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DEPARTMENT OF MOTOR VEHICLES

An Examination of the Characteristics and Traffic Risk of Drivers Suspended/Revoked for Different Reasons

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14. ABSTRACT

One measure that has traditionally been used to better control drunk and other high-risk drivers has been to suspend or revoke their privilege to drive. However, because the driving privilege is so highly valued, an increasing number of new laws have been passed which prescribe license suspension/revocation as a punishment for a variety of offenses, including some completely unrelated to driving. This has created a diverse group of suspended/revoked drivers.

Prior research has demonstrated that suspended/revoked drivers pose a significant traffic risk, but until now little has been known about whether, and if so how, this risk varies as a function of the reason for suspension/revocation. This study classifies suspended/revoked drivers into subgroups based on their reason for suspension/revocation, and then develops demographic and driving risk profiles for each group. Separate risk profiles are developed for the following traffic safety indicators, measured 3 years prior to the suspension/revocation action; 1) total crashes, 2) fatal/injury crashes, 3) total traffic convictions, and 4) total incidents (crashes + convictions).

The findings clearly show that: 1) suspended/revoked drivers are a heterogeneous group, both demographically and in their driving behavior; 2) some suspended drivers, such as those suspended/revoked for a non-driving offense, have low traffic risks that are comparable to those of validly-licensed drivers, and; 3) all suspended groups have elevated crash and conviction rates, compared to validly-licensed drivers. The implications of these findings for current laws and policies targeting suspended/revoked drivers are discussed, and recommendations for improving these laws/policies are presented.

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PREFACE

This project is a part of the California Traffic Safety Program and was made possible through the support of the California Office of Traffic Safety, State of California, and the National Highway Traffic Safety Administration. The report was prepared by the Research and Development Branch of the DMV under the administrative direction of Cliff Helander, Chief. The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the State of California or the National Highway Traffic Safety Administration.

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Several individuals made important contributions to this project, and the authors would like to acknowledge and express appreciation for their efforts. Cliff Helander, Chief of the Research and Development Branch, provided general direction to this project, and Debbie McKenzie, Associate Government Program Analyst, prepared the tables and figures in the report, and coordinated its production. In addition, Mary Depaoli, Bev Perry, and Edita Purnell in the department's Driver License Automation Development Section assisted in the classification of suspended/revoked drivers.

EXECUTIVE SUMMARY

Background

Deaths and injuries from motor vehicle crashes are a major public health problem in the United States. The National Highway Traffic Safety Administration (NHTSA) reports that in the year 2000, 41,821 people were killed and another 3,189,000 were injured in crashes in the United States (National Highway Traffic Safety Administration, 2001). The National Safety Council (2001) reports that motor vehicle crashes cost the United States more than 200 billion dollars in 2000.

One general approach that has been used to ameliorate the crash problem has been to develop and implement countermeasures designed to better control the driving risk posed by high-risk, or problem, drivers. One specific measure that targets problem drivers is to suspend/revoke their driver license.

Driver license suspension/revocation are logical and direct measures because they are punishments that fit the crime. In addition, research conducted in California and elsewhere has consistently shown that suspension/revocation are effective in reducing traffic crashes and convictions among drunk and other high-risk drivers (Peck, 1991; Peck & Healey, 1995; Wells-Parker et al., 1995; DeYoung, 1997).

However, while license suspension/revocation work, they do not make high-risk drivers safe; a 1997 study (DeYoung et al., 1997) found that suspended/revoked drivers were almost four times as likely to cause a fatal crash as validly-licensed drivers. In addition, the large number of suspended/revoked drivers—an estimated 1,800,000 in California—further exacerbates the risk they pose.

The discussion so far has treated suspended/revoked drivers as a homogenous group of high-risk drivers, and this is reflective of how the traffic safety system has dealt with them; laws and policies prescribing sanctions for suspended/revoked drivers tend to treat all suspended/revoked drivers alike. However, there are many offenses for which license suspension/revocation are prescribed as a penalty, ranging from serious traffic crimes such as drunk driving, to non-traffic offenses like failing to pay child support, and this has created a heterogeneous suspended/revoked population.

Currently, in California, there is a lack of congruence between some of the laws and policies targeting suspended/revoked drivers, and the suspended/revoked drivers themselves. For example, the current vehicle impoundment law (California Vehicle Code [CVC] Section 14602.6) applies to some relatively low-risk suspended/revoked drivers, while excluding more dangerous ones. This lack of consistency in the laws/policies targeting suspended and revoked drivers, which is at least partly due to a lack of good information on the risks posed by different groups of suspended/revoked drivers, threatens the integrity of these laws and countermeasures.

Current Study: Overview

The present study provides information on the demographic characteristics and driving behavior of different types of suspended/revoked drivers. Categories, or subtypes, of suspended/revoked drivers were developed based on their reason for suspension or revocation, and risk profiles were calculated for each subgroup using historical information on their numbers and types of crashes and traffic convictions. In addition, a risk profile was developed for a random sample of California drivers, and this provided a baseline to which the profiles of the suspended/revoked groups were compared. The implications of these findings for laws and policies concerning suspended/revoked drivers are discussed.

Research Methods

Two groups of drivers were sampled from DMV's databases. The first group consisted of all drivers whose licenses were suspended/revoked by the department in 2001, while the second group was comprised of a random sample of California drivers with valid driver licenses. The latter group served as a baseline for assessing the traffic risk of suspended/revoked drivers.

Drivers in the suspended/revoked group were categorized into subgroups based on data in their driver records that indicated the reason for their suspension/revocation. The following nine major suspended/revoked driving groups were identified:

Driving under the influence (DUI). Drivers suspended/revoked for DUI convictions, Administrative Per Se (blood alcohol content of .08% or greater) actions, or refusal to take a chemical test.

Physical and mental conditions (P&M). Drivers suspended/revoked based on evidence of physical or mental impairment that could affect their ability to drive safely. This category includes dementia, lapse of consciousness and Alzheimer's disease.

Lack of skill. These drivers were suspended/revoked due to evidence that they lack the requisite skills to drive safely. These drivers are typically either elderly people without obvious P&M impairment, or young drivers who never learned to drive.

Negligent operators (neg ops). Drivers suspended/revoked for accumulating neg op points, resulting from traffic convictions, or crashes for which the driver was judged responsible by a peace officer.

Serious offenders. These drivers were suspended/revoked for being convicted of one or more serious driving offenses, such as road rage, reckless driving, or manslaughter.

Failure to appear for a court hearing (FTA). Drivers suspended/revoked for failing to appear for a court hearing, failing to pay a fine levied by the court, or because they submitted a fraudulent application for a driver license. Drivers suspended/revoked for these different reasons were grouped together because of the anti-social element underlying the offenses.

Financial responsibility (FR). These drivers were suspended/revoked because they were unable to show proof of financial responsibility, or automobile insurance, at the time of a crash.

Proof failure (of financial responsibility). Like drivers in the FR group, drivers suspended/revoked for proof failure lost their licenses for lack of financial responsibility. However, unlike the FR group, drivers in the proof failure group did not receive their suspension/revocation action because of a crash, and they did have insurance at some point, but failed to maintain it.

Non-driving. Drivers suspended/revoked for failing to pay child support. Drivers in this group were included in order to examine a class of suspended/revoked drivers who lost their licenses for reasons completely unrelated to their driving behavior.

Demographic and driving history data for the suspended/revoked and validly-licensed groups were obtained from DMV's driver record database. One of the main goals of the study was to assess the relative traffic risk posed by each of the suspended/revoked groups, and this was accomplished by examining crashes and traffic convictions for drivers that occurred during the 3 years prior to the date of the suspension/revocation action (validly-licensed drivers, for the purposes of computing 3-year prior crashes/convictions, were assigned dates equivalent to the suspension/revocation action dates of suspended/revoked drivers). More specifically, the following four driving history measures were examined; 1) total crashes, 2) fatal/injury crashes, 3) total traffic convictions, and 4) total incidents (total crashes + total traffic convictions).

Each of the four driving history measures was examined separately. For each measure, a risk estimate was computed for each group using Poisson and negative binomial regression models. Relative risk ratios were developed for each suspended/revoked group, using validly-licensed drivers as a baseline, and the relative risks of the groups were compared. It should be noted that these procedures provided a picture of the relative traffic risks posed by different groups of suspended/revoked drivers up to the

point of the suspension/revocation action, but that because of both statistical (e.g., regression to the mean) and logical (e.g., confounding of different sanctions with group risks) reasons, these historical risks should not be extrapolated into the future.

Results

Demographic analysis

An examination of the age and gender composition of the groups revealed that there are significant differences among the groups on these two demographic measures. For example, drivers suspended/revoked for lack of skill were, on average, 72 years old, which is more than two-and-a-half times that of drivers suspended/revoked for neg op, who averaged 29 years of age. In addition, while most of the suspended/revoked groups were predominately male, the lack of skill suspended/revoked group was 52% male, which closely mirrors that of the general driving population. It is clear form this that suspended/revoked drivers are a heterogeneous group.

Total crashes

Figure 1 presents the total crash risks for the suspended/revoked and validly-licensed sample groups.

The total crash risks vary significantly among the suspended/revoked groups, and between these groups and the validly-licensed group. Drivers who were suspended/revoked for financial responsibility pose the greatest crash risk, with a risk that is more than five times that of the non-driving group, and more than seven times that of validly-licensed drivers. On the other hand, the total crash risk of the non-driving-related-incident group is not much different than that of the validly-licensed sample group of male drivers under the age of 25.

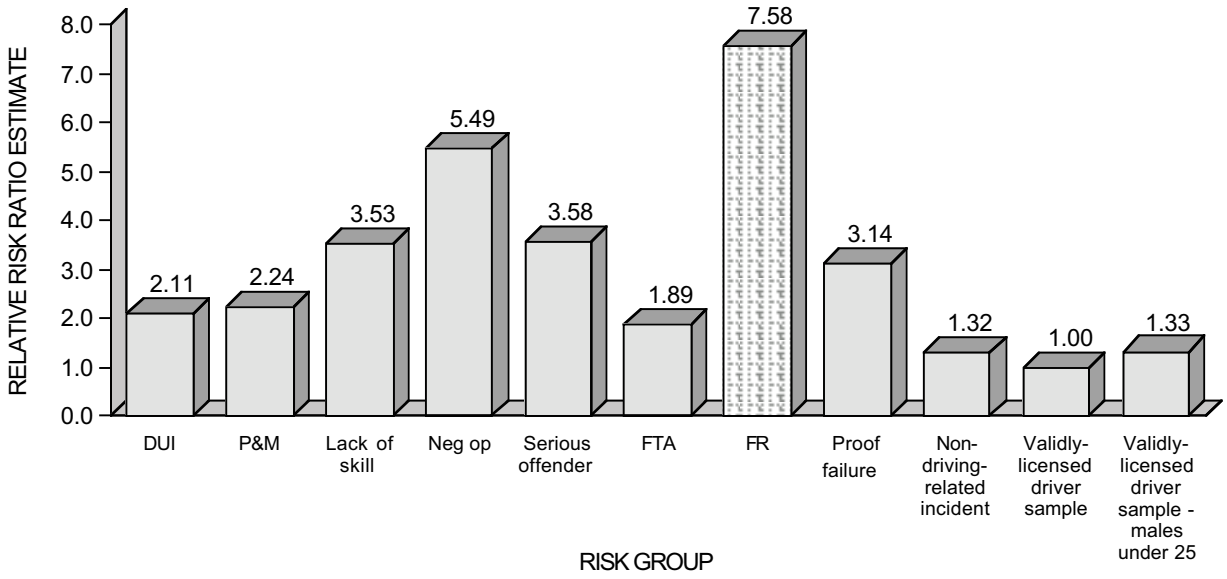

Figure 1. Relative 3-year prior total crash risk (risk ratio estimate) for each suspended/ revoked and validly-licensed driver sample group.

