Session title: Work-related Road Safety

Paper Title: Comparing IT-based driver assessment results against self reported and actual crash outcomes in a large motor vehicle fleet

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Biographys

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Abstract

This paper reports on three recent studies undertaken by Napier University's Centre for Mathematics and Statistics on behalf of Interactive Driving Systems. The studies were based on a large group of British Telecom (BT) van and company car drivers, who had undertaken an on-line RoadRISK assessment of their attitude, hazard perception, behaviour, knowledge and personal exposure. The study had the following four aims.

1. Identify the most at-risk drivers.
2. Compare driver assessment scores against crash outcomes.
3. Evaluate the capabilities of the RoadRISK driver assessment program to predict likely crash outcomes.

4. Compare the outcomes from self reported crash data against insurance claims.

To achieve these aims, the following three studies were undertaken using cross tabulation and logistic regression.

1. In March 2003 the overall assessment scores of just over 8,000 drivers were compared against their self reported crashes.
2. In October 2003 the individual section scores of just over 16,000 drivers were compared against their self reported crashes.
3. In March 2004 the individual section scores of just over 16,000 drivers were compared against their actual crashes (based on insurance claims data).

The main results from these studies were as follows.

1. A relatively small group of drivers appeared to be involved in a disproportionate number of crashes.
2. There was a positive relationship between driver assessment scores and crash outcomes for both the self-reported and actual crash data.
3. The system has some capability to be used as a predictor of likely crash outcomes for fleet drivers, but it should not be seen as a substitute for other best practice fleet risk management processes.
4. Recommendations were made on how the assessment tool could be improved.

Finally the paper discusses some of the limitations of the project. Many of these were data related, such as the problems with self-reported crash data, the processes involved in obtaining accurate claims information in large vehicle fleets and the dilemma of evaluating event-led driver training programs in an objective way.

Introduction

Work-related road safety has increasingly been seen as an area offering opportunities to help reduce the road toll in a number of countries in recent years, for a whole range of societal, business, legal and cost reasons. In the UK, Australia, New Zealand and the USA there have been many programs and initiatives implemented by Government agencies, researchers and industry (see for example Murray et al 2002 and NIOSH 2004).

Traditionally work-related road safety initiatives have tended to focus on drivers/training (eg Lynn and Lockwood 1998) but more recently their focus has become wider to incorporate the vehicle, the road/working environment, data (DfT 2003), systems, management culture (DfT 2004) and Occupational Safety and Health led risk assessments (Murray and Cuerden 2004).

The aim of this paper is to continue the development of work-related road safety by focusing on occupational drivers, and particularly the use of risk assessment to help determine their recruitment, management, development and monitoring needs. This is an important area for many reasons, but particularly because of the on-going

debate around the world on the efficacy of skills-based driver training as a road safety countermeasure. The debate is well summarized by three recent headlines in UK industry publications: ‘Driver education dismissed as big con’, ‘The case for driver education’ and ‘Study proves driver training works’.

The debate tends to be characterized on the one hand by trainers and their customers who argue the benefits; against researchers, academics and in some cases former trainers who argue that the benefits cannot be scientifically proven. In some cases they argue that training could actually make things worse because of over confidence and risk compensation. Jerrim (1997), Skewes (2002) and Christie (2001) summarise these criticisms in some detail. Murray (2004) attempted to balance both sides of the debate, suggesting that the right type of fleet safety training intervention can play a significant part in crash reduction. He developed a risk assessment led process to help ensure that where training is an appropriate countermeasure it can be used effectively, based on several research, management development and consultancy projects undertaken in recent years.

The majority of the findings below are based on three elements of a research project undertaken by Napier University on behalf of Interactive Driving Systems to help evaluate and validate its online ‘RoadRISK’ driver assessment tool. The paper begins by describing the development of RoadRISK, then focuses on the outcomes of the Napier studies. By identifying some of the limitations in these studies it is also possible to make a range of recommendations that are relevant to industry, researchers, government and driver trainers.

The development of RoadRISK

RoadRISK is an on-line tool for driver risk assessment that focuses on driver attitude, knowledge, behaviour, hazard perception and risk exposure. It has evolved out of a series of IT-based driver assessment and training projects that were undertaken when computer based training (CBT) for drivers first emerged in the mid 1990s (see Murray and Dubens 2001). Much of the initial research was based around a two-year project undertaken by the University of Huddersfield in collaboration with Interactive Driving Systems and part funded by the European Regional Development Fund and Exel Logistics. The project initially involved over 120 University employees and 20 companies who were the first users of the original RoadRISK CD-ROMs. More detailed use of the system was also made by 15 small organisations in the North of England in a project described by Murray, Whiting and Bamford (2002).

