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STRATEGIC PRINCIPLES OF DRINK- DRIVING ENFORCEMENT

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Abstract:

This study aims to review the existing drink-driving enforcement research conducted by the Monash University Accident Research Centre (MUARC) to develop operational principles of drink-driving enforcement and emphasise where the best results are to be achieved. In addition, drink-driving enforcement studies undertaken in other Australian jurisdictions and internationally are reviewed. Both the Australian and international research indicates that existing drink-driving enforcement efforts have successfully contributed to reductions in casualty crashes at all severity levels. There has been little research on the costs and benefits associated with the RBT program as it operates in Victoria, however, international evidence suggests that RBT programs operated in a similar manner to the Victorian program are cost beneficial. The research also highlights a remaining group of drivers who have not been influenced by current enforcement methods. Finally, future research in the drink-driving enforcement area is discussed and the need to update this review as the nature of drink-driving enforcement evolves is noted.

Key Words:

Drink-driving, enforcement, random breath testing

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Preface

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EXECUTIVE SUMMARY

Since the first introduction of drink-driving enforcement through random breath testing in Victoria in 1976, it has grown to become an important component of road safety enforcement in this State. As a result, there is a significant history of research evaluating the effectiveness of this form of enforcement and associated activities. In reviewing the existing drink-driving enforcement research conducted both in Australia and internationally, the following key strategic principles have been developed:

- Random breath testing (RBT) achieves its effects principally through the mechanism of **general deterrence**. It detects relatively few drink-drivers per hour of testing because the proportion of drivers with illegal blood alcohol levels on the road is in fact quite low. Hence the mechanism of specific deterrence has very limited effect.
- When conducted intensively, random breath testing can result in substantial reductions in fatal and serious injury crashes at night. The impact of the testing persists for at least two weeks following the enforcement presence.
- RBT operations in urban areas must reach a threshold intensity of about 20 hours per 100 square kilometres per week to achieve significant crash reductions.
- The visibility of the RBT operations, and/or the capacity of the testing station to test high proportions of passing motorists, are important factors in increasing the general deterrence effect of RBT.
- Given the success of randomised scheduling of enforcement operations in other domains, further investigation of the potential benefits of adopting this approach for drink-driving enforcement is warranted.
- In provincial cities, RBT operating through booze buses alone and RBT operating through cars alone have successfully reduced serious casualty crashes during high alcohol hours. However, booze buses operating alone generate the greatest crash reductions in provincial cities across both major and minor roads. Car based RBT operated alone has its greatest effect on minor roads in provincial cities.
- Car-based RBT operating alone is the only enforcement method that resulted in crash reduction in the less built up areas of rural Victoria (i.e. outside provincial cities). There was no evidence of crash reductions during booze bus operations or combined booze bus/car RBT operations in these areas.
- Social and lifestyle factors are very important issues in rural drink driving. There is a need to minimise the success of avoidance behaviours in the presence of known enforcement activity, as this type of behaviour is likely to be self-perpetuating.
- Contact with enforcement does influence the perceived risk of detection. There is a high-risk cluster of drivers who continue to offend despite their perceptions about the risk of detection. In addition, in rural areas a group of drivers continue to perceive a relatively low risk of detection.
- Combined with the estimated duration of the initial effects and the enforcement effects described, it appears that RBT testing levels must be increased over time to maintain significant reductions in the target crash population.

- Compulsory (random) breath testing is a very effective countermeasure. However, the total program effect is greatest when CBT involves the use of booze buses and is supported by intense media publicity.
- The benefit-cost ratio of the Victorian RBT program is unknown. However, international research suggests that RBT enforcement will achieve the greatest crash reductions and be most cost beneficial when conducted at high intensities in a highly visible manner. Supporting media publicity also appears to improve the BCR of RBT enforcement.
- The use of RBT enforcement is generally regarded as the most effective means of deterring drink-drive behaviour. In particular, the use of sustained and highly intensive random breath testing operations is the most effective means of drink-drive enforcement.

1. INTRODUCTION

Since the first introduction of drink-driving enforcement through random breath testing in Victoria in 1976, it has grown to become an important component of road safety enforcement in this State. As a result, there is a significant history of research evaluating the effectiveness of this form of enforcement and associated activities. This study aims to review the existing drink-driving enforcement research conducted by the Monash University Accident Research Centre (MUARC) to develop operational principles of drink-driving enforcement and emphasise where the best results are to be achieved. In addition, drink-driving enforcement studies undertaken in other Australian jurisdictions and internationally are reviewed. In adopting this approach, it is intended that this report act as a companion piece to the existing MUARC report entitled 'MUARC's speed enforcement research: principles learnt and implications for practice' (Delaney, Diamantopoulou & Cameron, 2003).

1.1 BACKGROUND

When evaluating drink-driving enforcement and its effectiveness it is useful to first consider the factors that motivate the illegal behaviour and the mechanisms that may be used to influence it. The following factors have been identified (in order of importance) as those which influence the decision to drink and drive: (Riley (1991) as cited in Zaal, 1994).

1. Whether drivers perceive drinking and driving as necessary aspects of their social lives;
2. Beliefs that drinking will increase their chances of being detected by the police, the risk of apprehension and their concern about the legal consequences of conviction;
3. Beliefs about the dangers of drinking and driving;
4. Beliefs about the likelihood that family and friends would disapprove of their drinking and driving; and
5. The experienced effects of alcohol on mood and behaviour.

Traditionally, the focus of drink-driving enforcement operations using RBT has been to influence drivers' perceptions of those factors identified in point 2. Supporting media publicity and education have also been used to address a number of the other factors identified by Riley.

In trying to influence these motivating factors, enforcement efforts can operate through two primary mechanisms of effect: **general deterrence and specific deterrence**. General deterrence is a process of influencing a potential traffic law offender, through his fear of detection and the consequences, to avoid offending. The threat of detection as perceived by the driver is the key issue. The perceived risk of detection may be higher than the actual risk. The perceived risk may be increased by the unpredictability of the enforcement operations, and magnified by mass media publicity that emphasises these operations. In contrast, specific deterrence is a process of encouraging an apprehended offender, through his actual experience of detection and the consequences, to avoid re-offending. The magnitude of the penalty, especially that applying if subsequent offences are committed, is the key issue. Such offenders have actually experienced the threat of

detection, so they know that the risk is real. In addition, mass media publicity highlighting the consequences of offending serves to remind past offenders of the penalties if they offend again. Both these forms of deterrence may act as a moral or educative influence on road user behaviour in the longer term.