Fatal/injury crashes

The fatal/injury crash risks for the suspended/revoked and validly-licensed sample groups are presented in Figure 2.

As with total crashes, fatal/injury crash rates vary significantly among the suspended/revoked and validly-licensed groups. Serious offenders pose the greatest fatal/injury crash risk, with a rate that is more than nine times higher than the rate for the validly-licensed group. There are also significant differences among the suspended/revoked groups; the non-driving-related-incident group's fatal/injury rate is the lowest, and is only about one-fifth that of the serious offender group.

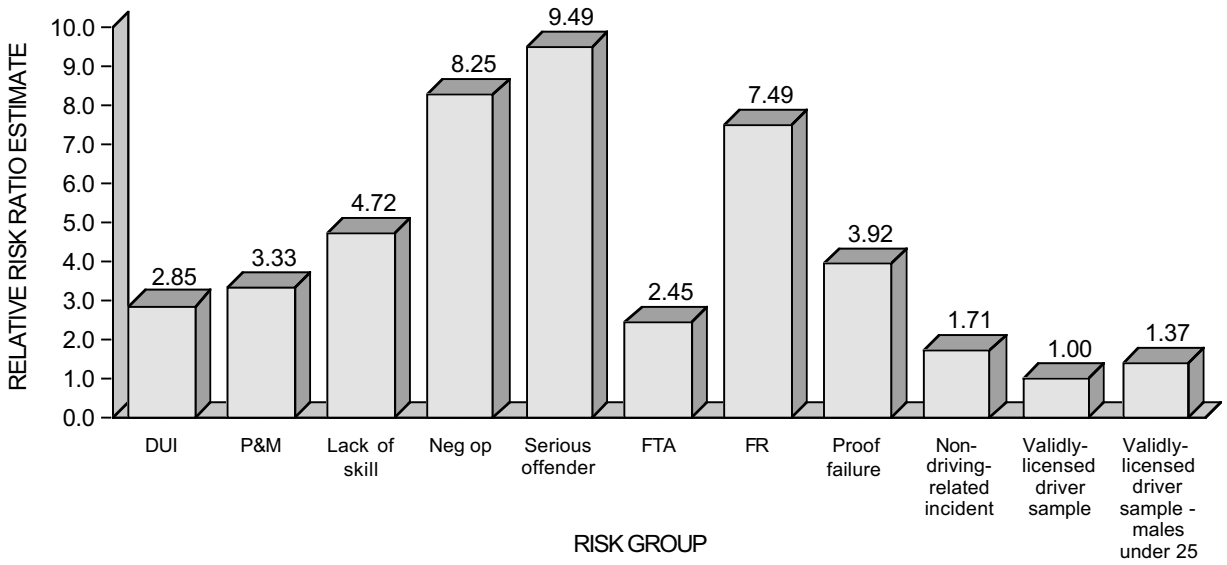

Figure 2. Relative 3-year prior fatal/injury crash risk (risk ratio estimate) for each suspended/revoked and validly-licensed driver sample group.

Total traffic convictions

The relative risks of the groups change when the focus shifts from crashes to traffic convictions, as can be seen from Figure 3, below.

The neg op group has the highest rate of total traffic convictions, which is more than ten times that of the P&M group's rate. The P&M and lack of skill groups have rates of total traffic convictions that are only marginally higher than the validly-licensed group, and actually lower than validly-licensed males under the age of 25.

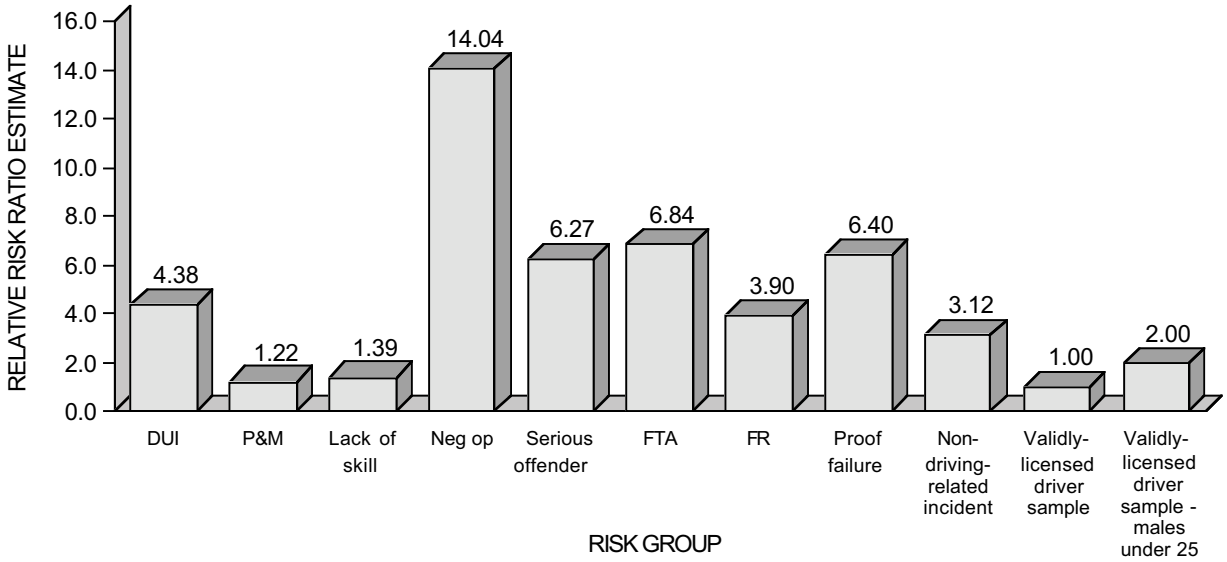

Figure 3. Relative 3-year prior total conviction risk (risk ratio estimate) for each suspended/revoked and validly-licensed driver sample group.

Total incidents

Total incidents, which consist of a combination of crashes and traffic convictions, can be considered a summary measure of risk. Total incidents for the suspended/revoked and validly-licensed groups are presented in Figure 4, below.

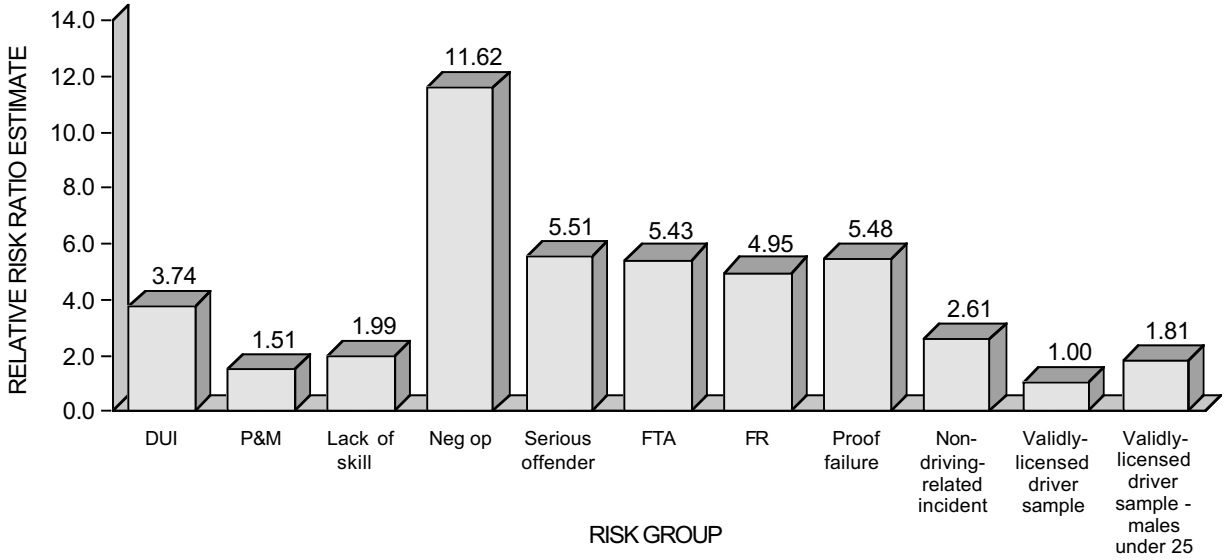

Figure 4. Relative 3-year prior total driving incidents risk (risk ratio estimate) for each suspended/revoked and validly-licensed driver sample group.

By far the group with the highest total incident rate is the neg op group, whose rate is about twice that of the second highest group, serious offenders. The P&M group has the lowest total incident rate, which is higher than the rate for validly-licensed drivers, but lower than the rate for validly-licensed males under the age of 25.

Discussion and Recommendations

The findings from this study clearly demonstrate three important points:

1. Suspended/revoked drivers are a heterogeneous group, both demographically and in their driving behavior.

2. Some suspended/revoked drivers, such as those suspended/revoked for the non-driving offense of failing to pay child support, have relatively low traffic risks that are not much higher than the validly-licensed group.

3. All suspended/revoked groups have elevated crash and traffic conviction rates, compared to validly-licensed drivers.

These findings show that different suspended/revoked groups pose different risks to other road users, and strongly suggest that laws and policies targeting suspended/revoked drivers differentiate between such drivers based on their reason for suspension/revocation. A prime example is California's vehicle impoundment law (CVC 14602.6), which presently excludes high-risk FR and neg op drivers. This law, and others, should be modified to better reflect the nature and risk of the suspended/revoked offenders to whom they apply; the findings from this study provide the necessary information upon which such changes should be based.

However, there are even more serious problems with the current suspension/revocation laws, as the findings on the risks of drivers suspended/revoked for failing to pay child support point out. This group, which is suspended/revoked for reasons completely unrelated to their driving, has the lowest crash risk of any suspended/revoked group, and poses little more risk on the highways than the validly-licensed drivers. This raises the question as to whether they should be suspended/revoked in the first place.

