashboard screens)
4. Scenery/window shopping
5. Radio/music/ear buds or headphones
6. Passengers (including children/pets)
7. Other vehicles/hazards

X. THE VEHICLE

A. VEHICLE REQUIREMENTS TO OPERATE ON THE ROAD

1. Lights/instrument panel indicators
2. Belts/fluid levels
3. Horn

4. Windows/mirrors
5. Tires (including spare)
6. Seats/car seats/child safety locks (in the side of back doors)
7. Seat belts
8. Brakes

B. USE OF THE PARKING BRAKE
C. HANDLING MECHANICAL FAILURES ON THE ROAD

1. Safest in vehicle with seat belt and doors locked
2. Strangers offering help

XI. THE ROAD

A. RULES OF THE ROAD

1. Use of lanes

   a. Bicycle lanes
   b. Ending turns
   c. Center left turn lanes
   d. Motorcycle speed used when passing other vehicles and splitting lane rules

2. Passing other vehicles

   a. Special situations

      - Bridges or abutments
      - On hills
      - Intersections or railroad crossings
      - Class A and Class B vehicles

   b. Dangerous situations

      - Long line of vehicles ahead
      - Intention to stop or turn
      - Vehicle ahead is at or near speed limit
      - Sight/distance ahead is limited
      - Unable to pass before reaching no passing zone

3. Right-of-way situations

   a. Controlled intersections (at 4-way stop, yield sign, unprotected left turn)
   b. Intersections when signal is out
   c. Vehicles stopped at crosswalk
   d. Respecting the pedestrian right of way at crosswalks (with/without lines, right turns) and driveways with sidewalks
   e. Respecting the bicyclist's right of way, share the road, entitled to use turn lanes, stay to right when moving slow
   f. Anti-gridlock law
   g. School buses with red flashing lights
   h. Where road or lane narrows
   i. Entering freeways
   j. Where U-turns are illegal
   k. Railroad crossings
   l. Proper lanes to end turns
   m. Traffic breaks

4. Adjusting your driving for conditions
   a. Different road conditions (city, country, construction, congestion)
   b. Different weather conditions (rain, snow, fog or sand/dust storm).

XII. POST LESSON EXAMINATION/REVIEW

XIII. COURSE EVALUATION

Information for Brochures and/or Statistics:
This is not an all inclusive list. The web sites and information posted are subject to change by the identified agencies.

California Office of Traffic Safety	http://ots.ca.gov
National Highway Traffic Safety Administration	http://nhtsa.gov
Aggressive Driver Brochure	http://www.nhtsa.gov/aggressive
Distracted Driver Brochure "Put it Down"	http://www.distraction.gov/campain-tools/
National Road Safety Foundation	http://www.nationalroadsafety.org
CA DMV brochures	http://dmv.ca.gov
Driver/Commercial/Motorcycle handbooks	
It's Not My Fault	Driver Safety 420 (DS 420)
Vehicle Collisions! What to Do	Fast Facts Driver License 16 (FFDL 16)
Driver Distractions	Fast Facts Driver License 28 (FFDL 28)
Safety Tips for Bicyclists and Motorists	Fast Facts Driver License 37 (FFDL 37)
CA DMV Computer Videos (with caption option)	http://apps.dmv.ca.gov/video/index.html
Cellular Phone Use and Driving	
Sharing the Road (segmented, downloadable)	

APPENDIX 2

VARIABLES ASSESSED FOR THE PROPENSITY SCORE LOGISTIC REGRESSION EQUATION

1. Age
2. Gender
3. License class
4. S/R action
5. Total convictions
6. Countable convictions
7. Alcohol/drug major convictions
8. Total crashes
9. Police reported crashes
10. Fatal/injury crashes
11. Total 14601 convictions
12. Solo 14601 convictions
13. Negligent operator points
14. Days of S/R action
15. Days on probation
16. Uncleared major FTAs
17. Uncleared minor FTAs
18. Total cleared FTAs
19. TVS dismissals/masked convictions
20. Responsible crashes
21. Total crashes associated with DUI or reckless convictions
22. Had been drinking crashes
23. Fatal night crashes
24. Injury night crashes
25. Total night crashes
26. Fatal weekend crashes
27. Injury weekend crashes
28. Total weekend crashes
29. Ran off road and hit fixed object crashes
30. Multiple vehicle crashes
31. Misdemeanor DUI convictions
32. Felony DUI convictions
33. Reckless driving convictions
34. Alcohol related reckless driving convictions
35. Hit and run convictions
36. Major convictions involving injury/death
37. Total implied consent refusals

38. Total crashes while under S/R actions
39. Total convictions and FTAs while under S/R action
40. S/R actions due to DUI related major convictions
41. S/R actions due to noncompliance with DUI program
42. S/R actions due to noncompliance with restrictions, IID and probation violations
43. S/R actions due to neg-op violations
44. S/R actions due to FR violations
45. S/R actions due to proof failure
46. S/R actions due to P&M conditions
47. S/R actions due to all other reasons
48. Major FTAs
49. Prior 3-year zip code total crashes
50. Prior 3-year zip code injury crashes
51. Prior 3-year zip code total crashes
52. Prior 3-year zip code moving violations
53. Prior 3-year zip code major convictions

APPENDIX 3

BIOGRAPHICAL/LICENSING CHARACTERISTICS AND PRIOR DRIVER RECORD BY PROPENSITY SCORE QUINTILE

Appendix 3 Table. Distribution of Select Covariates for the Combined TVS Masked Conviction and Conviction Interventions within Quintile

	Quintile				
Variable	1	2	3	4	5
N	98,977	98,983	98,978	98,979	98,980
Mean age	49.79	41.58	37.82	35.08	33.29
% Male	37.88	52.84	59.40	64.97	72.20
% with prior 3-year S/R action	0.23	0.60	1.08	3.70	41.60
Prior 3-year total convictions/100 drivers	13.44	21.04	33.20	59.24	163.71
Prior 3-year alcohol/drug major convictions/100 drivers	0.28	0.55	0.83	1.76	4.70
Prior 3-year total reported crashes/100 drivers	12.71	13.73	13.78	19.56	21.47
Prior 3-year CHP/police reported crashes/100 drivers	7.42	7.25	8.01	9.57	14.26
Prior 3-year fatal/injury crashes/100 drivers	2.85	3.04	3.33	3.95	6.15
Prior 3-year cleared FTAs/100 drivers	0.00	0.01	0.06	0.94	26.99
Prior 3-year TVS dismissals/masked convictions/100 drivers	10.99	11.92	13.02	14.98	15.92
Prior 3-year countable crashes/100 drivers	2.15	2.78	3.72	5.05	8.49
Prior 3-year crashes associated with a DUI or reckless conviction/100 drivers	0.05	0.08	0.10	0.23	0.58
Prior 3-year prior HBD crashes/100 drivers	0.08	0.13	0.17	0.35	0.91
Subsequent 1-year total crashes/100 drivers	6.02	6.04	6.38	7.14	8.25