Since this initial product development work, RoadRISK has evolved from CD-ROM to the internet and has been successfully implemented by many high profile organisations in the UK, Europe, Australia and USA. These users include Zurich Risk Engineering, Arriva Passenger Services, TNT Express and British Telecom (BT) – all of whom have publicly credited RoadRISK with helping to reduce their crash rate.

To date BT is the biggest user of RoadRISK with over 26,000 drivers assessed. It has recently stated in the UK trade press that the system has helped its crash rate reduce by 30% over the past few years. BT has also won two major road safety awards on the back of its RoadRISK program and was particularly supportive in

allowing the use of sensitive data on its drivers to be used in the Napier University studies described below.

Napier University RoadRISK evaluation studies

To date Napier University has been involved in four RoadRISK studies, between March 2003 and June 2004, with the following aims.

1. Identify the most at-risk drivers.
2. Compare driver assessment scores against crash outcomes.
3. Evaluate the capabilities of the RoadRISK driver assessment program to predict likely crash outcomes.
4. Compare the outcomes from self reported crash data against insurance claims.

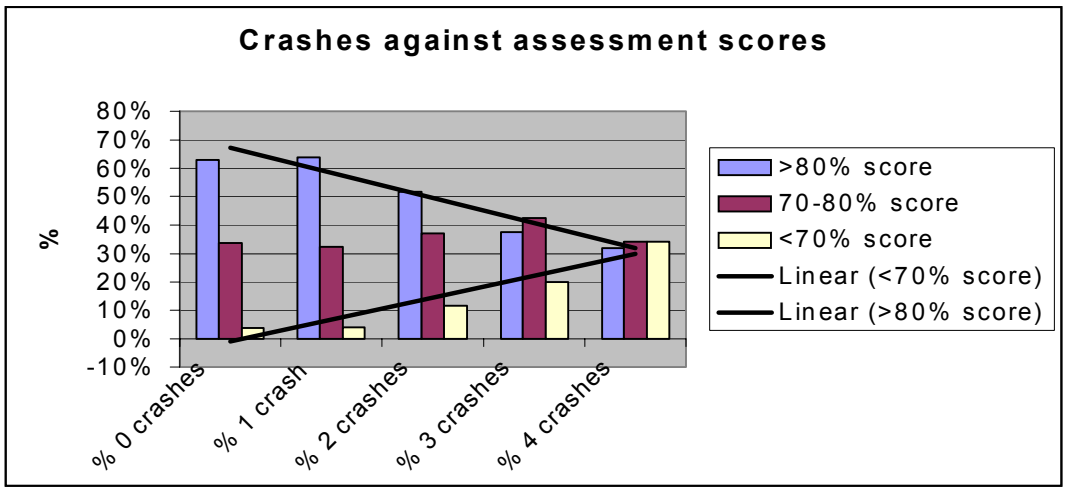
Study 1: 8,206 drivers, total score against self reported crash data

In March 2003 the overall assessment results (combined attitude, hazard perception, behaviour and knowledge score) of just over 8,000 drivers were compared against the self reported crashes captured in the RoadRISK database by Interactive Driving Systems. The initial outputs from this analysis can be seen in Table 1 and Graph 1. A clear relationship is shown between low scores on the assessment and self reported crash outcomes. For example 3.7% of drivers with no crashes scored <70%, whereas 34% of drivers with 4 crashes scored <70%.

Table 1 – Comparison of RoadRISK score against self reported crashes

RoadRISK Score	0 crashes	1 crash	2 crashes	3 crashes	4 crashes	Total
>80% score	4371	620	98	15	14	5118
70-80% score	2331	315	70	17	15	2748
<70% score	257	38	22	8	15	340
Total	6959	973	190	40	44	8206

Graph 1 - Comparison of RoadRISK score against self reported crashes



At this stage Napier University was requested to take a 'quick look at the numbers' to evaluate them in more detail, and they used a Logistic Regression analysis to provide the data in Table 2. This shows the likelihood of a driver having a crash based on their RoadRISK score relative to someone who had a high RoadRISK score. Results are given in the table together with the 95% confidence intervals for the odds ratio. For example someone who scored in the mid range on RoadRISK is 2.07 times as likely to have three accidents compared to someone who had a high score.