This isn't to say that failure to pay child support is not a serious offense, only that from a traffic safety perspective, suspending offenders' driver licenses is the wrong punishment. Not only does the punishment not fit the crime, such drivers pose little risk to other road users. It is difficult enough to enforce the license suspension laws, as the low rates of detection, prosecution, and conviction for driving-while-suspended show (DeYoung, 1990), and prescribing license suspension/revocation for an ever-increasing number of offenses, some of which are unrelated to driving, threatens the foundation of the license suspension system. The current license suspension/revocation laws should be rewritten to exclude persons who have committed a non-driving offense (failure to pay child support is a national mandate and would need to be revised at the federal level, but other non-driving offenses can be changed at the state level).

Based on the findings from this study, and other research on suspension/revocation, the following specific recommendations are made.

1. The R&D Branch at DMV should write a proposal to convene an interagency committee to examine and consider revising the current suspension/revocation laws, and submit this proposal to the Office of Traffic Safety for funding consideration.

2. The R&D Branch should establish an interagency committee consisting of representatives from DMV, the courts, law enforcement agencies, and the Legislature, and facilitate meetings of the committee to examine and consider revising the suspension/revocation laws based on research evidence from this study and other valid research.

3. The current vehicle impoundment law, CVC 14602.6, should be rewritten to more rationally reflect the risks of the suspended/revoked drivers it includes and excludes from its provisions.

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INTRODUCTION

Deaths and injuries from motor vehicle crashes are a major public health problem in the United States. The National Highway Traffic Safety Administration (NHTSA) reports that in the year 2000, 41,821 people were killed and another 3,189,000 were injured in crashes in the United States (National Highway Traffic Safety Administration, 2001). Motor vehicle crashes were the most common type of unintentional fatal injury for persons between the ages of 1 and 77 in 2000, and the most common reason overall for death for those between 1 and 33 years of age (National Safety Council, 2001). In addition to this high human cost, crashes also exert an enormous economic cost on society; the National Safety Council (2001) reports that, in the year 2000, motor vehicle crashes cost the United States more than 200 billion dollars.

There have been numerous attempts over the years to ameliorate the motor vehicle crash problem, and these have had some success. Such attempts have focused on two broad areas. The first involves measures designed to improve the safety of vehicles, or the driving environment (highway geometry, pavement surface, lighting, etc.). The second general focus has been on drivers. Within this latter category are countermeasures which attempt to control the risk posed by certain groups of drivers: Those who have a history of negligent driving, involvement with drugs or alcohol, physical or mental impairment, or otherwise pose a significant risk to other road users. While there are a variety of countermeasures targeted towards high-risk drivers, the most direct action is to suspend or revoke the driving privilege.

License Suspension/Revocation

License suspension/revocation has been used for decades, often in combination with other countermeasures, to control problem drivers. License suspension/revocation is a logical measure to prescribe for problem drivers, as driving behavior that threatens other road users is punished by withdrawing the person's privilege to drive. License suspension/revocation is a penalty that fits the crime.

Not only is license suspension/revocation a logical measure, it is one that works, to some extent. Research conducted in California and elsewhere has consistently shown that license suspension/revocation is effective in reducing traffic crashes and traffic convictions among drunk and other high-risk drivers (Peck, 1991; Peck & Healey, 1995; Wells-Parker et al., 1995; DeYoung, 1997). Ironically, license suspension/revocation has demonstrable traffic safety benefits even though a majority of suspended/revoked drivers continue to drive during their period of suspension. Research conducted in California (Hagen et al., 1980) and New Mexico (Ross & Gonzales, 1988) has shown that as many as 75% of suspended/revoked DUI offenders violate their suspension/revocation order and continue to drive. While it seems counterintuitive, license suspension/revocation works even though it is violated, because while suspended/revoked drivers continue to drive, they do so less often and more carefully, in order to avoid detection and prosecution for driving-while-suspended (DWS).

Therefore, license suspension/revocation does work, but it does not completely remove the risk posed by problem drivers. A 1997 study (DeYoung et al., 1997), which used quasi-induced exposure to measure the fatal crash culpability of suspended/revoked and unlicensed drivers in California, found that suspended/revoked drivers were almost four times as likely to cause a fatal crash as validly-licensed drivers. This study and others (DeYoung, 1990) clearly show that suspended/revoked drivers are a serious traffic safety problem and warrant special attention.

Suspended/revoked drivers are a problem not just because of their driving behavior, but also because of their large numbers. Several years ago, a systematic random sample of drivers was selected from DMV's driver license master file, and the individual records were examined for evidence of an active suspension/revocation action (Gebers, 1995). This study showed that, at a given point in time, about 1,800,000 drivers were suspended or revoked in California. Their large numbers make these high-risk suspended/revoked drivers all the more dangerous.

The discussion so far has treated suspended/revoked drivers as a homogeneous group of high-risk drivers. However, upon closer inspection, suspended/revoked drivers are composed of different subgroups of drivers who have received their license suspension/revocation for different reasons. For example, drivers who are suspended/revoked for physical or mental conditions tend to be older and more balanced in gender than drivers suspended/revoked for negligent operation of a motor vehicle.

This heterogeneity in suspended/revoked drivers is likely increasing over time, as more new laws are enacted prescribing license suspension/revocation for a variety of different offenses. Because the privilege to drive is so highly valued in our society, license suspension/revocation is viewed as a useful "stick" to encourage people to comply with a variety of laws, most related to traffic offenses, but others involving a variety of non-traffic criminal behavior. For example, in California, a driver license can be suspended for such non-traffic offenses as failure to pay child support, graffiti or vandalism.

Although drivers can be suspended/revoked for a variety of traffic or nontraffic reasons, we tend to think of suspended/revoked drivers as a homogenous group of high-risk drivers, and laws and policies are developed and directed at them as if these drivers were all alike, with similar driving behaviors and crash expectancies. One example is California's vehicle impoundment law (California Vehicle Code [CVC] Section 14602.6). This law, which allows peace officers to seize and impound vehicles driven by suspended/revoked and unlicensed drivers, was originally written so that impoundment was applied uniformly to all suspended/revoked drivers, regardless of their reason for suspension/revocation. Even subsequent clean-up legislation, which now excludes certain types of suspended/revoked drivers from impoundment, makes only crude distinctions between the various types of suspended/revoked drivers, and not necessarily based on the risk these drivers represent.

Current Study

One of the reasons that laws and policies in California tend to treat suspended/revoked drivers as a homogenous group is that relatively little is known about the different types of suspended/revoked drivers. While a significant body of research exists that examines the relative efficacy of license suspension/revocation as a traffic safety countermeasure, comparatively little research has been conducted on the nature of suspended/revoked drivers themselves, and almost none on the different types of suspended/revoked drivers and their risk profiles.

One California study (DeYoung, 1990) that did examine suspended/revoked drivers to some extent showed that subgroups of drivers suspended for DUI, and for a history of DWS (i.e., habitual traffic offenders), had somewhat different crash and traffic conviction histories than that of suspended/revoked drivers overall, and that of validly-licensed drivers as well. Importantly, this study also showed that the fatal/injury and total crash rates of all of the suspended groups were elevated, and that suspended/revoked drivers represent a significant traffic safety risk. In addition, an examination of Department of Justice arrest records showed that fully one-third of suspended/revoked drivers had an arrest for some type of non-traffic criminal offense (80% of habitual traffic offenders had such an arrest), indicating that there is a significant anti-social element in this driving population. While these data are important, they are now more than a decade old, and the findings are limited to only two categories of suspended/revoked drivers.

Many important questions about suspended/revoked drivers remain unanswered. How different from one another are the various types of suspended/revoked drivers with respect to age, gender and other characteristics? What are their relative traffic safety risks? Are some groups more likely to have a history of crashes, while others have a pattern of traffic convictions? If such data were available, laws and policies could be crafted that would better reflect the offenders to whom they are applied. This is important for several reasons. A punishment should fit the crime and the risk posed by the offender, and relatively harsh penalties such as vehicle impoundment and forfeiture should not be prescribed for relatively low-risk suspended/revoked drivers, especially those suspended/revoked for non-traffic offenses. In addition, the integrity of laws and countermeasures is better maintained when they are regarded as fair and evenly applied. Finally, laws and policies tailored to the risk level of the offender may ultimately prove to be more effective measures than current ones that make no distinction between the risks posed by different types of suspended/revoked drivers.

The present study provides information on the demographic characteristics and driving behavior of different types of suspended/revoked drivers. Categories, or subtypes, of suspended/revoked drivers were developed based on their reason for suspension/revocation, and risk profiles were calculated for each subgroup using historical information on their numbers and types of crashes and traffic convictions. In addition, a risk profile was developed for a random sample of California drivers, and this provides a baseline to which the profiles of the suspended groups can be compared. The implications of these findings for laws and policies concerning suspended/revoked drivers are discussed.

METHODS

Subjects

Two groups of drivers were used for the analyses. The first group consisted of all individuals who had a departmental contact relating to a driver license suspension/revocation action during the year 2001. The second group consisted of licensed drivers randomly selected from the department's California Driver Record Study Database and was used as a baseline for assessing the traffic safety risk of the suspended/revoked drivers. These two groups are described in more detail below.

Suspended/revoked group

The Department of Motor Vehicles maintains monthly and annual computer files containing information on individual drivers receiving suspension/revocation actions initiated by the department. These automated datasets are collectively titled the suspension/revocation, or S/R, Files. The 2001 annual S/R File was used as the source for identifying the suspended/revoked drivers for the present study.

An examination of the 2001 S/R File revealed that the department took approximately 1.4 million suspension/revocation actions during calendar year 2001. Because the S/R File did not include data on the effective dates of the actions, or the date the suspension/revocation order was mailed, it was necessary to match data on the S/R File with data on the department's electronic Driver License (DL) Master File, which also contains biographical and driver record information.

After data on the S/R File were matched to information on the DL Master File, it was necessary to identify and exclude certain types of suspended/revoked drivers from the study. The first type of excluded driver consisted of those drivers whose suspension/revocation action was subsequently set aside by the department. For example, this situation can occur when a driver is unable to show proof of financial responsibility at the time of a crash. When this occurs, the department suspends the person's driver license, and a record of this action is stored on the S/R File (as well as on the DL Master File). However, in many cases, the driver actually has insurance but simply did not have proof of it available at the time of the crash. When the driver subsequently demonstrates the insurance proof to the department, the suspension/revocation action is set aside. Because these are not "true" suspensions/revocations, drivers with suspensions/revocations that were later set aside were removed from the sample.

There were several other suspended/revoked driver record profiles excluded from the study as well. All records with an "X" driver license number prefix (i.e., records created for drivers who do not have a known or valid license number) were excluded from the analyses. While the department issues the X-prefixed driver license number in an attempt to track them and/or subsequently match them to a valid DL record, driver record and demographic data for these drivers is notoriously unreliable and spotty. In addition, some drivers had multiple suspension/revocation actions during 2001. For these drivers, only the first suspension/revocation action during the year was identified and included in the sample, and second and subsequent suspension/revocation actions were omitted. Drivers whose records indicated that they were deceased were also

removed from the sample. Finally, a small number of drivers identified on the 2001 S/R File had suspension/revocation actions in which the order was not mailed in 2001. Because the calendar year 2001 mail date of the suspension/revocation order was used to reference or "anchor" an individual's driver record in time, drivers with mail dates in years other than 2001 were excluded from the sample. Following completion of the selection process, 676,623 suspended/revoked drivers were retained in the final sample for use in the subsequent data analyses.

