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Choice of licensing method and crashes of young drivers

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Abstract

Five years of data (1998-2002) were used to examine whether there was a relationship between the method of driver licensing - Competency Based Training (CBT) or Vehicle On-Road Test (VORT) - and the subsequent crash experience of young drivers, using logistic regression analysis.

The main findings of this study were:

Statewide, choosing the VORT was associated with a 6% increase in the odds of having at least one crash in the first 180 days. In one year, if those who chose VORT had an equivalent crash risk to those who chose CBT, there might have been 20 fewer non-casualty and 10 fewer casualty crashes in new drivers' first six months of driving. The choice of licensing method was less important than the variables: area of residence, sex, age and the period spent on a learner's licence.

However, choosing VORT rather than CBT could easily be due to factors (amount of travel, personality, social habits) that are also associated with a greater likelihood of crashing. For example, we found that choosing VORT rather than CBT was associated with a 25% increase in the odds that the driver had been involved in a crash as a driver prior to the issue of a P licence. This means that there is a real possibility that the slight increase in the odds of having at least one subsequent crash (noted in 1. above) is not due primarily to any characteristic of the VORT test itself but rather something about the drivers who chose to take the VORT.

We therefore found no clear evidence that any differences between the VORT and CBT methods of licensing are related to subsequent crash experience.

In separate analyses, we found no evidence that the choice of examiner for the VORT, or the instructor for the CBT test, has any significant influence on subsequent crash outcome.

Keywords: Young drivers, risk factors for crash involvement, licensing methods, driving instructor, logistic regression, data linkage

Introduction

This paper describes the findings of a study, prepared to assist Sir Eric Neal in his review of driver licensing in South Australia. We have constructed and analysed a dataset consisting of the records of young (18-25 year old) newly-licensed drivers, including whether each had a road crash within 180 days of getting their licence. The data include all drivers in that age range in South Australia who gained their P licence in the years 1998 to 2002. We examined whether certain characteristics of the drivers influenced the probability of crashing. These characteristics were: age, sex, area of residence in South Australia, method by which they obtained their licence, and the period spent on a learner's (L) licence

There are two methods of obtaining a driving licence in South Australia. These will be called the vehicle on-road test (VORT) and competency-based training (CBT). For the drivers obtaining a licence by VORT, we know the examiner who certified that they passed the test. For the drivers obtaining a licence by CBT, we know their instructor.

We concentrate on three issues: a comparison of drivers obtaining their licence by VORT and by CBT, whether the VORT examiners differ in the crash records of their examinees, and whether the CBT instructors differ in the crash records of their students. Some analyses are reported for the whole of South Australia, and some for the geographically compact area of postcodes 5000 to 5099 (roughly, within 15 km of central Adelaide).

Materials and Methods

We are grateful to Transport SA for supplying us with the records of drivers obtaining their P licence. This information included the age, sex, and postcode of residence of the drivers, the period they had spent on an L plate, the method by which they gained their licence (VORT or CBT), a code referring to who their examiner (for VORT examinees) or instructor (for CBT students) had been, and their licence number. For each of these drivers, we interrogated the database of traffic crashes in South Australia that we maintain at the Centre for Automotive Safety Research (and which is derived from police reports via processing by Transport SA), and used the licence number to determine whether or not they had had a crash within 180 days of getting their P licence. We then attempted to relate the probability of their having had a crash to such variables as age, sex, and method of licensing.

Logistic regression

Logistic regression is a statistical technique that attempts to predict the probability of something happening when influenced by some independent variables. In our case, we are trying to predict the probability of a crash within 180 days of obtaining a licence, and the independent variables include sex and age of driver, postcode of driver and so on.

Results are expressed in terms of the odds ratio. The odds of an event occurring are the number of times it occurred divided by the number of times the event did not occur. The relevant event is having at least one crash within 180 days, so the odds are the number of drivers who had at least one crash divided by the number of drivers who had no crashes. The odds have a different meaning from the *probability* of an event occurring. The probability is the number of times the event occurred divided by the number of times it *could* have occurred. The odds ratio is the ratio of the odds of an event in one group (e.g. VORT drivers) divided by the odds in another group (CBT drivers). The odds ratio is very close to the relative risk when the chances of the event are small (such as having a crash within 180 days) and so, the odds ratio may be considered a good approximation of relative probability in this report.