Table 2 - Logistic Regression outcomes for Study 1

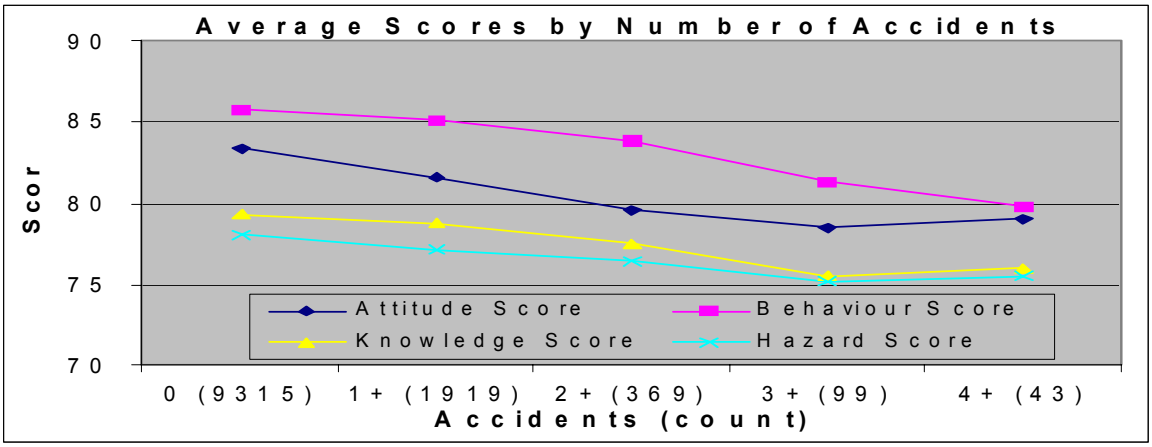
	1 or more crashes	2 or more crashes	3 or more crashes	4 crashes
Low score (<70%)	1.89 (1.46-2.45)	5.99 (4.18-8.59)	12.73 (7.28-22.26)	16.83 (8.05-35.16)
Mid. Score (70-80%)	1.05 (0.92-1.19)	1.51 (1.16-1.97)	2.07 (1.25-3.42)	2 (0.96-4.15)

Napier University also cautioned that although the results in Table 2 were promising, some of the relationship between the assessment scores and crash outcomes may actually be explained by other factors such as exposure (distance, time on the road) or driver age. For this reason a more detailed study, based on the individual section scores in the assessment, was proposed.

Study 2: 16,004 drivers section scores against self reported crash data

In October 2003 the individual section scores of just over 16,000 drivers were compared against their self reported crashes by Napier University. Graph 2 shows the initial outcomes from this analysis and identifies a clear relationship between the scores on the individual elements of the assessment and driver crash history, which appeared to back up and extend the findings from Study 1.

Graph 2 – Average assessment scores by crash history



More detailed statistical analysis in the form of a logistic regression was then undertaken on the data by Napier University. In this analysis they were able to allow

for exposure – which they could not in Study 1 due to the limited nature of the data. The results are shown in Table 3. A driver scoring <70% on the assessment, for example, is 3.3 times more likely to report 4 crashes than a driver scoring >80%.

Table 3 - Logistic Regression outcomes for Study 2

	1 or more crashes	2 or more crashes	3 or more crashes	4 crashes
Low score (<70%)	1.3	1.5	2.2	3.3
Mid. Score (70-80%)	1.2	1.3	1.5	1.9

Study 2 therefore confirmed that there is a relationship between the assessment score and crash outcomes, but by controlling for exposure this has decreased from Study 1 – where no controls were made.

Study 2 also found that driver attitude, age, distance (which was also a surrogate for time on the road) and personality were important and statistically significant factors. Overall RoadRISK was shown to be identifying approximately 7% of the total risk assessed. Although this may appear relatively low, it is in line with a recent study undertaken by Willis (2003) in a work-related road safety setting where the key drivers of risk can be seen to be societal/situational factors (15.5%), followed by organisational factors (8.2%), driver factors (7.8) and vehicle factors (2.5%). This confirms that although important, driver-based initiatives are only one element of a wider work-related road safety program – and goes some way to explaining why driver training programs implemented in isolation can easily be open to criticism.