After the suspended/revoked drivers were identified and sampled, DL Master File information about the license suspension/revocation action was used to classify the drivers into suspended/revoked subtypes. The DL Master File contains a 3-digit code used to describe the various reasons that licenses are suspended or revoked. While there are literally hundreds of these reason codes, the majority reflects only minor variations within several major reasons for suspending/revoking a driver license. A group of DMV staff with expertise in the department's application and electronic coding of the suspension/revocation actions was convened in order to identify and categorize the major suspension/revocation typologies used in the present study.

Nine major suspended/revoked groups were identified, and these are listed and briefly defined below:

Driving under the influence (DUI). These are suspension/revocation actions associated with DUI convictions, Administrative Per Se (blood alcohol content [BAC] of .08% or greater) sanctions, or refusal to take a chemical test.

Physical and Mental Conditions (P&M). These are suspension/revocation actions taken for various indications of P&M impairment believed to affect the ability to drive safely. These actions include dementia, lapse of consciousness, and Alzheimer's.

Lack of Skill. These suspension/revocation actions are imposed upon evidence of a driver's lack of driving skill. These are predominately elderly drivers without obvious physical or mental impairment, or young drivers who have never learned to drive competently.

Negligent Operators (neg op). These suspension/revocation actions are imposed by the department's negligent operator treatment system as a result of a driver's accumulating neg op points resulting from traffic convictions, and/or involvement in crashes in which the driver is deemed to be the responsible party by a law enforcement officer.

Serious Offenders. These actions are taken upon the recording on a driver's record of one or more serious driving offenses such as road rage, reckless driving, or manslaughter.

Failure to Appear for a Court Hearing (FTA). This group includes licensing actions that were taken because the driver failed to appear for a court hearing, failed to pay a fine levied by the court, or persons suspended/revoked because they submitted a fraudulent application for a driver license. While these offenses are somewhat different, they were combined due to the anti-social component underlying them.

Financial Responsibility (FR). These actions are applied to the driver who is unable to demonstrate proof of financial responsibility, or automobile insurance, at the time of a crash.

Proof Failure (of financial responsibility). While these suspensions were also ordered due to a lack of financial responsibility, they were classified separately from the FR group because proof failure actions differ from FR actions in two important ways. One difference is that proof failure is not necessarily associated with a crash. A second difference is that drivers receiving a proof failure action had insurance at some point but failed to maintain it.

Non-driving. These suspensions were taken due to the driver failing to pay child support. They were included in order to examine a class of suspensions taken for reasons completely distinct from the person's driving behavior.

Sample of licensed California drivers

A random sample of licensed California drivers was selected from the California Driver Record Study Database. This database stores information on a systematic 1% random sample of licensed California drivers (i.e., those with a driver license number ending in 01). Detailed information on this database is provided by Peck, McBride, and Coppin (1971), Peck and Kuan (1983), and Gebers and Peck (in press).

This sample was used to create a comparison group for assessing the relative crash risk of drivers in the suspended/revoked groups defined above. The sample that was created provided prior 3-year driving record histories and demographic information in a manner comparable to drivers in the suspended/revoked action groups.

The sample of licensed California drivers utilized for the present study consisted of 200,737 drivers. Drivers in this group were assigned equivalent reference dates to subjects in the suspended/revoked action groups. All records with an 'X' driver license prefix, with a deceased indicator, or with invalid gender and/or birth date information were excluded from the analyses. Additionally, any suspended/revoked subject whose driver license ended in 01 was eliminated from the sub-sample of licensed drivers to ensure that the same driver was not included in both groups. Thus, this random sample consists of a comparison group of validly-licensed drivers.

Statistical Analysis

In this section, an overview is presented of the statistical analyses along with a description of the sequential steps used in the parameter estimation process. Some methodological details are reserved for the Results section because they are more understandable in the context of the findings. The data analyses were performed using SPSS Frequencies (SPSS, 1999), SAS Proc Freq, SAS Proc Genmod, and SAS Proc Tabulate (SAS, 1987; SAS, 1989ab).

The traffic safety risks posed by drivers in the suspended/revoked groupings above were assessed in a series of analyses. The statistical analyses proceeded in the following sequence:

1. Create profiles of suspended/revoked risk groups;
2. Examine the raw crash and citation rates for the suspended/revoked risk groups and;
3. Conduct a series of regression analyses to assess the traffic safety risk of the suspended/revoked groups on the following four criteria or dependent variables:
   - Total crashes (defined as the total number of reported [by law enforcement agencies and /or involved drivers] motor vehicle collisions on file);
   - Fatal/injury crashes (defined as a motor vehicle collision resulting in the death and/or reported or observed injury to one or more persons);
   - Total convictions (defined as the total number of traffic convictions, failure to appear violations, and traffic violator school citation dismissals on file) and;
   - Total driving incidents (defined as the sum of total crashes and total convictions).

Regression model development

Following the collection and processing of the data, it was necessary to select the appropriate model form for the crash and conviction measures. A review of prior traffic citation and crash frequency modeling efforts was conducted to help determine the appropriate model form, with the major effort focusing on the criterion of most interest, traffic crash involvement. Attempts to analyze traffic crash and/or citation data have ranged from the use of conventional multiple linear regression using least squares regression techniques, to methods involving exponential distributions such as Poisson and negative binomial (Gebers, 1998).

Historically, the most common statistical approach has been to model the relationship between a set of predictors and traffic crash frequency through the use of ordinary least squares regression. The ordinary least squares regression equation is defined as the following: $\gamma_I = \beta_0 + \beta_{1x1} + \beta_{2x2} + \ldots + \beta_{kxk} + \varepsilon$ where γ_I is the dependent variable (total crashes in the present example), β_0 is a constant value, and β_{1x1} through β_{kxk} represent the parameter estimates associated with the predictor or independent variables.

It is often reported in the traffic safety literature that ordinary least squares regression is inappropriate for modeling crash frequency data for several reasons (Boyer, Dionne, & Vanasse, 1990; Grogger, 1990; Davis, 1990). One reason is that the model form is not restrained from predicting negative values. The computation of a negative value produces bias in the estimated regression coefficients. A second reason is that heteroscedasticity problems have been found when using ordinary least squares regression to model crash frequency data. A fundamental assumption underlying ordinary least squares regression is that all random errors have the same variance at different levels of the explanatory variable. The homogeneity of residual error assumption is invariably violated with crash data because of the direct proportional relationship between the means and variances of the arrays, thereby introducing heteroscedasticity into the distribution of the residuals.

As a result of the problems encountered with using ordinary least squares regression to model crash data, Poisson regression has emerged as a more viable statistical technique to model crash frequency. In the case of traffic crashes, the Poisson distribution yields the following:

$$\Pr(Y = K) = (e^{-\lambda})\frac{\lambda^K}{K!}$$

where Pr (Y = K) is the probability that the number of crashes, Y, will equal K, e = 2.71828… (base of the natural logarithm), and λ is the expected number of crashes. Given a vector of variables, λ for an individual driver can be estimated by the following equation: $\lambda_i = e^{(\beta_0 + \beta_{1x1} + \beta_{2x2} + \ \ldots \ + \beta_{kxk})}$ or as more commonly expressed in the linear form of the logit $\ln(\lambda) = \beta_0 + \beta_{1x1} + \beta_{2x2} + \ \ldots \ + \beta_{kxk}$ where all variables are as earlier defined.

Poisson regression models are not restricted to all of the assumptions noted above for ordinary least squares multiple regression models and are specifically applicable to discrete count data where the probability of a given event (e.g., traffic crashes) is relatively infrequent and can be approximated by a Poisson probability function.

The Poisson distribution, however, suffers from a potentially important limitation, namely that the dependent variable's mean and variance are constrained to be equal (Kleinbaum, Kupper, & Muller, 1988). Data overdispersion (in which the variance is greater than the mean) or underdispersion (in which the variance is less than the mean) violates this constraint and leads to biased estimates of the significance of the regression coefficients. If overdispersion is present, the negative binomial regression model is employed as an alternative.

The negative binomial model is more appropriate for overdispersed data because the model relaxes the constraint of equal mean and variance (McCullagh & Nelder, 1989). This relaxation of the Poisson constraint is accomplished through the addition of a Gamma-distributed error term to the Poisson model. The resulting negative binomial model is expressed as the following: $\ln(\lambda) = \beta_0 + \beta_{1x1} + \beta_{2x2} + \ldots + \beta_{kxk} + \varsigma$ where ς is the Gamma-distributed error term. All other variables are as defined above. The addition of ς allows the mean to differ from the variance.

It is possible to account for the degree of overdispersion with respect to the Poisson model by introducing a dispersion parameter ϕ into the relationship between the variance and the mean: $\mathrm{Var}(Y_i) = \phi\mu$. When $\phi = 1$, the data are not overdispersed, and the ordinary Poisson regression model is appropriate. When $\phi > 1$, the data are overdispersed, and modeling the data with a negative binomial equation is more appropriate.[1] McCulagh and Nelder (1989) suggest to estimate the dispersion parameter ϕ as a ratio of the deviance or the Pearson chi-square to its associated degrees of freedom.

As a result of the above noted assumption violations related to modeling traffic safety criteria, ordinary least squares multiple regression was not considered in the present

[1] An additional option to modeling overdispersed data is the application of a Poisson model corrected for overdispersion. The Poisson model corrected for overdispersion utilizes a dispersion parameter in the equation. However, the inclusion of the dispersion parameter does not introduce a new probability distribution but just gives a correction term for testing the parameter estimates under the Poisson model. The Poisson models are fit in the usual way, and the parameter estimates are not affected by the correction term, but the estimated covariance matrix is inflated by this factor. This method produces an approximate inference if overdispersion is modest (Cox, 1983). In the present study, when overdispersion was encountered, the more commonly accepted negative binomial regression model was employed rather than use of a Poisson model corrected for overdispersion.

study. Instead, Poisson and negative binomial model forms were examined with the presence of overdispersion, determined by both the ratio of the deviance and Pearson chi-square to its associated degrees of freedom, employed as the final model form determinant.

RESULTS

Group Characteristics

Table 1 displays the biographical characteristics of the suspended/revoked driver groups and the random sample of all non-suspended licensed drivers.