Drink-driving enforcement may also result in the removal of serious traffic offenders from the road system, at least temporarily. In practice, this mechanism affects relatively few road users and is not considered a primary mechanism of effect.

*Strategic Principle: Random breath testing (RBT) achieves its effects principally through the mechanism of **general deterrence**. It detects relatively few drink-drivers per hour of testing because the proportion of drivers with illegal blood alcohol levels on the road is in fact quite low. Hence the mechanism of specific deterrence has very limited effect.*

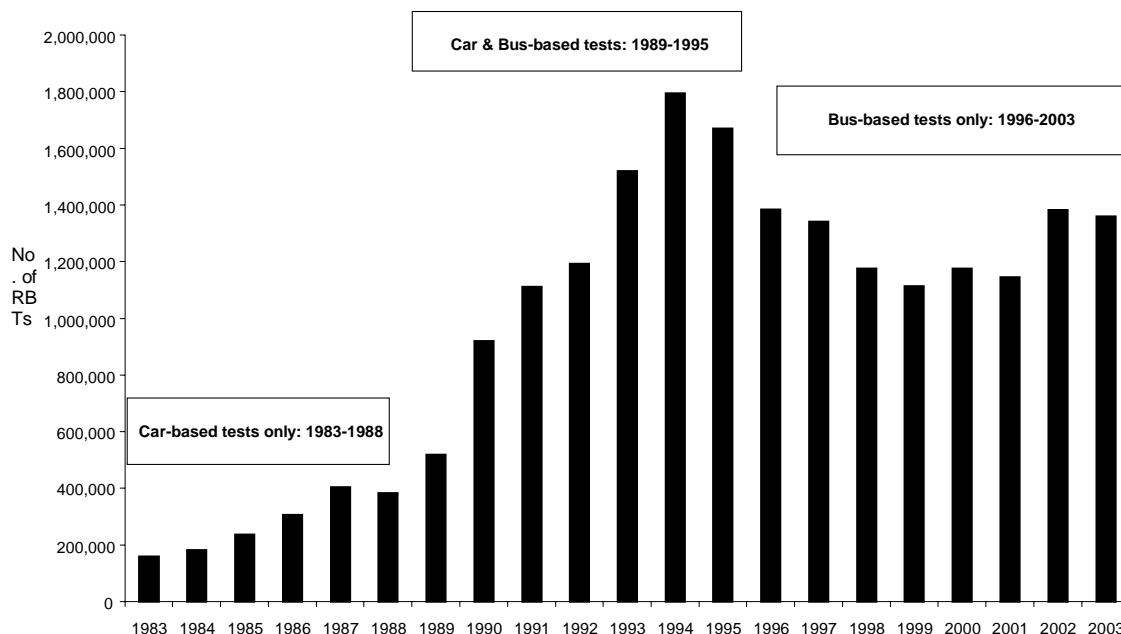
1.2 RANDOM BREATH TESTING IN VICTORIA

Drink driving has been regulated in Victoria since the introduction of the Motor Car Act 1909 which created the offence of driving whilst under the influence of alcohol. Following the introduction of the Motor Car (Breath Testing Stations) Act 1976, Victoria Police commenced random breath testing of drivers at designated roadside preliminary breath testing stations. Random breath testing involves Police randomly stopping drivers and testing their blood alcohol levels using a preliminary breath test (PBT). If that PBT is positive then an evidentiary breath test is administered (Cameron and Sanderson, 1982). A key feature of the RBT regime is that all drivers who are stopped are tested. There is no need to establish that a driver may be impaired by alcohol before administering the breath test.

From 1976, RBT was predominantly conducted from Police cars, although four, relatively small, Toyota Coaster buses were also used (Sullivan, Cavallo & Drummond, 1992). In late 1989, custom-built buses, now commonly known as “booze buses”, were gradually introduced in Victoria to increase the number of drivers who could be randomly breath tested and to enhance the visibility of RBT operations. It was anticipated that by increasing the number of drivers exposed to random breath testing, the buses would likely act as a greater deterrent to drink driving than car-based tests. The shift from traditional car-based to bus-based RBT operations predominantly occurred in metropolitan Melbourne whilst in rural areas of Victoria the introduction of bus-based tests was delayed until 1990 and occurred on a smaller scale than in metropolitan Melbourne (Cavallo & Cameron, 1992).

Since the introduction of bus-based RBT the number of random breath tests conducted in Victoria has increased progressively to a peak of nearly **1.8 million** in **1994** (Figure 1.1). A change in the recording of RBT operations has meant that from January 1996 the total number of RBTs conducted by both cars and buses has not been available. Only information on the number of RBTs conducted via bus operations has been available since that time. During the period 1996 to 2003 the annual number of bus based tests has ranged from about 1.1 million to almost 1.4 million (Figure 1).

Figure 1. Annual Number of Random Breath Tests: Victoria 1983-2003



It is clear from Figure 1 that bus-based RBT continues to play an important role in the Victorian road safety program with at least one in three drivers tested annually since 1990.

2. AUSTRALIAN DRINK-DRIVE ENFORCEMENT RESEARCH

2.1 THE EARLY RESEARCH

Evaluations of the first RBT operations commencing in 1976 were conducted to determine their effectiveness. From July 1976 to October 1978 RBT operated for an average of 8 hours per week in the metropolitan Melbourne area. In addition, during two periods in 1977 lasting 6 and 7 weeks respectively, there was an increase in RBT operations to an average of 32 hours per week on Tuesday, Thursday, Friday and Saturday nights¹. Some additional RBT was also conducted in rural Victoria. A further three periods of “intensified” RBT operations were conducted during 1978 and 1979 on Thursday, Friday and Saturday nights. These three periods of intensified enforcement last for 7, 4 and 8 weeks respectively with the average number of RBT hours per week ranging from 74 to 100 during these periods. The increased hours were targeted at areas representing about one-quarter of urban Melbourne and during these periods, the intensity of testing per unit area ranged from 17 to 23 hours per 100 square kilometres per week (Cameron and Sanderson, 1982). RBT enforcement operations were also supported by Melbourne-wide publicity campaigns targeting drink-driving offences (Cameron and Strang, 1982).