Overall Study 2 helps to confirm the usefulness of RoadRISK as a tool for driver risk assessment, and to quantify the importance of exposure measures. This was particularly useful, as previously BT did not monitor the distances or time spent on the road by its drivers, so these findings, and the exposure information provided by RoadRISK, was very useful in the further development of its work-related road safety program to include elements of journey risk assessment, planning and management.

Whilst Study 2 was on-going, a separate project was being undertaken by BT to better analyse and understand its claims data. Whilst discussing this data, and the outcomes from Study 2, Study 3 evolved – which aimed to compare the assessment outcomes from RoadRISK against the drivers' actual claims history rather than their self reported crashes.

Study 3: 16,004 drivers section scores against claims data

In March 2004 the individual section scores of just over 16,000 drivers were compared against their actual crashes (based on insurance claims data). This analysis was 'fraught' with difficulties – particularly data related, but also the event-led training program that was in place.

A cross tabulation of self-reported crashes against actual claims is shown in Table 4. The ideal table would have had all entries on the diagonal. The majority of drivers had neither self-reported a crash (13,285 or 75%) nor made a claim (12,026 or 83%), suggesting that most of the incidents involved only a small proportion of the drivers.

Table 4 - Cross tabulation of self-reported crashes and actual claims

			Self-reported crashes (Aug 03)				
			0	**1**	**2**	**3**	**4+**
		Total	13,285	2,188	394	79	55
C	**0**	12,026	10,958	911	93	24	40
l	**1**	2,963	1,920	903	116	15	9
a	**2**	786	348	296	124	16	2
i	**3**	168	43	62	50	12	1
m	**4**	46	14	11	10	8	3
s	**5**	11	2	5	1	3	0
	6	1	0	0	0	1	0

Although there is some correlation between the data sets, heavily influenced by the large number of zeros, this table has many off diagonal entries. For example 911 drivers admitted to one crash over the previous 3 years in RoadRISK, but had made no work-related claim in the last 2 years according to the claims data. This difference between the self-reported crashes and actual claims data can be explained by several data related factors.

- The reporting periods differ. The self-reported crashes were from a 3-year period prior to undertaking the assessment, but the actual claims data was from only 2 years (April 2001 to March 2003) and took place before and after the assessment.
- Participants self-reported crashes included those occurring in private vehicles whereas the actual claims relate to company vehicles only. 16% of RoadRISK participants said they drive their own vehicle on work business.
- Problems with the claims reporting and recording system, where it is not always clear whether the person reporting the incident was actually the driver of the vehicle. For example many incidents appear to be reported by workshops repair staff.

Despite these limitations, the data was used to build a logistic regression model, to predict the propensity of having made at least one claim in the previous 2 years.

This model was able to explain 13.6% of the total risk assessed, which compares favourably to the model for self-reported crashes (7%) in Study 2, with a significant correlation between the Behaviour, Knowledge, Hazard Perception and Attitude scores. For each percentage decrease in Behaviour score the risk of a claim increases by 0.5%. This finding is in line with, but slightly weaker than, the relationship identified in Study 2. The exposure measures (age, time on the road, distance and personality) were also in line with Study 2.

Overall the relationship between the assessment score and crash propensity were not as statistically significant as the findings based on the self-reported data in Study 2. This was explained by the current ‘incident led training referral system’, whereby drivers involved in two incidents or a high cost crash receive training.