Table 1

Number of Subjects (*N*), Mean Age, and Percentage of Women for the Suspended/Revoked Driver Groups and the Validly-Licensed Sample of All Non-Suspended Drivers

Driver group	N	Mean age	% women
DUI	162,648	34.65	17.62
P&M	22,547	55.76	43.57
Lack of skill	8,146	71.87	47.89
Negligent operator	32,783	28.88	14.75
Serious offender	1,294	31.52	15.07
FTA	252,988	31.34	32.21
FR	35,994	34.03	38.48
Proof failure	89,616	33.37	20.86
Non-driving-related incident	70,607	36.90	14.00
Validly-licensed sample	200,737	45.24	49.86

The results show the following:

- The largest subgroup of suspended/revoked drivers, at 37%, are those drivers who were suspended/revoked for failure to appear for a court hearing. The DUI group contains the second largest number—approximately 24% of the total suspended/revoked driver groups.
- Drivers in the lack of skill suspended/revoked driver group were substantially older than all other driver groups, while drivers in the neg op group were the youngest.
- With the exception of the P&M and lack of skill groups, the average age of the remaining suspended/revoked driver groups was younger than the validly-licensed group.

- While the P&M and lack of skill groups, like the validly-licensed sample group, were about half male, the remaining suspended/revoked groups were dominated by men.

Comparison of Group Driver Record Means

Table 2 presents rates of total crashes, fatal/injury crashes, total convictions, and total driving incidents for the suspended/revoked driver groups during the three years prior to a departmental suspension/revocation contact in 2001. Also shown are the prior 3-year rates for the sample of validly-licensed drivers and the sample of validly-licensed male drivers under the age of 25.

Table 2

Prior 3-Year Crash and Conviction Rates (Per 100 Drivers) by Group

Driver group	Total crashes	Fatal/injury crashes	Total convictions	Total incidents
DUI	31.08	10.41	163.68	194.76
P&M	33.02	12.17	45.61	78.63
Lack of skill	52.10	17.26	51.82	103.92
Negligent operator	81.07	30.14	524.46	605.53
Serious offender	52.86	34.70	234.16	287.02
FTA	27.82	8.96	255.28	283.10
FR	111.89	27.39	145.81	257.70
Proof failure	46.34	14.34	239.05	285.40
Non-driving-related incident	19.46	6.25	116.49	135.95
Validly-licensed sample	14.76	3.65	37.35	52.10
Validly-licensed sample – males under age 25	19.62	5.01	74.80	94.41

An examination of the table entries under the column entitled total crashes indicates the following:

- Among the suspended/revoked driver groups, the FR group exhibited the highest prior 3-year total crash rate, with a value of 111.89 total crashes per 100 drivers. This is perhaps not surprising given that the FR group is identified by crash-involved drivers (without insurance).
- Drivers suspended/revoked for a non-driving-related incident had the lowest rate at 19.46 total crashes per 100 drivers.
- Every suspended/revoked driver group had a total crash rate higher than the rate for the validly-licensed group (14.76 per 100 drivers).
- The validly-licensed group of male drivers under the age of 25 had a lower total crash rate relative to all suspended/revoked driver groups with the exception of the suspended/revoked group receiving a license action as the result of a non-driving-related incident (19.62 and 19.46 total crashes per 100 drivers, respectively).

The values in Table 2 under the column labeled fatal/injury crashes yield the following conclusions:

- Among the suspended/revoked driver groups, the serious offender group had the highest prior 3-year fatal/injury crash rate, with a value of 34.70 fatal/injury crashes per 100 drivers.
- Drivers suspended/revoked for non-driving-related incidents had the lowest rate of 6.25 fatal/injury crashes per 100 drivers.
- Every suspended/revoked driver group had a fatal/injury crash rate higher than the fatal/injury crash rate for the validly-licensed group and the validly-licensed sample of males under the age of 25 (3.65 and 5.01 fatal/injury crashes per 100 drivers, respectively).
- The fatal/injury crash rate of DUI offenders was lower than all but two (FTA and non-driving-related incident) of the suspended/revoked groups.

With respect to the entries under the column associated with total convictions, the following conclusions are observed:

- Among the suspended/revoked driver groups, the neg op group had the highest prior 3-year total convictions rate, with a value of 524.46 total convictions per 100 drivers.
- Drivers suspended/revoked for a P&M condition had the lowest rate of 45.61 total convictions per 100 drivers.
- Every suspended/revoked driver group had a total convictions rate higher than the rate for the validly-licensed group (37.35 per 100 drivers).
- The validly-licensed sample group of males under 25 years of age had a lower rate of total convictions (74.80 per 100 drivers) than the suspended/revoked driver groups with the exception of the P&M condition group (45.61 total convictions per 100 drivers) and the lack of skill group (51.82 total convictions per 100 drivers).

The final column of Table 2 is labeled total incidents. The entries under the column represent the sum of each group's prior total crashes and prior total convictions. An examination of the number of total driving incidents indicates the following:

- Among the suspended/revoked driver groups, the neg op group had the highest prior 3-year total incident rate, with a value of 605.53 total incidents per 100 drivers.
- Drivers suspended/revoked for a P&M condition had the lowest rate of 78.63 total incidents per 100 drivers.
- Every suspended/revoked driver group had a total incident rate higher than the rate for the validly-licensed group (52.10 per 100 drivers).
- The validly-licensed group of male drivers under the age of 25 had 94.41 total incidents per 100 drivers, which was lower than all suspended/revoked driver groups except drivers receiving a suspension/revocation action as the result of a P&M condition, who had 78.63 total incidents per 100 drivers.

Crash Risk Equations

In the previous section, the discussion was limited to a descriptive comparison of group rates. Because crash risk is a complex function of many factors, strategies for optimally estimating individual crash risk must be multidimensional in form. As discussed earlier in the Methods section, there are several techniques for doing this, but one of the

most powerful and frequently used is multiple regression. In the case of the crash criterion, the multiple regression analysis produces an equation that gives the most accurate possible prediction of individual crash involvement rate, using an optimum linear composite of the mean values of the independent variables (e.g., comparisons between the suspended/revoked and validly-licensed groups). The regression equation can also be used to predict, along a continuous scale, whether or not an individual driver will be involved in a future crash.
In this section, regression analysis results are presented for two crash criteria: (1) total crashes and (2) fatal/injury crashes.

Total crashes
The Poisson model form was initially evaluated for the total crash dependent variable. As reported in the model output, the deviance statistic was 0.8106, and the Pearson chi-square statistic was 1.09. The small values for both of these statistics confirm the absence of any notable overdispersion in the data, implying the appropriateness of the Poisson model form as applied to the total crash criterion.

Table 3 summarizes the multiple Poisson regression analysis for estimating the prior 3-year total crash rate of the suspended/revoked drivers and the validly-licensed sample of male drivers under the age of 25.

Table 3

Summary of Multiple Poisson Regression Analysis for Estimating Prior 3-Year Total Crash Rate of Suspended/Revoked Drivers and Validly-Licensed Driver Sample - Males Under Age 25 (N = 877,360)

Driver group (referent group: Validly-licensed driver sample)	Regression coefficient	Standard error	χ^2	p
Constant	-1.9136	0.0060	101,515.00	< .0001
Non driving related incident	0.2769	0.0104	704.46	< .0001
Proof failure	1.1445	0.0078	21,777.00	< .0001
FR	2.0259	0.0078	67,389.60	< .0001
FTA	0.6342	0.0071	7,998.32	< .0001
Serious offender	1.2760	0.0387	1,086.92	< .0001
Negligent operator	1.7037	0.0086	39,385.60	< .0001
Lack of skill	1.2616	0.0165	5,857.66	< .0001
P&M	0.8056	0.0131	3,809.73	< .0001
DUI	0.7449	0.0075	9,933.96	< .0001
Validly-licensed sample – males under age 25	0.2848	0.0208	187.45	<.0001

-2 log likelihood for intercept only = 1,212,426

-2 log likelihood for intercept and covariates = 1,117,770.5

χ^2 for covariates = 94,655.5, p = < .0001

Before discussing these results, some clarification is in order concerning the procedures used. The reader will note that while eleven risk groups were compared, Table 3 shows only ten categories of driver groups. The deletion of one category, identified as the referent group validly-licensed driver sample in Table 3, is required to prevent a singular matrix (i.e., the problematic situation in which a variable or category is a perfect linear function of the other categories). No information is lost in doing this because the regression coefficient for each predictor variable reflects the difference in the relative crash risk between the risk groups and the referent group.

The equation was created by including all of the variables (risk groups) in the model. The regression coefficient for each variable represents the risk group's likelihood of total crash involvement during the prior 3 years, relative to the referent group's total crash involvement likelihood.

Table 3 shows that the test of this model against that of a constant-only model (without any risk groups included) was statistically significant ($\chi^2 = 94{,}656$, $p < .0001$). This result indicates that the equation consisting of the risk groups reliably estimated the total crash involvement risk of the groups' drivers.

Table 3 also shows the regression coefficients and χ^2 for each risk group. The statistic simultaneously tests the significance of the regression coefficients in which the effect of each variable in the model is adjusted for the effects of all other variables. The sign and magnitude of each coefficient indicates that each suspended/revoked driver group and the validly-licensed sample of males under age 25 had a statistically significant higher rate of prior 3-year total crashes than did the validly-licensed sample of all drivers.

Using the model in Table 3, one can obtain risk of total crash involvement, λ_{i1}, in terms of the constant parameter α_i and the regression parameters β to obtain measures of risk relativities. That is, the regression coefficients in Table 3 were converted into ratios of risk relativities through exponential transformation. In other words, $RR_i = \lambda_{i1}/\lambda_{i0} = \exp(\alpha_i + \beta)/\exp(\alpha_i) = \exp(\beta) = e^{\beta}$

The risk relativities or risk ratios (RR_i) express the crash risk of each group in comparison to the crash risk of the validly-licensed group. The risk ratios can be interpreted as a "times-as-many" ratio that indexes the total crash rate of a particular risk group to the total crash rate for the validly-licensed group. The higher the risk ratios, or times-as-many index, the greater is the risk of a particular group relative to the risk of the validly-licensed group (which by definition has a risk ratio or times-as-many index of 1.0). For example, a risk ratio estimate of 3.5 would indicate that a particular risk group had a total crash risk that was 3.5 times higher than the total crash risk posed by all drivers.

Figure 1 illustrates the relative 3-year prior total crash risk (risk ratio estimate) for each suspended/revoked and validly-licensed group obtained by the appropriate exponentiation of the regression parameters displayed in Table 3. As defined above, the relative risk ratio estimates refer to the relative risk of being crash involved as a function of predicted risk group category compared to the validly-licensed group.