Research on the first six months of implementation (July-December 1977) provided only weak evidence of a positive effect of drink-driving enforcement on alcohol-involved

¹ “Nights” were defined as the period from 6:00 pm to 3:59 am.

crashes (Cameron, 1978a). However, analysis of the two periods of increased RBT enforcement revealed a 36 percent reduction in night-time serious casualty crashes in the enforcement areas during the week of RBT enforcement and for two weeks following. Night-time serious casualty crashes were used as a proxy for alcohol-involved crashes in this study as it was not possible to reliably determine alcohol involvement in crashes. In contrast, analysis of the effect of the three periods of intensified RBT focused on reductions in road crash fatalities. The results indicated a net reduction in crash fatalities of 59 percent in the testing areas both during operations and for the subsequent two weeks. Reductions in crash fatalities were greatest on Thursday, Friday and Saturday nights. Statistically significant reductions in serious casualty crashes were also identified during the period of RBT enforcement and the subsequent two weeks. In addition, there was a net 31 percent reduction in the proportion of driver casualties in single vehicle crashes with an illegal BAC (>0.05) on the nights of RBT enforcement and for the two subsequent weeks.

Surveys aimed at determining motorists' subjective risk of detection for drink driving offences were also conducted during the periods of intensified enforcement. In both 1977 and 1978 the perceived probability of detection for drink-driving offences increased. This suggests that RBT operations operate through a general deterrence mechanism. That is, potential offenders are influenced by a fear of detection and the consequences to avoid offending.

Strategic Principle: When conducted intensively, random breath testing can result in substantial reductions in fatal and serious injury crashes at night. The impact of the testing persists for at least two weeks following the enforcement presence.

Strategic Principle: RBT operations in urban areas must reach a threshold intensity of about 20 hours per 100 square kilometres per week to achieve significant crash reductions.

2.2 THE INTRODUCTION OF BUS-BASED OPERATIONS

In late 1989 Victoria adopted a new approach to drink-driving enforcement. Car-based operations were progressively replaced by thirteen, highly visible, bus-based RBT stations operating throughout Victoria. In addition, a high profile statewide publicity campaign using all mass media was launched in December 1989 and reinforced throughout 1990 and 1991. The key theme of the media campaign was "If you drink then drive, you're a bloody idiot". During this period the number of drivers tested more than doubled from around 500,000 in 1989 to over 900,000 in 1990 and 1,100,000 in 1991. The number of sessions conducted in Melbourne did not change, however, the number of session hours increased by modest amounts and the number of person hours spent testing increased substantially. Compared with car-based RBT operations, the new buses were highly visible to passing drivers and, due to the relatively high staffing levels, a high proportion of drivers could expect to be tested. Thus, the general deterrence effect of bus-based RBT per hour of operation might be expected to be greater than that of the previous car-based system.

Analysis of alcohol related crashes during this period indicated that the program had substantial, positive effects on both fatal and serious injury crash frequency. In particular, high alcohol hour fatal crashes fell by between 19 and 24 % in Melbourne during 1990. There was also some evidence of a reduction in serious injury crashes in high alcohol hours in both metropolitan Melbourne and rural Victoria. Analysis of high alcohol hour crashes in 1991 found a reduction in serious injury crashes in rural Victoria only. There was no statistically significant reduction in fatal crashes in either metropolitan Melbourne or rural Victoria during this period.

Subsequent research has linked monthly serious casualty crashes in Melbourne during high alcohol hours with monthly numbers of random breath tests, monthly alcohol sales, and awareness of drink-driving publicity placed during the month and previous months. (Cameron et al, 1994). In addition, research using similar methods, but separating bus-based and car-based random breath tests, has shown a statistically significant link with the bus-based tests but a weaker relationship with the car-based tests (Newstead et al, 1995).

Together with the earlier research on the effects of the “booze bus” initiative, these findings suggest the following strategic principle.

Strategic Principle: The visibility of the RBT operations, and/or the capacity of the testing station to test high proportions of passing motorists, are important factors in increasing the general deterrence effect of RBT.

2.3 TIME OF TESTING

An evaluation was carried out in Melbourne during October to December 1983 to determine the relative effectiveness of RBT during the afternoon and evening (4pm to 8pm), when the operations were visible to high traffic volumes, compared with RBT carried out at night (8pm to 4am) when drink-driving is more common (Armour, et al., 1985)

The night-time testing was carried out on Thursday to Saturday in urban areas north of the Yarra River and the afternoon/evening testing was carried out on Monday to Wednesday in areas south of the Yarra. The total hours of testing in the north area was relatively greater, and the area relatively smaller, resulting in an intensity of RBT around **16 hours per 100 square kilometres per week**. In the south area, the intensity of testing was about **one-third** of the level in the north area. Melbourne-wide mass media publicity about RBT accompanied the operations.

Separate evaluations of effects in the two areas showed a statistically **significant 24% reduction** in serious casualty crashes at night in the north area, compared with a **non-significant 13% reduction** in crashes of the same type in the south area (Armour, et al., 1985).

While the difference in time of RBT operations is confounded with a difference in the intensity of operations in the two areas, the results do suggest the following strategic issue.

Strategic Issue: RBT carried out during times of the week when drink-driving is frequent is highly likely to produce crash reductions, whereas there is less certainty about its effects when carried out at other times.

Improving the timing and location of drink-driving enforcement has also been considered elsewhere. Elliott (1992), has suggested that altering the mechanisms for deploying enforcement resources may result in improved effectiveness of RBT. In particular, he suggests that adopting a randomised scheduling approach, whereby enforcement resources are allocated randomly in time and space across the road network, may generate additional road safety benefits. The aim of such an approach is to maximise the general deterrence effect of enforcement operations by improving visibility across the road network and to increase the risk of apprehension by decreasing the ability of road users to predict the timing and location of enforcement activities. There has been little research regarding the

effectiveness of such an approach in the drink-driving domain. However, this approach has been used successfully as part of the Random Road Watch enforcement program in Queensland. This program involved the randomised scheduling of general enforcement operations (including drink-driving enforcement) from marked Police vehicles. Evaluation of this program found that it resulted in statistically significant crash reduction across Queensland at various severity levels (Newstead and Cameron, 1999).

Strategic Principle: Given the success of randomised scheduling of enforcement operations in other domains, further investigation of the potential benefits of adopting this approach for drink-driving enforcement is warranted.