Dependent variables

As mentioned previously, we examined any crash in the first 180 days. Crashes were any crash reported to the Police and could range in severity from a property damage only accident to a fatality. There are alternatives: we could choose a different time period, certain severities of crash, or certain types of crash (e.g. rear-end). In the course of this project, we have examined some of these, and believe that our chosen definitions are appropriate for revealing the effects of the factors examined.

Independent variables

Independent variables include Age, Sex, Method (CBT or VORT), Postcode (grouped into Regions), Period on L plate, Examiner (VORT) or Instructor (CBT). Certain independent variables are the subject of regulation: Method, Period on an L plate and Age of licensing are such variables. Others are not (Sex and Region). The variables amenable to regulatory intervention are highlighted in the results. An important independent variable that is not available is the amount of travel of drivers (their exposure to risk). Some individuals are likely to travel more than others due to their geographic location and/or propensity to drive, and others near border regions may regularly travel in adjacent states, so some crashes may occur outside SA's borders. Other variables that are not available and which might be important are ones related to temperament and social habits. It is possible that the choice of licensing method reflects these and that they also might affect risk of crashing.

While each independent variable may take on several values (age, for example) the essential effect of each was determined by categorising the variables into as few appropriate categories as possible, while maintaining the integrity of the analysis. This has been done to overcome computing difficulties and for clarity of the presentation of results.

Limits of interpretation

The chief aims of the analysis are to determine whether the method of licensing, the examiners (of VORT students) and instructors (of CBT students) have any effect on the crash risk of young drivers. However, it should be noted that an experiment has not been carried out: the young drivers have not been randomly assigned to one method or another, nor one examiner/instructor or another, but have themselves selected these things. The distortion that this may introduce is known as *self-selection* bias. So, if, for example, drivers who chose VORT are found to be more likely to crash than those who chose CBT, it may be that the drivers who chose VORT are more likely to crash for reasons unrelated to VORT per se. This means that if we find that the choice of method of licensing has an important influence on the odds of crashing, we cannot go further and say that the reason is the method itself, as it could be characteristics of the driver that are associated with the choice (although, if so, it must be above and beyond the ones that have already been taken into account – age, sex and region of residence).

Statistical inference

One important additional statistic is produced by the logistic regression: the statistical significance of each result. This is used as a tool to decide if the result should be considered reliable. We have used a statistical significance limit of 0.05; that is, there is less than a 5% probability that the odds ratio observed could be obtained by chance if no difference between the categories actually exists.

When several independent variables are included in the logistic regression, the regression will determine odds ratios for every category of each independent variable. It is, therefore, possible to use these to compare odds ratios over different driver characteristics. In Table 1 we have several independent variables, and each variable has two categories. The first category of each variable is our reference category relative to which the odds for the other categories are expressed. The odds ratio of the other category is then the odds of crashing for the second category over the odds of crashing for the first category. For example, males have 1.47 times the odds of crashing than females. Now, we can compare the odds of crashing for any driver compared to our baseline (reference) driver who is: female, aged 18-26, living outside the greater Adelaide area, who undertook the CBT method and had an L licence for more than 6 months. All these categories are our reference categories, and so we can simply set this driver's relative odds to one. Our comparison driver is a 16-17 year old male, living within greater Adelaide, who was licensed using the VORT, and had his L licence for less than 6 months. The relative odds of these two drivers for crashing are 1.64 x 1.47 x 1.29 x 1.15 x 1.06. That is, our second driver has 3.79 times the odds of crashing in the first 180 days than our baseline driver.

Comparison of VORT and CBT

The focus of this analysis is the comparison of VORT and CBT, but we have found that other variables have important effects on the odds of crashing, and these need to be taken into account. These were:

a) the age of the driver at the date of issue of the P licence,

b) the sex of the driver,

c) the length of time spent on an L plate, and

d) the region in which the driver resided at the time of issue of the P licence.

Additionally, certain categories of each variable were found in preliminary analyses to have similar effects on the odds of crashing. For example, drivers from the postcodes 5000 to 5199 (approximately the Adelaide Statistical Division) are quite distinct in that respect from those in more regional areas. Similarly 16 and 17 year olds were distinct from those 18 and older in terms of their risk of crashing.

Results of the analyses for the whole of South Australia

The influence of the variables discussed above on the risk of a crash of *any severity* is described in Table 1 below. The results of the logistic regression show that the most important predictor of crash involvement is living in the greater Adelaide area (postcodes 5000 – 5199). This result is largely uninteresting as it is likely to reflect the higher traffic densities and potential traffic conflicts that exist in the urban environment. Sex, age and period on L plate were all more strongly associated with crashing than method (CBT or VORT) – but method was predictive, with drivers who chose the VORT system of licensing being 6% more likely to have at least one crash in the first 180 days following the issue of their P licences.