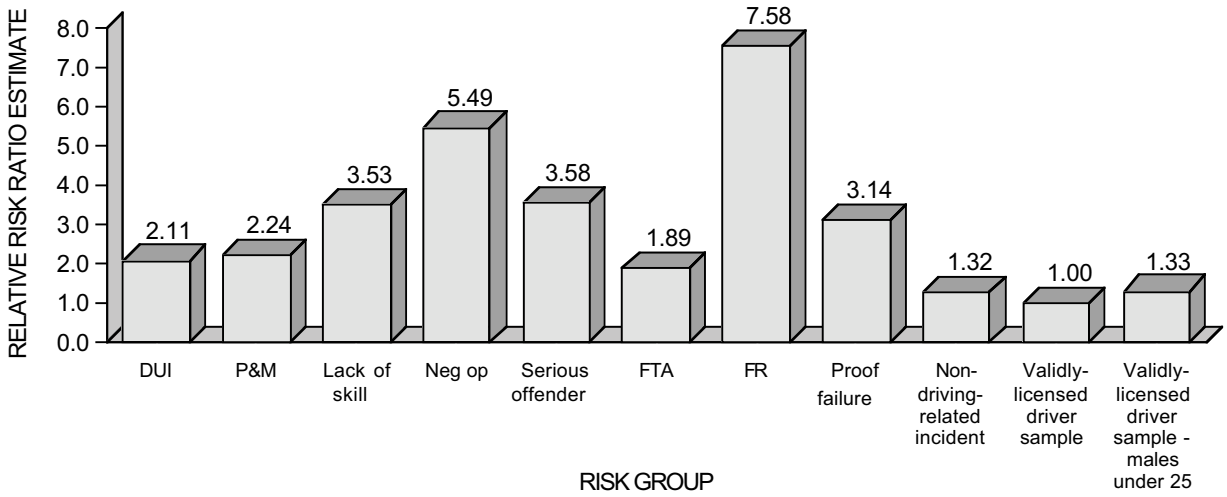

Figure 1. Relative 3-year prior total crash risk (risk ratio estimate) for each suspended/revoked and validly-licensed driver sample group.

An examination of the relative risk ratio estimates in Figure 1 yields the following conclusions about the total crash risk of each suspended/revoked group, compared to drivers with valid licenses:

- Drivers in the DUI group are 2.11 times more likely to be involved in a prior crash.
- Drivers in the P&M group are 2.24 times more likely to be involved in a prior crash.
- Drivers in the lack of skill group are 3.53 times more likely to be involved in a prior crash.
- Drivers in the neg op group are 5.49 times more likely to be involved in a prior crash.
- Drivers in the serious offender group are 3.58 times more likely to be involved in a prior crash.
- Drivers in the FTA group are 1.89 times more likely to be involved in a prior crash.
- Drivers in the FR group are 7.58 times more likely to be involved in a prior crash.
- Drivers in the proof failure group are 3.14 times more likely to be involved in a prior crash.
- Drivers in both the non-driving-related incident group and the validly-licensed group of males under 25 years of age exhibit nearly identical crash risk relativities. Drivers in the non-driving-related incident group are 1.32 times more likely to be involved in a prior crash. The validly-licensed group of males under 25 years of age are 1.33 times more likely to be involved in a prior crash.

Fatal/injury crashes

In addition to examining risk relativities associated with total crash involvement, the relationship between driver group and fatal/injury crash involvement was investigated. Involvement in fatal/injury crashes is often considered the bottom-line risk measure due to the major human and economic costs associated with fatal/injury crashes. Additionally, fatal/injury crashes are almost always reported and, therefore, are not subject to the same non-reporting biases inherent in the reporting of property damage only crashes.

The Poisson model was evaluated for the fatal/injury crash criterion. The model output for the deviance and Pearson chi-square statistics were 0.45 and 1.02, respectively. The small values associated with the two statistics indicates a lack of overdispersion in these data. Therefore, the Poisson model form was retained and applied to the fatal/injury crash data.

Table 4 presents the results of the multiple Poisson regression analysis estimating the prior 3-year fatal/injury crash rate of the suspended/revoked drivers and the validly-licensed group of males under 25 years of age.

Table 4

Summary of Multiple Poisson Regression Analysis for Estimating Prior 3-Year Fatal/Injury Crash Rate of Suspended/Revoked Drivers and Validly-Licensed Driver Sample - Males Under Age 25 (N = 877,360)

Driver group (referent group: Validly-licensed driver sample)	Regression coefficient	Standard error	χ^2	p
Constant	-3.3091	0.0121	75,195.00	< .0001
Non driving related incident	0.5361	0.0193	771.85	< .0001
Proof failure	1.3667	0.0149	8358.54	< .0001
FR	2.0139	0.0157	16,415.90	< .0001
FTA	0.8967	0.0138	4,237.96	< .0001
Serious offender	2.2506	0.0487	2,134.77	< .0001
Negligent operator	2.1097	0.0157	18,031.50	< .0001
Lack of skill	1.5523	0.0293	2,812.27	< .0001
P&M	1.2026	0.0226	2,834.53	< .0001
DUI	1.0470	0.0143	5,355.59	< .0001
Validly-licensed sample – males under age 25	0.3156	0.0412	58.66	< .0001

-2 log likelihood for intercept only = 583,976.30
-2 log likelihood for intercept and covariates = 553,762.80
χ^2 for covariates = 30,213.50, p = < .0001

A test of the full model including the suspended/revoked driver groups, the validly-licensed group of males under 25 years of age, and the validly-licensed group of all drivers against that of a constant-only model was statistically significant (χ^2 = 30,213.50, p < .0001). Results from the chi-square tests for the individual variables presented in the table indicate that each predictor (group) was significantly associated with the fatal/injury crash criterion. The direction and magnitude of the individual regression coefficients indicate that each group exhibited a prior 3-year fatal/injury crash risk significantly higher than that associated with the validly-licensed group.

A graphical illustration of the relative 3-year prior fatal/injury crash risk for each suspended/revoked and validly-licensed group is illustrated in Figure 2. The risk ratio estimates presented in the figure were obtained by exponentiating the respective regression parameters displayed in Table 4.

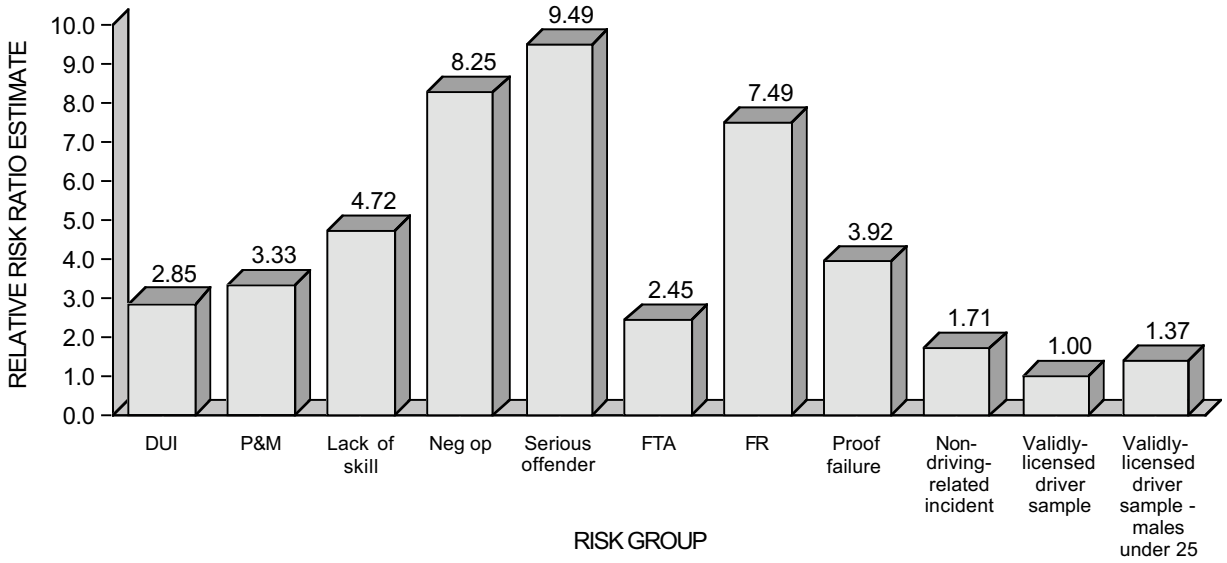

Figure 2. Relative 3-year prior fatal/injury crash risk (risk ratio estimate) for each suspended/revoked and validly-licensed driver sample group.

The relative risk ratio estimates presented in Figure 2 reflect the relative risk of being involved in a prior fatal/injury crash in comparison to the risk of a fatal/injury crash involvement among the random sample of all non-suspended drivers. One can conclude the following from the risk ratio estimates presented in Figure 2:

- Drivers in the DUI group are 2.85 times more likely to be involved in a prior fatal/injury crash.
- Drivers in the P&M group are 3.33 times more likely to be involved in a prior fatal/injury crash.
- Drivers in the lack of skill group are 4.72 times more likely to be involved in a prior fatal/injury crash.
- Drivers in the neg op group are 8.25 times more likely to be involved in a prior fatal/injury crash.
- Drivers in the serious offender group are 9.49 times more likely to be involved in a prior fatal/injury crash.
- Drivers in the FTA group are 2.45 times more likely to be involved in a prior fatal/injury crash.
- Drivers in the FR group are 7.49 times more likely to be involved in a prior fatal/injury crash.
- Drivers in the proof failure group are 3.92 times more likely to be involved in a prior fatal/injury crash.
- Drivers in the non-driving-related incident group are 1.71 times more likely to be involved in a prior fatal/injury crash.
- Validly-licensed males under 25 years of age are 1.37 times more likely to be involved in a prior fatal/injury crash.

Total Traffic Convictions Equation

It is readily acknowledged that a majority of traffic safety studies have emphasized the prediction of traffic crash frequency and have usually viewed traffic convictions as a predictor of crashes. However, when used as a criterion variable, traffic conviction variables (major violations and total convictions) have been found to be much more predictable than crashes (Peck & Gebers, 1992). The greater predictability of traffic convictions has been attributable to the fact that violations are more related to individual behavior and less related to chance than are crashes (Peck, McBride, & Coppin, 1971; Harrington, 1972). In addition, these and other authors have noted that crashes and convictions are known to have shared causative factors.
The present study evaluated the relationship between group membership and prior total convictions.

The Poisson model form was initially evaluated for the total convictions criterion variable. The model output reported a deviance value of 2.10 and a Pearson chi-square value of 2.22. The fact that both of these values significantly exceed the value of 1 confirms the presence of overdispersion in the data and implies the appropriateness of the negative binomial model form for the total convictions criterion.

Table 5 summarizes the results of the negative binomial regression analysis for estimating prior 3-year total convictions for the eleven study groups.