2.4 DRINK-DRIVING ENFORCEMENT IN RURAL AREAS

Until 1993, the growth in RBT in country Victoria had been relatively slow compared with Melbourne. However, in November 1993, the Victoria Police in conjunction with the Transport Accident Commission launched a program of substantially increased RBT in country Victoria supported by mass media publicity.

The country RBT and publicity program was evaluated in terms of implementation characteristics and its effects on road trauma. The evaluation found that after the introduction of the country RBT program in late November 1993, 790,445 tests were conducted in country Victoria to the end of 1994, with the relatively high level of RBT activity achieved in Melbourne in 1993 being maintained during 1994 (Cameron et al, 1996)

The Melbourne-based Traffic Alcohol Section (TAS) booze buses appeared to display considerable deterrent value for drink driving, by random breath testing a greater number of drivers per hour than either the country-based buses or cars across country Victoria. Substantial variation in RBT activity patterns between country Police Districts was also found. The crash-based component of the evaluation found evidence of a statistically significant 22% reduction in high alcohol hour serious casualty crashes when RBT was conducted by cars operating alone, during the weeks and in the regions when enforcement was present (Cameron et al., 1996.)

There was also some evidence of an interaction between the effects of the enforcement operations and the levels of awareness of drink-driving television advertising in country Victoria. Medium levels of awareness appear to increase the effects of the “car only” enforcement operations (33% reduction). Conversely, in regions and weeks influenced by car and bus combinations, a statistically significant net increase in high alcohol hour serious casualty crashes occurred when high publicity awareness accompanied the enforcement.

Further analysis, in which crashes by road type were examined, found evidence that some drink-drivers faced with intense enforcement (i.e. bus and car combinations), heightened by intense drink-driving publicity, changed their travel behaviour and used relatively unsafe minor roads (Diamantopoulou, et al. 1998). Under these circumstances, in rural areas of Victoria, significant increases in high alcohol hour serious casualty crashes occurred on minor roads but not on major roads. In response to this analysis, Victoria Police and the TAC introduced a program of strategic RBT blitzes targeting ‘high risk’

rural communities where ‘booze buses’ acted in tandem with covert ‘satellite’ cars in order to promote a ‘no escape’ message.

Strategic Principle: The effectiveness of car-based RBT in rural areas of Victoria appears similar to that achieved by RBT (both car- and bus-based) in Melbourne. This may relate to the perceived ability of the cars to cover broad areas and to raise the perceived risk of detection above a threshold level.

Strategic Principle: RBT operations should be scheduled on minor as well as on major roads in rural areas of Victoria. Greater emphasis should be placed on the use of car-based RBT, particularly near hotels and clubs, with patrol cars operating on minor roads in concert with booze buses located in towns.

In view of the above findings, further research examining the effect of booze bus operations in the major provincial cities and the rest of rural Victoria separately was commissioned (Diamantopoulou et al., 1999). Using the same data as that for the evaluation of the country RBT and publicity program, the study aimed to compare the effects of booze bus operations on crashes in major provincial cities and in other rural areas of Victoria, on both minor and major roads. Provincial cities and other rural areas were defined based on groupings of LGAs influenced by RBT activity. That is, 153 LGAs were amalgamated into 70 regions for the purpose of the analysis. These regions were classified as “provincial city” and “other rural areas” according to the following criteria:

Provincial City

- If the region contained a major provincial city where booze buses are likely to be stationed (based on advice given by TAS Police); or
- If the region contained a major provincial city which was the main contributor to that region’s population (based on 1994 ABS population figures); or
- If a region contained a shire which had a population in excess of 10,000, and that shire was the major contributor to the region’s population.

Other Rural Areas of Victoria

- A region not containing a major provincial city (usually comprised of shires only), with a relatively smaller population than a “provincial city” area.

A total of 25 regions were defined as “provincial cities”, whilst the remaining regions were classified as “other rural areas”.

The effect of RBT was estimated by examining the changes in serious casualty crashes during high alcohol hours in the regions influenced by RBT activity. These changes were compared to changes occurring in the same areas, over the same time period in the previous year. Changes in serious casualty crashes occurring in low alcohol hours over the same two time periods were used as controls to capture the effect of changes other than RBT enforcement that may influence serious casualty crash rates.

The main findings of the analysis relating to the effect of RBT operations on crashes in provincial cities and other rural areas of Victoria are as follows:

- Cars operating alone are apparently effective in both provincial cities and in other rural areas of Victoria. A statistically significant net 25% reduction in HAH serious casualty crashes occurred when cars alone were in operation in *provincial cities* during the RBT program (as compared to the pre-RBT program period). A smaller net 18% reduction occurred in rural areas other than provincial cities, but this reduction was not statistically significant.
- Cars were also apparently effective on both major and on minor roads both in provincial towns and the other rural areas, particularly:
 - On *major roads* in rural areas *other* than provincial cities, where a marginally statistically significant net 28% reduction (p=0.0862) in HAH serious casualty crashes occurred for car-only operations, and
 - On *minor roads* in *provincial cities*, where a statistically significant net 31% reduction (p=0.0580) occurred for car-only operations.
- Booze buses operating alone appear to be effective only in *provincial cities* and not in the other rural areas of Victoria,
 - i.e. A net 46% reduction in HAH serious casualty crashes occurred when booze buses were operating alone in major provincial towns during the country RBT program. Conversely when buses were operating in other rural areas of Victoria, a net 19% increase in HAH serious casualty crashes resulted. Neither of these net percentage changes was statistically significant, but the results suggest that bus operations are more effective in major provincial cities than in less built-up rural areas of Victoria.
- Booze buses operating alone were also apparently effective on both major and on minor roads in *provincial cities*, but not on major nor on minor roads in less built-up rural areas of Victoria.
 - i.e. A net 43% reduction in HAH serious casualty crashes occurred on *major roads* in *provincial cities* when TAS or District buses were in operation alone. Conversely, in *other rural areas* of Victoria there was no evidence of a reduction in crashes on major roads for bus-only operations, and
 - In provincial cities, a net 49% reduction in HAH serious casualty crashes occurred on *minor roads* during the country RBT program. Conversely there was no evidence of a reduction on minor roads in rural areas other provincial towns when buses were operating alone.
- There was no evidence of crash reductions when cars and booze buses were operating together in rural Victoria, neither in provincial cities nor in other rural areas. In addition, car/bus combinations did not appear to be effective on major roads nor on minor roads in either large provincial cities or in less built-up rural areas of Victoria.