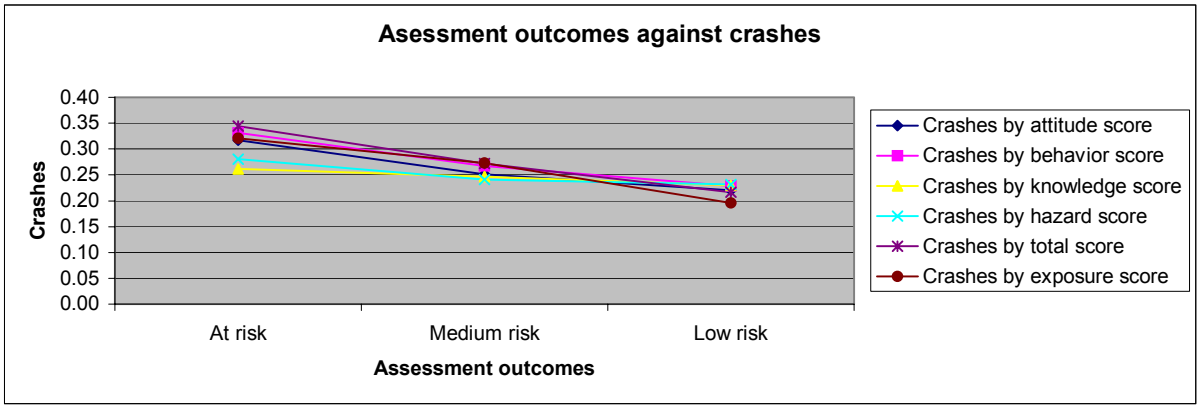
In Study 3 there was an obvious association between having two claims and then receiving training, which significantly distorts the data. For example, if a driver has two claims then receives 'training' **before** doing the RoadRISK assessment it is likely that their attitude, knowledge, behaviour and hazard perception scores will be improved by the training – even though they have been involved in two claims. In itself this may not be a bad thing, but it makes the evaluation of RoadRISK outcomes much more complicated – and is currently under review in the organisation.

For this reason it was recommended that more work needed to be done to improve the claims data and link it more effectively with assessment and training outcomes before it could be effectively used for evaluation. Until then any further analysis should continue to use the self-reported data. Such analysis was recently undertaken based on almost 26,000 drivers.

Study 4: 25,922 drivers section scores against self reported crash data

In June 2004 the Individual section scores of 25,922 drivers were compared against their self reported crashes by Interactive Driving Systems. The data shown in Graph 3 and Table 4 was checked for accuracy by Napier University, but no more detailed statistical analysis than that presented has been undertaken to date.

Graph 3 – Average assessment score by crashes in past three years



In Graph 3 there appears to be a clear relationship on all the assessment measures and on exposure (distance) when compared to the numbers of crashes the drivers have been involved in over the past three years. This is shown more clearly for 'attitude' and 'distance' in Table 4, which is indicative of the data currently being used to help target specific training and other interventions at the biggest areas of risk.

Table 4 – Attitude and distance by self reported crashes in last three years

Risk Group	Attitude Score (%)	No. of drivers	% of drivers	Crashes by attitude score	Distance (miles per annum)	No. of drivers	% of drivers	Crashes by distance
At risk	<70	3616	14%	0.32	>20,000	2702	10%	0.32
Medium risk	70-79	6200	24%	0.25	10-20,000	10769	42%	0.27
Low risk	80-100	16106	62%	0.22	<10,000	12451	48%	0.2

Conclusions, recommendations and areas for further work

The paper has focused on driver risk assessment, and in particular the RoadRISK tool developed by Interactive Driving Systems. The main findings and recommendations from the research, which have implications for industry, government and researchers, can be described are as follows.

1. There was a positive relationship between assessment scores and crash outcomes for both the self-reported crash data and the insurance claims, although data problems and the event based training program made the latter less clear cut.

2. As well as the assessment criteria of attitude, hazard perception, behaviour and knowledge, exposure measures such as distance were also important – and all offer scope for the development of need-based countermeasures.

3. The system has some capability to be used as a predictor of likely crash outcomes for fleet drivers, and to determine specific training needs in areas such as knowledge, behaviour, attitude, behaviour and personal exposure, but it should not be seen as a substitute for any other best practice fleet risk management processes. The driver is only one element of work-related road safety, and other areas such as management systems and culture, vehicles, routes and site, as well as journey planning should not be overlooked.

4. The studies have allowed several recommendations to be made on how RoadRISK can be improved, such as including elements on organisational safety culture and more effectively using the existing exposure variables – particularly in cases where the organisation is uncertain about the levels of exposure its driver face.

No research is without limitations. In this case many of them were data related, such as the problems with self-reported crash data, the processes involved in obtaining accurate claims information in large vehicle fleets, comparing these two sets of data in an effective way and the dilemma of evaluating event-led driver training programs. Some of these problems were caused by the applied nature of the project, which developed over time on the basis of need, opportunity and what data was available – rather than in a scientific pre-planned way.

Overall, the study reinforces the value of a needs based risk assessment led approach to crash reduction, but also highlights the importance of using accurate and relevant data and particularly the challenge organisations face in effectively linking their risk assessment, training and claims outcomes data much more accurately, effectively and in a ‘joined up’ way.

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