Table 5

Summary of Multiple Negative Binomial Regression Analysis for Estimating Prior 3-Year Total Conviction Rate of Suspended/Revoked Drivers and Validly-Licensed Driver Sample - Males Under Age 25 (N = 877,360)

Driver group (referent group: Validly-licensed driver sample)	Regression coefficient	Standard error	χ^2	p
Constant	-0.9849	0.0039	63062.10	< .0001
Non driving related incident	1.1375	0.0055	42353.10	< .0001
Proof failure	1.8564	0.0047	153697.00	< .0001
FR	1.3621	0.0064	45985.8	< .0001
FTA	1.9221	0.0042	207891.00	< .0001
Serious offender	1.8357	0.0226	6611.58	< .0001
Negligent operator	2.6421	0.0053	252163.00	< .0001
Lack of skill	0.3275	0.0167	385.18	< .0001
P&M	0.1998	0.0110	327.07	< .0001
DUI	1.4777	0.0045	106795.00	< .0001
Validly-licensed sample – males under age 25	0.6945	0.0117	3547.60	< .0001

-2 log likelihood for intercept only = 1,054,971.10
-2 log likelihood for intercept and covariates = 680,569.64
χ^2 for covariates = 374,401.46, p = < .0001

A test of the full model including all groups against that of a constant-only model was statistically significant (χ^2 = 374,401.46, $p < .0001$). The chi-square tests for the individual variables presented in Table 5 imply that each group was significantly associated with the total convictions criterion. The direction and magnitude of the regression coefficients indicate that each group accumulated significantly higher counts of prior 3-year total convictions relative to the random sample of all drivers.

Figure 3 illustrates for each group the prior 3-year total convictions relative risk estimates obtained by exponentiating the regression coefficients presented in Table 5.

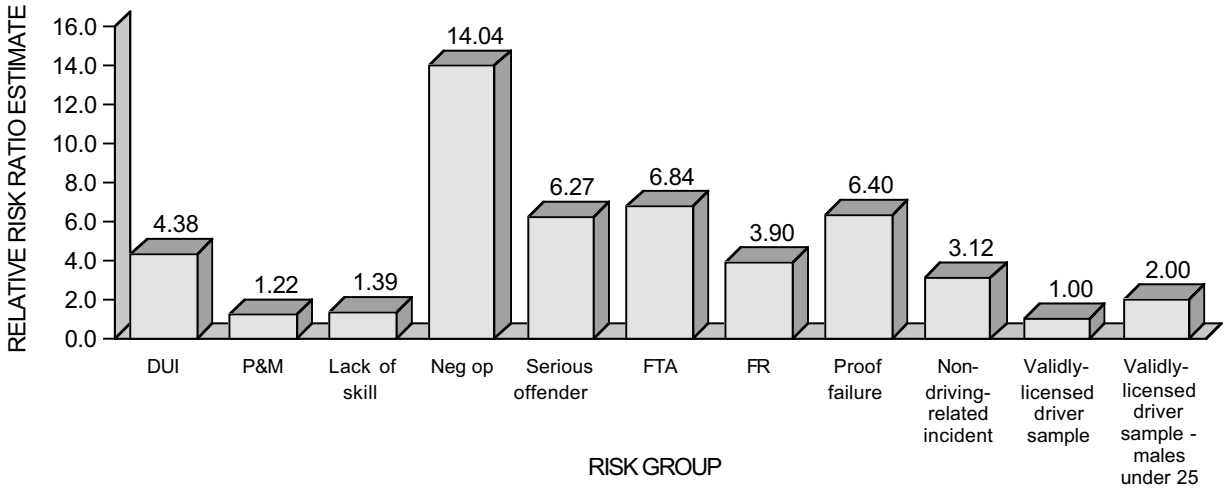

Figure 3. Relative 3-year prior total conviction risk (risk ratio estimate) for each suspended/revoked and validly-licensed driver sample group.

An examination of the values in Figure 3 indicates the following about each group's total conviction risk, relative to the risk of all validly-licensed drivers.

- Drivers in the DUI group have 4.38 times-as-many total convictions.
- Drivers in the P&M group have 1.22 times-as-many total convictions.
- Drivers in the lack of skill group have 1.39 times-as-many total convictions.
- Drivers in the neg op group have 14.04 times-as-many total convictions.
- Drivers in the serious offender group have 6.27 times-as-many total convictions.
- Drivers in the FTA group have 6.84 times-as-many total convictions.
- Drivers in the FR group have 3.90 times-as-many total convictions.
- Drivers in the proof failure have 6.40 times-as-many total convictions.
- Drivers in the non-driving-related incident group had 3.12 times-as-many total convictions.
- Validly-licensed males under 25 years of age exhibited a risk ratio (2.00) of prior total convictions exceeding that of drivers suspended/revoked due to P&M and lack of skill reasons (1.22 and 1.39, respectively).

Total Driving Incidents Equation

The final set of analyses was conducted on the prior total driving incidents criterion. As noted in the Methods section, prior total driving incidents is a composite variable consisting of the sum of prior total crashes and prior total convictions. The prior total driving incidents criterion is intended to provide a summary measure of overall driving risk posed by the groups evaluated in this study.

An assessment of the Poisson model distribution for the total driving incidents variable produced a deviance statistic of 2.21 and a Pearson chi-square value of 2.29. As both of these values indicate the presence of overdispersion in these data, the negative binomial model was employed for the prior 3-year total driving incidents criterion.

Table 6 summarizes the multiple negative binomial regression analysis for estimating the prior 3-year total incidents for each group.

The test of the full model of all groups against that of a constant-only model was statistically significant (χ^2 = 361,472.20, $p < .0001$), indicating that the model consisting of the eleven groups reliably estimated counts of prior driving record incidents. Chi-square tests for the individual variables in the table imply that each group was significantly associated with prior incidents. The direction and magnitude of the individual coefficients indicate that each group had significantly higher counts of prior 3-year driving incidents in comparison to validly-licensed drivers.

Table 6

Summary of Multiple Negative Binomial Regression Analysis for Estimating Prior 3-Year Total Driving Incidents Rate of Suspended/Revoked Drivers and Validly-Licensed Driver Sample - Males Under Age 25 (N = 877,360)

Driver group (referent group: Validly-licensed driver sample)	Regression coefficient	Standard error	χ^2	p
Constant	-0.6520	0.0034	37473.40	< .0001
Non driving related incident	0.9591	0.0050	37148.30	< .0001
Proof failure	1.7007	0.0042	164178.00	< .0001
FR	1.5986	0.0053	91234.40	< .0001
FTA	1.6926	0.0037	211018.00	< .0001
Serious offender	1.7063	0.0211	6553.03	< .0001
Negligent operator	2.4529	0.0048	263400.00	< .0001
Lack of skill	0.6904	0.0125	3065.40	< .0001
P&M	0.4116	0.0088	2195.68	< .0001
DUI	1.3186	0.0040	110023.00	< .0001
Validly-licensed sample – males under age 25	0.5945	0.0105	3205.44	< .0001

-2 log likelihood for intercept only = 648,661.96
-2 log likelihood for intercept and covariates = 287,189.76
χ^2 for covariates = 361,472.20, p = < .0001

Figure 4 displays the risk ratio estimates of 3-year prior total driving incidents for each group relative to the validly-licensed referent group. An examination of the relative risk ratio estimates in the figure warrants the following observations:

- Drivers in the DUI group have 3.74 times-as-many total driving incidents.
- Drivers in the P&M group have 1.51 times-as-many total driving incidents.
- Drivers in the lack of skill group have 1.99 times-as-many total driving incidents.
- Drivers in the neg op group have 11.62 times-as-many total driving incidents.
- Drivers in the serious offender group have 5.51 times-as-many total driving incidents.
- Drivers in the FTA group have 5.43 times-as-many total driving incidents.
- Drivers in the FR group have 4.95 times-as-many total driving incidents.
- Drivers in the proof failure group have 5.48 times-as-many total driving incidents.
- Drivers in the non-driving-related incident group have 2.61 times-as-many total driving incidents.
- Validly-licensed males under 25 years of age have a relative risk (1.81) of prior total driving incidents exceeding the relative risk (1.51) of drivers suspended/revoked for a P&M reason.

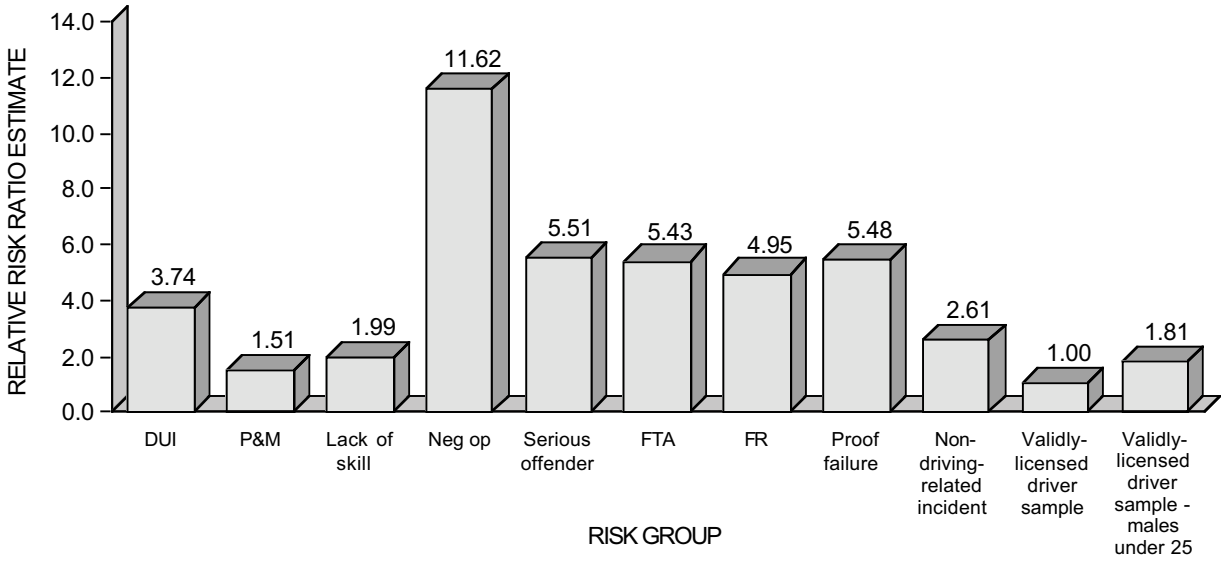

Figure 4. Relative 3-year prior total driving incidents risk (risk ratio estimate) for each suspended/revoked and validly-licensed driver sample group.

DISCUSSION

Before discussing the results of the analyses comparing the demographic characteristics and risk profiles of the suspended/revoked groups and the validly licensed groups, some limitations inherent in the research design need to be acknowledged. Perhaps the most important issue is that there is a relationship between the nature or definition of the suspended/revoked groups and their history of crashes and traffic convictions.

This is an especially significant issue for the negligent operator, serious offender and FR groups.

When crash and conviction rates are compared among the suspended/revoked groups, it is not surprising that neg ops are near or at the top of the list; they received their neg op suspension/revocation because they had a high number of prior crashes and traffic convictions. In other words, by definition neg ops have an elevated rate of prior crashes and convictions. Similarly, serious offenders top the list for the highest rate of prior fatal/injury crashes, since they are defined by their involvement in serious driving incidents. Finally, while not as obvious as the situation with neg ops and serious offenders, FR drivers would be expected to have high numbers of crashes. The reason for this is that the FR suspension/revocation action was taken because these drivers were unable to show proof of financial responsibility at the time of a crash. A similar but less direct relationship might be expected among the proof failure group.