Together with the previous study of the rural operation of RBT these results suggest the following strategic principles:

Strategic Principle: In provincial cities, RBT operating through booze buses alone and RBT operating through cars alone have successfully reduced serious casualty crashes during high alcohol hours. However, booze buses operating alone generate the greatest

crash reductions in provincial cities across both major and minor roads. Car based RBT operated alone has its greatest effect on minor roads in provincial cities.

Strategic Principle: Car-based RBT operating alone is the only enforcement method that resulted in crash reduction in the less built up areas of rural Victoria (i.e. outside provincial cities). There was no evidence of crash reductions during booze bus operations or combined booze bus/car RBT operations in these areas.

In addition to the crash analysis of the effectiveness of rural RBT, two separate studies have surveyed licensed drivers drawn from patrons of rural hotels (Harrison, 1996 and Harrison, XXXX). These surveys suggest that:

- Many rural hotel patrons actively avoid enforcement activity if possible, regardless of their self-reported alcohol consumption. Many (especially patrons defined as high-risk) believe others do the same.
- Knowledge of others' contact with drink-drive enforcement was common.
- About two-thirds of patrons had been tested at RBT stations.
- Any relationship between enforcement activity and self-reported behaviour is more likely to be the result of lifestyle factors than the result of any effect of contact with enforcement on behaviour.
- Avoidance behaviours (using alternative routes) were successful for patrons identified as potential drink-drivers. High-risk patrons reported less contact with drink-drive enforcement activity than other groups, in spite of their higher likelihood of driving after drinking relatively large amounts at the hotel.

Strategic Principle: Social and lifestyle factors are very important issues in rural drink driving. There is a need to minimise the success of avoidance behaviours in the presence of known enforcement activity, as this type of behaviour is likely to be self-perpetuating.

2.5 RBT AND THE PERCEIVED RISK OF DETECTION

The relationship between direct exposure to enforcement activity and the perceived risk of detection is relevant to an understanding of the mechanisms that operate in successful RBT operations. A survey of 3,700 drivers in four Police Districts in Victoria was conducted as part of an evaluation of a specific enforcement program (Harrison et al, 1998). The survey data suggested that:

- The perceived risk of detection was related to the number of times respondents saw drink-drive enforcement activity.
- On average, respondents reported seeing 1.3 instances of drink-drive enforcement activity in the four weeks prior to the survey.
- One cluster of respondents (8% of the sample) saw a lot of enforcement activity, perceived there to be a high risk of detection for drink-driving, but were more likely than others to report drink-driving.
- A separate cluster (17%) had a low perceived risk of detection and tended to live in rural areas.

The application of recent developments in decision-making theory and psychology to drink-driving enforcement suggest that, the direct experience of enforcement activity or detection act at a different point in the decision-making process to the threat of detection or indirect experiences and knowledge of others' experiences of enforcement. Direct experiences and detection are more likely to influence decisions such as drink-driving decisions (Harrison, 1998b).

Strategic Principle: Contact with enforcement does influence the perceived risk of detection. There is a high-risk cluster of drivers who continue to offend despite their perceptions about the risk of detection. In addition, in rural areas a group of drivers continue to perceive a relatively low risk of detection.

Strategic Principle: Emphasis on direct experiences of enforcement activity may be critical in modifying the behaviour of those who continue to drive in spite of current, relatively high risks of detection.

2.6 PERSONALITY AND DRINK DRIVING

A number of MUARC research projects have examined the involvement of personality factors in drink driving (Harrison, 1996 and Harrison, 1998). A key conclusion arising from this research is that, in the current high enforcement and high publicity environment, particular personality orientations are associated with continued drink-driving behaviour in Victoria. Rural drink-drivers were more likely to fall into the largest personality cluster associated with drink driving than metropolitan drink-drivers. These personality factors are especially predictive of drink driving amongst male drivers and may serve to immunise offenders from the more-general effect on behaviour of the current enforcement and publicity program.

Strategic Principle: There is considerable potential for the use of psychological characteristics in targeting enforcement and publicity programs.

Strategic Principle: There are significant differences between rural and metropolitan drink driving. Rural drink-drivers are less likely to be influenced by current approaches to enforcement than are metropolitan offenders.

It is clear that lifestyle and social factors play a role in drink-driving, that experience with enforcement increases the perceived risk of detection, that there are still drivers who drink-drive in spite of current levels of enforcement, that rural drivers may be more persistent in this than metropolitan drivers, that the avoidance techniques used in rural areas do help offenders or potential offenders avoid direct contact with enforcement, and that indirect or threatened exposure to enforcement of detection may be insufficient to change the behaviour of persistent offenders.

Strategic Principle: There is a need to provide more widespread direct exposure to enforcement activity to persistent offenders and (perhaps) rural drivers while continuing to reinforce the general high-enforcement message provided by the current RBT program.

2.7 DRINK DRIVING ENFORCEMENT IN OTHER AUSTRALIAN STATES

Although RBT was first introduced in Victoria, successful RBT operations now exist throughout Australia. A study examining the long-term impact of RBT on crashes was conducted using Police enforcement and crash data from 1976 to 1992 from four Australian states (Henstridge et al, 1997). The dates of introduction of RBT in these four states are as follows;

- NSW: RBT introduced 17th December 1982;
- Queensland RBT introduced 1st December 1988;
- Western Australia RBT introduced 1st October 1988; and
- Tasmania RBT introduced 6th January 1983.

The nature of RBT operations differed across these four states. NSW and Tasmania introduced RBT early in the 1980s and tested all drivers who passed through Police roadblocks. In contrast, in Western Australia and Queensland, “de facto RBT” operated prior to 1989 and involved only those drivers who Police suspected of drinking being tested. In the late 1980s RBT was introduced in these states, however, there is evidence that universal testing of drivers did not occur even after the introduction of RBT.

Further differences between states existed in relation to the level of publicity associated with RBT operations in these states. NSW launched an expensive media publicity campaign at the time of introduction of RBT whereas Tasmania relied on word of mouth and press coverage to enhance the general deterrence message. Western Australia and Queensland has less intense levels of both enforcement and publicity than NSW and Tasmania. For these reasons, the authors of the report defined NSW and Tasmania as revolutionary states Western Australia and Queensland as evolutionary states.