Table 1 Odds ratio of involvement in a crash of any severity in the first 180 days by specified independent variables, in descending order of influence.

Independent variable	Category	Odds ratio
Region	5200 and above **5000 – 5199**	1.00 1.64
Sex	Female **Male**	1.00 **1.47**
Age of driver	18-25 **16-17**	1.00 **1.29**
Period on L plate	6 months or more **1–5 months**	1.00 **1.15**
Method	CBT **VORT**	1.00 **1.15**

Notes:
Bold categories are more predictive of crashing
Shaded variables are amenable to some regulatory intervention
All results shown are statistically significant

Similar analyses were conducted for more severe crashes only: casualty (injury and fatality crashes), and just fatalities. The results for casualties are shown in Table 2. Neither the method of licensing nor the period spent on an L plate were statistically significant predictors of crash involvement at this level of severity. No results are shown for fatalities, as no variable used was reliably predictive of fatal crash involvement. We presume this is due to the (fortunate) rarity of fatal crashes and the consequent low power of the statistical analysis.

While the odds ratio for casualty crashes by method of licensing was not statistically significant, it is in broad agreement with the odds ratio estimated for crashes of all severities (Table 1). There is no reason to think that casualty crashes would be

affected differently from all crashes. Therefore, we will assume that the estimate of a 6% increase in the odds of being involved in a crash for drivers who chose the VORT system of licensing is likely to apply to casualty crashes as well.

The small elevated level of crashing among VORT drivers approximately equates to 27 drivers more than would otherwise be expected experiencing a crash of any severity in the first 180 days, out of each year's population of 18,400 new licensees (aged 16-25). About 7% of the drivers who crashed at least once, crashed again within the 180 days; so these 27 drivers had approximately 30 crashes. If we assume that the estimate of the odds ratio for VORT drivers experiencing a casualty crash is correct, 10 of these surplus crashes would have been casualty crashes. Therefore, the choice of VORT was associated with an average of 20 non-casualty crashes and 10 casualty crashes greater than would otherwise be expected in the first 180 days of driving, in each of the five years that we analysed. For reference, about 1700 new drivers, aged 16-25, reported at least one crash in their first 180 days of driving. Of these, 390 report a casualty crash.

Table 2 Odds ratio of involvement in a casualty crash in the first 180 days by specified independent variables, in descending order of influence

Independent variable	Category	Odds ratio
Region	5200 and above **5000 – 5199**	1.00 **1.44**
Age of driver	18-25 **16-17**	1.00 **1.18**
Sex	Female **Male**	1.00 **1.13**
Method	CBT **VORT**	1.00 **1.08***
Period on L plate	6 months or more **1–5 months**	1.00 **1.06***

Notes:
* "Method" and "Period on L plate" were not statistically significant
Refer also to notes for Table 1

As was previously discussed, the difficulty in interpreting this kind of result is that the data used in this report were not generated from an experiment: we must consider whether students who take the VORT are different in any way from CBT students (beyond age, sex and region of the State, which we have controlled for). We strongly suspected that self-selection bias would be operating in the data. In other words, drivers who chose VORT may be different in important respects from those who chose CBT. We checked this by examining the odds of a crash occurring prior to the issue of a P licence. It is unlikely that method of licensing would affect the odds of having a crash prior to licensing (when time spent on an L plate is allowed for), therefore if the choice of VORT is associated with a pre-licensing crash, we must assume that the difference between VORT and CBT in terms of post-licensing crashes is not causal. That is, it should not be assumed that if these drivers had taken CBT rather than VORT, their crash risk would have been reduced correspondingly. The results of the regression of pre-P licence crashes on the independent variables show that persons who chose VORT were 25% more likely to have had at least one reported crash prior to the issue of the P licence. This indicates that, while we can control for Region, Age, Sex and Period on an L plate, there are further distinctions between drivers who chose VORT and drivers who chose CBT that we cannot account for, and hence the association between VORT and a 6% increased odds of crashing post-licence should not necessarily be viewed as causal.

A further problem of interpretation is that because the two categories of region used in the analysis encompass large areas with distinct geographies, we may be inadequately capturing the effect of geography in this categorisation. A better coding of geographical location would assist the analysis, but we have instead, in the absence of such coding, focussed on a geographically compact region (postcodes 5000 to 5099, corresponding to areas within 15 km of the Adelaide GPO) and repeated the analysis.