There is not inherently a problem with this relationship between the definition of some of the suspended/revoked groups and their prior driving history, especially if the characteristics of the groups are kept in mind. However, it needs to be recognized that the risk profiles describe the driving history of these groups, and do not necessarily indicate the extent to which these groups will drive unsafely in the future. For example, based on the phenomenon of regression to the mean, we could expect that these groups with high prior rates of crashes and convictions would tend to "regress to the mean," or have lower future rates of crashes and convictions. This phenomenon would be expected to occur even in the absence of any administrative or court-applied sanctions.

In addition, drivers in the various suspended/revoked groups, besides receiving a license suspension/revocation, will receive additional penalties that will differ somewhat between the groups, and these may differentially affect their future driving. For example, DUI suspended/revoked drivers will likely receive relatively high fines, jail terms, assignment to alcohol treatment and, possibly, an order to install an ignition interlock device; drivers suspended/revoked for P&M conditions may experience none of these additional sanctions. Thus, all other things being equal, we would expect the DUI group's future driving behavior to be more affected by these sanctions than the P&M group's. In short, the data presented here reflect the nature of each group's driving risk, but caution should be exercised in extrapolating these rates into the future. As a group, we know based on previous research (DeYoung et al., 1997) that suspended/revoked drivers will continue to pose a significant risk in the future, but we don't know the degree to which the historical risks among the groups will change in the future.

It should also be noted that covariates were not used in the analyses that created risk profiles, because the purpose of the analyses was simply to develop a descriptive profile of the groups. For example, neg op drivers tend to be young males, and we know that young males tend to be riskier drivers; however, it would not make sense for the purposes of this project to use age and gender as covariates, because we are interested in comparing the groups as they are. Age and gender are not competing or confounding effects, but rather an intrinsic part of each group that we are measuring.

Suspended/Revoked Group Profiles

It was stated in the Introduction that we tend to view suspended/revoked drivers as a homogenous group of high-risk drivers, and that we base laws and policies largely on that assumption. However, in reality these are diverse groups with vastly different crash expectancies. The risk data reported in this paper support the contention that they are heterogeneous subgroups of drivers.

Based on the limited demographic information available in DMV's databases, it was shown that the nine suspended/revoked subgroups differed noticeably on gender and age composition. The mean age of the highest group, which was almost 72 years for drivers suspended/revoked for lack of skill, is approximately two-and-a-half times that of the youngest group, neg ops (mean age of 29 years). In addition, neg ops are overwhelming male (85%), while the lack of skill group, at 52% male, closely reflects the gender composition of the overall driving population. Even with this limited information, it is clear that the subgroups of suspended/revoked drivers differ substantially from one another, and in some cases, from the general driving population.

Risk Levels of Suspended/Revoked Groups

The findings from this study clearly show that there is significant variation in risk among the different groups of suspended/revoked drivers, and that all of the suspended/revoked groups have crash and conviction rates that are higher than that of the general driving population. Interestingly, the comparative risk profiles for the groups change depending upon which outcome measure is being considered.

When traffic convictions are the basis for comparison, neg ops stand out as the most deviant and dangerous group. The risk ratio estimate for neg ops is 14.04, which is more than double that of the next highest group, 6.84, for drivers suspended/revoked for FTA. As the risk ratio estimates are based on a comparison with validly-licensed drivers, it can be seen that neg ops have 14 times the likelihood of a prior traffic conviction as drivers with valid licenses. The suspended/revoked groups differ markedly among themselves, ranging from 1.22 and 1.39 respectively, for P&M and lack of skill suspended/revoked drivers, to 14.04 for neg ops. Thus, an examination of prior traffic convictions clearly shows that suspended/revoked drivers are a diverse group.

While traffic convictions provide an indication of driving behavior, a more direct measure, and one that reflects the true human and economic costs of risky driving, is crashes. When crashes are examined, it is not neg ops which pose the greatest risk, but drivers suspended for lack of financial responsibility. The FR group's prior total crash risk is more than 7 times that of validly licensed drivers. More importantly for the present study, an examination of crashes again shows substantial variation among the suspended/revoked groups. One of the suspended/revoked groups, drivers who lost their license for a non-driving offense, have crash rates that are not much different than drivers with valid licenses, showing that even though they are suspended/revoked, they do not pose a significant crash risk. This raises questions about the appropriateness of license sanctions applied to drivers suspended/revoked for a non-driving incident, and even whether such drivers should be suspended/revoked in the first place.

The picture changes somewhat when fatal/injury crash rates are considered. Arguably, this is the bottom-line measure, because of the huge human and economic costs associated with fatal and injury crashes. Serious offenders, neg ops and FR drivers pose the highest risk for fatal/injury crashes, with rates that are seven-and-a-half to nine-and-a-half times that of validly-licensed drivers. Importantly, fatal/injury crashes again show significant variation among the suspended/revoked groups, with the highest group, serious offenders, having more than 5 times the risk of the lowest group, drivers suspended/revoked for a non–driving incident.

The final outcome variable examined was the rate of prior total driving incidents, which was measured as a combination of crashes and traffic convictions. Not surprisingly, neg ops had the highest total driving incident rate, which was more than double that of the next highest suspended/revoked group rate (serious offenders). As with the previous three outcome measures, there was substantial variation among the rates for the various suspended/revoked groups, again demonstrating that suspended/revoked drivers are not a homogeneous group.

Implications

The findings from this study conclusively demonstrate three important points:

1. Suspended/revoked drivers are a heterogeneous group, both demographically and in their driving behavior.

2. Some suspended/revoked drivers, such as those suspended/revoked for a non-driving offense, have low traffic risks that are not much higher than validly-licensed drivers.

3. All suspended/revoked groups have elevated crash and conviction rates, compared to validly-licensed drivers.

We have known for some time that suspended/revoked drivers pose a significant risk on the highways, but we have assumed, in the absence of detailed information, that their risk is uniform, and that they are a homogeneous group of drivers. The lack of information on who these drivers are, and how their crash rates differ, has led to the creation of laws and policies that tend to treat the various subgroups of suspended/revoked drivers alike.

Does it make sense to treat all suspended/revoked drivers in pretty much the same way? Should a driver suspended/revoked for lack of skill, who on average is 72 years old and equally likely to be male or female, be subject to the same penalties as a young, male neg op driver? Would the two respond the same way to a given sanction? Clearly, these two groups pose very different driving risks to other road users. Inasmuch as traffic convictions are an indication of general driving behavior, neg ops pose a far higher risk than drivers suspended/revoked for lack of skill, and this is further confirmed by a comparison of the crash rates for the two groups.

This isn't to argue that drivers suspended/revoked for lack of skill shouldn't be suspended/revoked, but rather that a cogent case can be made for treating neg op suspension/revocation violators differently than lack of skill suspension/revocation violators, because the two represent significantly different risks. Harsh, but effective, sanctions for suspension/revocation violators, such as vehicle impoundment and vehicle forfeiture, should be reserved for those suspended/revoked drivers who represent a real risk on the highways. This is currently not the case in California. For example, drivers suspended/revoked for financial responsibility do not experience the full weight of the vehicle impoundment sanction, because the impoundment law (CVC 14602.6) was changed to allow them to retrieve their vehicles early. This decision was made on political grounds in the absence of compelling evidence on the risks FR drivers represent. The findings from this study show that FR drivers do represent a significant risk, and this suggests that they should be subject to vehicle impoundment.

The findings on the risks posed by another group of drivers, those suspended/revoked for the non-driving offense of failing to pay child support, point out a more serious problem with the current suspension/revocation laws. This suspended/revoked group had the lowest crash risk of any of the suspended/revoked groups, and their rate was not much higher than drivers with valid licenses. This raises a question beyond that of whether they should receive a different penalty than the other suspended/revoked groups for violating their suspension/revocation, suggesting instead that perhaps they should not be suspended/revoked in the first place.

Because the privilege to drive is so highly valued, and withdrawal of the privilege so feared, an increasing number of new laws have been enacted prescribing license suspension/revocation for a greater number of new offenses, some of which have nothing to do with driving. Failure to pay child support is one such offense, and the findings from this study show that such offenders do not pose much of an elevated risk on the highways. This is not to suggest that failure to pay child support is not a serious offense, only that from a traffic safety perspective, license suspension/revocation is the wrong penalty for it. The punishment does not fit the crime.

One might argue that if license suspension/revocation is effective in getting delinquent parents to pay child support, isn't it worth it? The problem here is that we currently suspend 5.56% of California drivers, or about 1,900,000 people (Roberts, 2002). This is a very large number. It is difficult to enforce suspension/revocation laws, because it is basically an "invisible" offense, and rates of detection, prosecution and conviction of drivers who violate their license suspension/revocation orders are very low (DeYoung, 1990). For all of these reasons—the punishment doesn't fit the crime for drivers suspended/revoked for non-driving reasons; non-driving suspended/revoked drivers do not pose a significant risk on the highways; the detection, prosecution and adjudication system is already not working well to process suspension/revocation violators, and; there are a large number of drivers who are suspended/revoked each year, and most of them continue to drive—the integrity of the license suspension/revocation system is threatened. The first place to begin improving the system is to examine and consider revising the current license suspension/revocation laws to more rationally reflect the traffic risks of the offenders to whom they apply. While the suspension/revocation laws targeting offenders who fail to pay child support are national mandates that must be changed at the federal level, the other

suspension/revocation laws, including those targeting such non-driving offenses as graffiti and vandalism, can be changed at the state level.

Conclusion and Recommendations

License suspension/revocation is one of the most effective sanctions currently available to control problem drivers, but over the years it has begun to be so broadly applied that it is in danger of losing its effectiveness. In addition, sanctions for suspension/revocation violators treat suspended/revoked drivers as if they were one, homogeneous, high-risk group, because heretofore not much information was available on the nature and risks of different groups of problem drivers.

The findings from this study show that while suspended/revoked drivers as a group do represent a significant risk on the highways, there is significant diversity among drivers suspended/revoked for different reasons, and their relative risks vary widely. Some groups, especially drivers suspended/revoked for non-driving reasons, have risks that are only marginally higher than drivers with valid licenses. The implications of these findings are that current laws and policies can be more effectively crafted to reflect the risk posed by different suspended/revoked drivers, and more significantly, that the suspension/revocation laws should be rewritten to exclude non-driving-related offenses from the license suspension/revocation penalty. The specific recommendations are discussed below:

1. The R&D Branch at DMV should write a proposal to convene an interagency committee to examine and consider revising the current suspension/revocation laws, and submit this proposal to the Office of Traffic Safety for funding consideration.

2. The R&D Branch should establish an interagency committee consisting of representatives from DMV, the courts, law enforcement agencies, and the Legislature, and facilitate meetings of the committee to examine and consider revising the suspension/revocation laws based on research evidence from this study and other valid research.

3. The current vehicle impoundment law, CVC 14602.6, should be rewritten to more rationally reflect the risks of the suspended/revoked drivers it includes and excludes from its provisions.

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