Given the differences in the nature and extent of RBT enforcement and publicity across the four states it is not surprising that the impact of the enforcement campaigns also differed across states. A time series analysis of fatal and serious injury road crashes examined the initial impact of RBT on various crash types. Statistically significant initial reductions in crashes varied across states and the types of crashes analysed but ranged from 13% to 48%. In NSW, RBT operated from both stationary and mobile testing stations. A 26% initial reduction in single vehicle night-time crashes and a 19% initial reduction in all serious casualty crashes was attributed to these operations. The impact of the introduction of RBT on single vehicle night-time crashes was reduced to 5% of its original value after 10 years. The enforcement effect was estimated to impact upon single vehicle night-time crashes for a period of up to 18 months. In contrast, the impact of RBT operations on all serious casualty crashes was sustained for an average of only 200 days (about 6.5 months) in NSW. The analysis of the three other states produced results consistent with those for NSW. The impact of RBT was immediate and persisted for a minimum of one year. The enduring effect of RBT operations was particularly evident for single vehicle night-time crashes (i.e. those crashes most likely to be related to excessive alcohol consumption).

Strategic Principle: There is consistent evidence across Australian jurisdictions demonstrating that RBT operations can result in both immediate and longer-term reductions in alcohol-related casualty crashes.

This research also examined the effect of increasing levels of RBT operations. In NSW, the impact of RBT operations declined throughout the 1980s despite initial, large decreases in single vehicle night-time crashes following the introduction of RBT. At the same time the number of RBTs conducted increased only slightly. However, from 1987 enforcement intensity was increased and, by 1992, an average of 5742 RBTs were conducted daily in NSW. An 18% reduction in serious casualty crashes and a 22% reduction in single vehicle night-time crashes followed. In more general terms, it was estimated that an increase of 1,000 tests per day would reduce single vehicle night-time crashes by 19.3%. In addition, it was estimated that serious injury crashes could be reduced by around 3.5% given a 10% increase in existing testing levels (1997).

Strategic Principle: Based on historical data, there is evidence to suggest that modest increases in the number of RBT's administered can result in considerable reductions in both serious injury and single vehicle night-time crashes.

Strategic Principle: Combined with the estimated duration of the initial effects and the enforcement effects described, it appears that RBT testing levels must be increased over time to maintain significant reductions in the target crash population.

2.8 THE OVERALL CONTRIBUTION OF THE DRINK-DRIVING ENFORCEMENT PROGRAM IN VICTORIA

Given the significant resources devoted to the drink-driving enforcement program in Victoria, it is useful to examine the contribution of this program, including supporting publicity, to reductions in serious casualty crashes in this state. A study of the contributions of various road safety initiatives has estimated the effects the levels of random breath testing and the awareness of supporting publicity on serious casualty crashes in Victoria during 1990-93 (Newstead et al., 1995). Table 1 below presents the key results of this study.

Table 1. Estimated reductions in serious casualty crashes attributable to various sources. Victoria, all hours, 1990-93.

	1990	1991	1992	1993
Modelled actual serious casualty crashes	6168	5342	5192	5183
(actual serious casualty crashes)	6156	5371	5156	5193
Expected* serious casualty crashes	8827	9118	9419	9731
Reduction in serious casualty crashes	30.1%	41.4%	44.9%	46.7%
Contribution of increased unemployment	0.8%	11.5%	14.4%	15.3%
Contribution of reduced alcohol sales	4.7%	7.1%	9.0%	11.5%
Contribution of speed camera TINs	7.9%	8.9%	9.0%	8.9%
Contribution of speed and concentration publicity	6.2%	8.7%	8.7%	8.3%
Contribution of Bus-Based RBT	6.3%	6.5%	6.5%	6.8%
Contribution of drink-driving publicity	7.5%	6.7%	7.3%	7.1%
Contribution of above four road safety programs	25.2%	27.5%	27.9%	27.6%

* Expected if the road safety initiatives and other factors had remained at base levels

During the period 1990 to 1993, the contribution of bus-based RBT was estimated to be an average of 6.5% to total reductions in serious casualty crashes. Similarly, drink-driving publicity contributed an average of 7.2% to total reductions in serious casualty crashes

over the same period. The contributions of increased unemployment and reduced alcohol sales have also been estimated, though it is unclear in the latter case whether the alcohol sales reductions may represent an additional, indirect effect of drink-driving enforcement and publicity programs.

The analysis of the effects of the enforcement operations and levels of supporting publicity was not able to consider the interactions of these initiatives. It is likely that the effects of the enforcement would not have been as great without the publicity, and vice versa. It is also possible that the combination of enforcement and publicity, both addressing the same road trauma problem, may have synergistic effects so that their combined effect is greater than that suggested by the effects estimated for each component.

In addition to the above research, an economic analysis of the effects of both the speed camera and RBT programs (including the supporting mass media publicity) during 1990-93 has been conducted (Cameron et al, 1995). The results showed that, together these programs were estimated to have saved 10,800 serious casualty crashes during the four-year period. Further, social cost savings worth more than 20 times the total cost of those programs were produced. These findings suggest the following strategic principle.

Strategic Principle: Effective programs of enforcement and supporting publicity aimed at drink driving and speeding are highly cost-beneficial.

The cost to benefit ratio for RBT programs alone has not been estimated for Victoria. However, research from New Zealand suggests that RBT enforcement is cost beneficial (Miller et al, 2004). Compulsory breath testing (CBT) was first introduced in NZ as a mix of mobile and fixed breath testing in 1993. Mobile operations involve randomly stopping motorists across the road network whilst fixed operations are stationary, involve a larger number of Police and operate at individual sites across the road network. The program was based on that operating in Victoria and enables Police to test the BAC of all drivers stopped regardless of whether excessive alcohol consumption is suspected. A national publicity campaign was also launched at this time and the allowable BAC for drivers under 20 years of age was reduced to 30mg/100ml. In 1995, a remodelled publicity campaign was launched with greater intensity. Finally, in 1996 the visibility of CBT operations was increased with the introduction of a booze bus unit in the Northern Police Region. This enabled the streamlined processing of offending drivers and eliminated the need for Police to accompany such drivers to a Police station for processing.