Results for Adelaide inner-metro (postcodes 5000 to 5099)

Crashing in the first 180 days was regressed on the variables Age, Sex, Period on L and Method (CBT or VORT). The calculated odds ratios for age, sex, period on L were almost identical to those calculated for the whole State (refer to Table 1). However, the odds of crashing associated with the choice of VORT were somewhat higher than for the whole State. In the inner Adelaide metropolitan region, choice of VORT was associated with a 14% increase in the odds of crashing. This is consistent with the notion of self-selection bias. The bias might be expected to operate most strongly in areas in which most choice of licensing method exists. It is reasonable to assume that student drivers residing in Adelaide have more choice about licensing method than students in more remote regions where CBT instruction may not be convenient.

Effect of VORT examiner

The analysis of the influence of the VORT examiner on crashes was an extension of the analyses of crashes presented above, with the addition of a new independent variable – Examiner. In this analysis we are only discussing drivers who undertook the VORT.

Results of the analyses for the whole of South Australia

The analysis of all examiners in the State is computationally challenging, and so we chose to look at examiners who have passed at least 200 students in the 5 year period (39 examiners) with all other examiners being grouped together in an "other" category.

As in the analysis reported in Table 1, residing in the greater Adelaide area, being male and 16-17 are all associated with increased odds of crashing. The computed odds were similar to those reported in Table 1. Choice of examiner affected the odds of crashing: this variable was statistically significant. As with CBT instructor (below) we consider that there probably is no true effect, as indeed was found for the area defined by postcodes 5000 to 5099 (see below).

We believe that the apparent effects of VORT examiner and (below) CBT instructor are misleading results that derive from not fully accounting for geographical region in the analysis. For example, students of instructors/examiners who operate near the border of the State may have crashes over the border, which, of course, do not appear in the statistics analysed. More generally, it is likely that the large geographical areas that we used in the analysis encompass students with quite different crash risks and exposures (amount of driving). Consequently, effects that would be attributed to geography, if the analysis accounted for this in sufficient detail, are instead mistakenly attributed to instructor/examiner. Hence we now report on an analysis of a geographically compact region (Adelaide postcodes 5000 – 5099), and we regard this latter analysis as preferable.

Results for Adelaide inner-metro (postcodes 5000-5099)

As with the analysis for the State as a whole, computational considerations meant that the number of examiners had to be restricted in the analysis. The 32 examiners who had passed more than 100 students in areas covered by postcodes 5000-5099 were chosen, with all other examiners placed in an "other" category. When this was done, the choice of examiner was non-significant, while all other variables were, with computed odds ratios almost identical to those reported in Table 1. The results showed that the variation in the odds of crashing of students of particular examiners was well within what might be expected due to chance.

Conclusion

These results show that choice of examiner in the VORT system does not have a significant bearing on the post-crash experience of drivers: if variation exists, we might expect it to reveal itself in the Adelaide region (postcodes 5000 – 5099) where 40% of newly licensed drivers reside. As mentioned previously, the apparent influence of individual examiners on drivers' crash experience when the whole State is examined must be treated with caution due to unaccounted-for geographical influences in the data.

Effect of CBT instructor

The analysis of the influence of the CBT instructor on crashes was similar to that of the VORT examiner. In this analysis, we are only discussing drivers who undertook CBT. As with the analysis of VORT examiners, we had to choose a limit on the number of CBT instructors in the analysis. By choosing a instructors who had passed 500 or more drivers in the five years we analysed 30 instructors and an "other" category into which all other instructors were placed. The results showed that Region, Age and Sex were all significantly associated with crashing, with odds ratios very similar to those reported in Table 1. Additionally, choice of CBT instructor was statistically significant. However, as with VORT examiner, we consider this likely to be misleading, deriving from not fully accounting for geographical region in the analysis. Hence we now report on an analysis of Adelaide postcodes 5000 – 5099, and we regard this latter analysis as preferable.

Results for Adelaide inner-metro (postcodes 5000-5099)

As with the analysis for the State as a whole, computational considerations meant that the number of examiners had to be restricted in the analysis. Instructors who had passed more than 100 students in areas covered by postcodes 5000-5099 were chosen, with all other examiners placed in an "other" category. CBT instructor was now not statistically significant.