The effectiveness of these measures and the relative costs and benefits associated with them have been evaluated (Miller et al., 2004). Cumulatively, the introduction of CBT, reduced BAC limits for young drivers, the media campaign and the use of a booze bus have been estimated to reduce night-time fatal and serious crashes by 54% nationally. The largest impact resulted from the introduction of CBT (22%), followed by the booze bus (18%) and media campaign (14%). A cost benefit analysis of each of the phases of the CBT program found that, when considered from society's point of view, a comprehensive package of enforcement including CBT, intensive media publicity and booze buses is the most cost beneficial with a return on investment of 26.1. CBT operating alone and CBT operating with media publicity were also estimated to be cost beneficial from society's perspective although the benefit to cost ratios were slightly lower (14.4 and 18.8 respectively). The marginal return on each intervention has also been estimated with the addition of a booze bus estimated to generate a marginal return of 124, media campaigns returning a marginal benefit of 37.2 and CBT a marginal return of 14.1. Despite the

apparently large benefit-cost ratios, the statistical models used to estimate them appear to be robust. Further, the estimated crash reductions should be viewed in light of the extensive drink-driving problem existing prior to implementation that likely increased the crash savings that could be achieved.

Strategic Principle: Compulsory (random) breath testing is a very effective countermeasure. However, the total program effect is greatest when CBT involves the use of booze buses and is supported by intense media publicity.

Supporting evidence for the idea that comprehensive testing regimes are likely to generate the greatest reductions in alcohol related crashes can be found in the European literature. The first study examines the total additional benefits to be gained by European Union member countries if all enforcement was to be implemented as currently done in the best performing member State (ICF Consulting, 2003). Sweden was considered the best performing state in terms of the implementation of drink-driving countermeasures on the basis of a 0.2mg/ml BAC limit, the ability to test drivers randomly, very severe sanctions if detected drink driving and a testing intensity of 22% of licensed drivers per year. Based on previous research the authors then estimated the additional costs and benefits associated with the remaining 14 member States adopting this style of enforcement. It was found that across all EU member states a benefit-cost ratio of 8.1 could be achieved if all States were to implement drink-driving enforcement as it is currently conducted in Sweden. This would involve increasing the intensity of testing across all but one member States, uniformly allowing random testing, decreasing the allowable BAC and increasing the sanctions for drink-driving offences.

Strategic Principle: The randomness of testing, the severity of sanctions, testing intensity and the allowable BAC level are important determinants of the success of a drink-driving enforcement program.

It is noted however, that the Victorian RBT program operates in a similar manner to European best practice but has a higher intensity of testing and additional media publicity to that used in Europe. Therefore, the cost-benefit ratios of the programs may differ to those in Europe. Nevertheless, it is instructive to consider a further cost-benefit analysis of drink-driving enforcement through RBT in Sweden. Elvik and Amundsen (2000) considered the potential benefits for improving safety through the optimal implementation of a number of road safety strategies including drink-driving enforcement. They found that in Sweden, optimal implementation of RBT would result in a cost-benefit ratio of 1.5. Optimal enforcement was defined as ten times the current testing levels (2002).

The use of media campaigns was also considered by Elvik and Amundsen (2000). They considered them to be an ineffective measure, except in some cases when combined with other measures such as new legislation or police enforcement. Elliott (1993) found that increased enforcement in conjunction with mass-media publicity increased the effectiveness of campaigns, and also found cases of effective television campaigns without enforcement. Delhomme (1999) concurred with this finding, noting that alcohol-related campaigns reduced crashes by 6.9% during the campaign, speeding-related campaigns by 16.9%, and that the effects were greater when accompanied by enforcement and/or legislative initiatives. However neither of these studies attempted to estimate benefit-cost ratios for mass-media publicity, either alone or in support of enforcement operations

Strategic Principle: The benefit-cost ratio of the Victorian RBT program is unknown. However, international research suggests that RBT enforcement will achieve the greatest crash reductions and be most cost beneficial when conducted at high intensities in a highly visible manner. Supporting media publicity also appears to improve the BCR of RBT enforcement.

3. INTERNATIONAL DRINK-DRIVE ENFORCEMENT RESEARCH

A MUARC study reviewed Australian and international literature relating to traffic law enforcement including drink-driving enforcement (Zaal, 1994). This review concluded that the use of enforcement is generally regarded as being the most effective means of deterring drink-driving behaviour. However, the most effective operations were found to be those supported by legislation enabling police to randomly test *any* driver for alcohol impairment. In addition, to maximise the effects of RBT, a large proportion of drivers should be stopped and *all* breath tested.

Zaal suggests that RBT maximises the perceived risk of apprehension by creating an awareness among road users that enforcement is highly active and can be encountered at any time and any place. Therefore, RBT operations should be highly visible and accompanied by sustained high levels of publicity. Such publicity is likely to be most effective when it raises the awareness of the likelihood of apprehension & the severe consequences of apprehension (i.e. punishment and increased crash risk). Further, Zaal concludes that the most effective RBT operations are those that are highly intensive and maintained over a longer period of time. Finally, RBT operations should be rotated among a number of fixed locations and undertaken for a period of no more than one hour at any location.

The author also considers the effectiveness of different forms of punishment. He concludes that the most effective drink driving sanction is the combined use of fines & licence actions such as suspension/cancellation. The suspension and/or cancellation of licences removes potentially high-risk drivers from the road system thus potentially reducing crash risk. Further, the introduction of special legislation for road users with higher alcohol-related crash risk can be effective in reducing alcohol-related crashes. Examples of such special legislation include: lower BAC limits for young/inexperienced drivers and for drivers with special risks/responsibilities/high traffic exposure such as heavy vehicle drivers.

The research by Zaal provides consistent results with that conducted within Australia and suggests the following strategic principle:

Strategic Principle: The use of RBT enforcement is generally regarded as the most effective means of deterring drink-drive behaviour. In particular, the use of sustained and highly intensive random breath testing operations is the most effective means of drink-drive enforcement.

A meta-analysis of 39 studies that evaluated the effect of drink-driving enforcement (either alone or in combination with other measures) has been conducted by Elvik (2001). Using the meta analysis technique, it is possible to combine results from previous studies to provide a single estimate of the effectiveness of a given countermeasure. Table 2 below

presents estimated percentage reductions in crashes (including confidence intervals) attributable to drink-driving enforcement.

Table 2. Estimates and confidence intervals (95% CI) of the effects on accidents of drink-driving enforcement. (Elvik et al 1997, as cited in Elvik 2001)

Accident Severity	Accident types affected	Percentage change of the number of accidents	
		Best estimate	95% CI
Fatal accidents	All	-9	(-11; -6)
Injury accidents	All	-7	(-8; -6)
Property-damage-only accidents	All	-4	(-5; -3)

The results of the meta-analysis show that, across a large number of drink-driving enforcement programs, significant reduction in all crash types can be achieved. However, the magnitude of the reductions appear to be smaller than those estimated for individual drink-driving enforcement programs in Australia. Those enforcement programs included in the analysis include ASAP (Alcohol Safety Action Projects), STEP (Selective Traffic Enforcement Project) and RBT. Although alternative enforcement programs to RBT involve education and rehabilitation aspects, the enforcement component of these programs is often implemented in a less than optimal way. That is, enforcement is not always conducted in a random way and testing of drivers may be restricted to those suspected of exceeding the legal BAC limit. Therefore, the inclusion of these programs is a likely contributor to the magnitude and range of enforcement effects reported in this study.

4. CONCLUSION

There has been a significant volume of research conducted within Victoria and other Australian states that indicates existing drink-driving enforcement efforts have successfully contributed to reductions in casualty crashes at all severity levels. International research on the effectiveness of drink-driving enforcement programs such as RBT is consistent with that conducted in Australia and confirms that such programs generate positive road safety outcomes. In addition, there is international evidence to suggest that RBT programs operated in a similar manner to the Victorian program are cost beneficial. However, there has been little research on the costs and benefits associated with the RBT program as it operates in Victoria. The research also highlights a remaining group of drivers who have not been influenced by current enforcement methods.

In the context of these conclusions it is suggested that the following issues would be relevant to future drink-driving enforcement research:

- A complete cost-benefit analysis of the Victorian RBT program would enable the total benefit of the program to be estimated as well as the influence of individual program components on the total impact of the program. Such information would be valuable in developing strategic directions for future drink-driving enforcement work in the Victorian context.
- Consideration of alternative strategies for influencing those drivers not currently influenced by existed enforcement methods may prove beneficial.

Finally, it is noted that the effect of drink driving enforcement may change over time. The outcomes of this review should be updated and supplemented by future research in the area particularly as the nature of enforcement programs evolves.

5. REFERENCES

Armour, M., Monk, K, South, D and Chomiak, G. (1985) Evaluation of the 1983 Melbourne random breath testing campaign – casualty accident analysis. Report No. 8/85, Road Traffic Authority, Victoria.

Cameron, M.H. (1978a), “Effect of random breath test legislation on road accidents in Victoria, Report to Road Safety and Traffic Authority, Victoria, July 1978.

Cameron, M.H. and Strang, P.M. (1982) “Effect of intensified random breath testing in Melbourne during 1978 and 1979”. ARRB Proceedings Volume 11, part 5, pp1-12.

Cameron, M.H., Strang, P.M. and Vulcan, A.P. (1980) “Evaluation of random breath testing in Vicotira, australia”, Eighth International Conference on Alcohol, Drugs and Traffic Safety, Stockholm, Sweden, 15-19 June, 1980, 18p.

Cameron, MH. Economic analysis – an essential tool. Proceedings from the First National Conference on Injury Prevention and Control, Sydney, February, 1995. Australian Government Publishing Service.

Cavallo, A. and Cameron, M. (1992) “Evaluation of a Random breath Testing Initiative in Victoria 1990 & 1991: Summary Report” Report No. 39, Monash University Accident Research Centre, Melbourne.

Cameron, MH, Diamantopoulou, K, Mullan, N and Gantzer, S. Evaluation of the country random breath testing and publicity program in Victoria 1993-1994. *Proceedings of ROADS 96 – Combined 18th ARRB Transport Research Conference and Transit New Zealand Land Transport Symposium*, Christchurch, New Zealand, 1996.

Cameron, MH, Newstead, SV and Vulcan, AP. Analysis of reductions in Victorian road casualties, 1989 to 1992. *Proceedings, 17th Australian Road Research Board Conference, 1994*).

Delaney, A., Diamantopoulou, K., & Cameron, M. (2003), “*MUARC’s speed enforcement research: principles learnt and implications for practice*”. Report No. 200, Monash University Accident Research Centre, Melbourne.

Delhomme, P. (1999). Evaluated Road Safety Media Campaigns: an overview of 265 evaluated campaigns and some meta-analysis on accidents. Deliverable 4, GADGET Project, European Commission. French National Institute for Transport and Safety Research, Arcueil, France.

Diamantopoulou, K and Cameron, MH. Localised effects on crashes of the country random breath testing and publicity program in Victoria. *Proceedings, 19th ARRB Transport Research Conference, Investing in Transport*, Sydney, December 1998.

Elliott, B. (1992) Achieving high levels of compliance with road safety laws: a review of road user behaviour modification.

Elliott, B. (1993). Road Safety Mass Media Campaigns: A Meta Analysis. Report CR 118, Federal Office of Road Safety, Canberra.

Elvik, R. (2001). Cost-benefit analysis of Police enforcement. Working paper 1, ESCAPE (Enhanced Safety Coming from Appropriate Police Enforcement) Project, European Commission.

Elvik, R. and Amundsen, A.H. (2000). Improving road safety in Sweden: An analysis of the potential for improving safety, the cost-effectiveness and cost-benefit ratios of road safety measures: Main report. Report 490/2000, Institute of Transport Economics, Oslo, Norway.

Henstridge, J., Homel, R. and Mackay, P. (1997) "The long-term effects of random breath testing in four Australian states: a time series analysis", Federal Office of Road Safety, CR162.

Harrison, W.A. The Potential for the Use of Psychological and Situational Factors in the Targeting of Drink-Drive Countermeasures. Report 108. Monash University Accident Research Centre, 1996.

Harrison W.A. The occupations of drink-drivers: Using occupational information to identify targetable characteristics of offenders. *Accident Analysis and Prevention*, 30, 119-132, 1998a.

Harrison WA Applying psychology to a reluctant road safety: A comment on South (1998) *Australian Psychologist*, 22, 1998b.

ICF Consulting (2003) Cost-benefit analysis of road safety improvements. Imperial College Centre for Transport Studies, London, UK.

Miller, T., Blewden, M. and Zhang J. (2004) Cost savings from a sustained compulsory breath testing and media campaign in New Zealand. *Accident Analysis and Prevention*, 36, pp. 783-794.

Newstead, SV, Cameron, MH, Gantzer, S and Vulcan, AP. Modelling of some major factors influencing road trauma trends in Victoria 1989-93. Report No. 74, Monash University Accident Research Centre, 1995.