Conclusion

Thus, as with VORT examiner, we conclude that choice of instructor in the CBT system does not have a significant bearing on the post-crash experience of drivers. Again, the apparent influence of individual examiners on drivers' crash experience when the whole State is examined must be treated with caution due to unaccounted-for geographical influences in the data.

Effect of pass rate of VORT examiner

In the course of this investigation, it was brought to our attention that certain VORT examiners had a very high pass rate, with over 90% of VORTs conducted by them being recorded as a pass. The average pass rate of all examiners is approximately 60%. There was some concern that the drivers passed by examiners with high pass rates were below acceptable standard.

We identified two examiners who had passed a large number of students, whose pass rate was over 90%. In the results of the analysis of the effect of VORT examiner in the inner Adelaide region (above), we were able to identify their students' relative odds of crashing. One examiner' s students were about 8% more likely to crash in the first 180 days than the average of all newly licensed young drivers in the State, and the other examiner's students were about 15% less likely to crash than the average, and neither of these differences were statistically significant.

Figure 1 shows the odds ratios of the students of different examiners, plotted against the number of students (from postcodes 5000 – 5099) that that examiner has passed in the last 5 years. The two examiners in question are highlighted. We would expect that the more students an examiner passes, the less random variation there would be in their students' odds of crashing: for those examiners with few students, one less or one more student who crashed would make a large difference to the odds ratio for the group as a whole. As an examiner passes more students, one student more or less who crashes will not be as influential on the odds ratio of the group. Therefore the scatter should be greatest to the left of the graph and least to the right, which is what is apparent. It is also apparent that the two examiners in question are not distinguished by particularly different odds of their students crashing than that of the average of all students (odds ratio = 1.00).

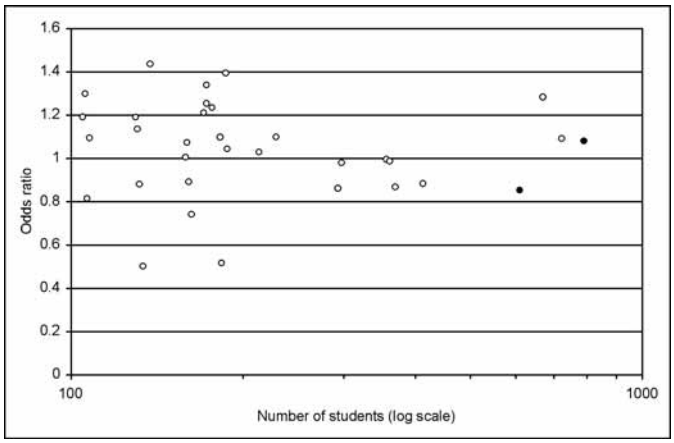

Figure 1 The odds ratio for crashing at least once in the first 180 days for VORT students who reside in postcodes 5000-5099, by specified examiners. The average odds ratio of all students is 1.0. Each point represents the odds ratio of crashing for one examiner's students compared with the average odds of at least one crash in the first 180 days for all students. The students of two examiners with particularly high pass rates and who have passed many students in the 5 years (1998-2002) are represented with solid markers

Summary

We could detect no differences between CBT and VORT drivers in the odds of being involved as a driver in at least one casualty crash in the first 180 days of licensure. A small difference was apparent when all crashes were considered. Drivers who chose VORT were 6% more likely than those who chose CBT to crash at least once in the first 180 days. However, there are reasons to believe that the groups of drivers entering the VORT and CBT systems appear to be different in certain important respects, and so we cannot assign the differences in crashes in their post-licensure period solely to the inherent differences between CBT and VORT. For example, drivers who chose VORT were more likely to have been involved in at least one crash prior to being issued with a P licence.

Our interpretation of the evidence is that choice of examiner and instructor do not affect the odds of crashing in the first 180 days. This is based on an analysis of students who resided in postcodes 5000-5099 (representing 40% of the students in the State). Furthermore, an analysis of pass rates showed that VORT instructors with high pass rates did not appear to produce drivers with increased odds of crashing. We have carried out several variations on the analyses reported here, and there are many more that it would be valuable to carry out in future in order to check specific ideas about what might be happening. The reader may feel that the choices behind the analyses presented were subjective, and other people may have made different ones, and obtained different results. To that we say "yes", analysis of a complex dataset does involve the exercise of judgment. However, we began the analysis with an open mind, and tried to remain faithful to wherever the results of analyses led us. We believe our conclusions to be broadly correct.

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