Re-Investigation of the Effectiveness of the Victorian TAC's Road Safety Campaigns

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Summary

One aim of this paper is to summarise the findings of a report on a *Re-Investigation of the Effectiveness of the Victorian Transport Accident Commission's Road Safety Campaigns* that has recently been released by Transport SA. An overview of the whole report (White, Walker, Glonek & Burns, 2000) is provided.

Another aim is to provide a more detailed consideration of two of the main arguments in the report.

Overview of White et al. (2000)

Monthly numbers of road crashes in the state of Victoria, Australia, increased from 1983 to 1988, before falling sharply over a period of about two years, and then remaining at a low level until the end of 1992. Fatal crash numbers fell by about 50%; and the numbers of less severe crashes also fell substantially.

In the late 1980s, the Victorian Transport Accident Commission (TAC) greatly increased the level of funding for road safety television advertising and enforcement. These TAC-funded countermeasures focused on speeding and drink driving.

A program of research at the Monash University Accident Research Centre (MUARC) was undertaken to investigate the downturn in crashes. That program has resulted in the publication of at least 30 reports and papers.

Early research undertaken at MUARC by Cameron, Haworth, Oxley, Newstead and Le (1993) had attempted to determine cost-effective levels of road safety television advertising. That research involved the assumption that countermeasure effects were *quantitative* - in the sense that there were *dose-response* relationships between monthly advertising levels and monthly crash numbers. Those assumed quantitative relationships were central to Cameron et al's conclusion that there were additional benefits to be obtained from high, sustained levels of television advertising.

Much of the MUARC research was brought together in a report by Newstead, Cameron, Gantzer and Vulcan (1995). Their analyses of monthly *serious casualty crashes* in the *Melbourne metropolitan area* were taken to be representative; and have provided the main focus of this re-investigation. Newstead et al. separately analysed 'Low Alcohol Hour' (LAH) and 'High Alcohol Hour' (HAH) crashes, by conducting multiple linear regression analyses which used a linear trend, seasonality, unemployment levels, enforcement levels, advertising levels, and, in the case of HAH crashes, alcohol sales, as predictor variables. They used log-transformed values of the variables. Their main findings were that, beyond an appreciable effect of the downturn in the economy (and reduced alcohol sales in the case of HAH crashes), the TAC-funded countermeasures had been successful in reducing crash numbers.

In 1996, Transport SA commissioned MUARC to review the effectiveness of enforcement strategies in South Australia. MUARC proposed that the review be extended to include road safety television advertising, and their proposal was accepted by Transport SA. The consultancy report (Vulcan, Cameron, Mullan & Dyte, 1996) recommended "That resources be allocated to double the exposure of television advertisements which support the speed camera and random breath testing programs" (p. 23). The main aim of the project reported here is to check the soundness of the advice concerning the effectiveness of high levels of television advertising, through re-analyses of the data originally analysed by Newstead et al. (1995).

One of the first re-investigations undertaken was simply to plot time-series of crash trends and countermeasure levels in the same graphs. It became obvious that crashes started to fall some months before the countermeasures were first implemented. The countermeasures could not, therefore, have been responsible for triggering the fall in crashes in the late-1980s. (These findings are reported in more detail under the heading 'Argument (1)' below.)

Re-analyses of the data failed to confirm that the countermeasure and crash variables were related at the quantitative level. These results indicate that the dose-response findings of Cameron et al. (1993) in favour of high levels of road safety television advertising were not well grounded. (These findings are reported in more detail under the heading 'Argument (2)' below.)

It was discovered that the regression models of Newstead et al. (1995) were not robust. Minor changes in the definitions and combinations of predictor variables resulted in very different conclusions about the strengths of the countermeasure effects (and, therefore, about the numbers of crashes 'saved').

A regression model should be treated cautiously unless its specification is tightly determined by a sound theory, or unless it has been successfully replicated against an independent set of data. The methods employed for the selection of variables in the MUARC modelling process can be described as 'data dredging'. As such, the models should be considered to be 'hypothesis generating' rather than 'hypothesis testing'. While such models may appear to provide accurate *descriptions* of the past, they should not be taken to provide proven *explanations* of the past; nor should they be taken to provide trustworthy *predictions* of the future (either at the place they were developed, or elsewhere). Accordingly, the results of the MUARC regression analyses should not be considered to provide an adequate basis for recommending the implementation of TAC-type countermeasures.

The authors of this report propose a simple, 'three factor' model to explain Melbourne total serious casualty crash trends from 1983 to 1992. The factors are: (1) gradual, long-term improvements in road safety; (2) seasonality; and (3) changing economic circumstances. In its most general form, the three factor model is not controversial: it simply demands that three well-recognised influences on crash trends be taken into account in any statistical modelling of time-series crash data. The specific version of the three factor model employed in this re-investigation involved the use of raw-data versions of the quantitative variables (rather than log-transformed versions, as used by the MUARC researchers). Gradual improvements in road safety were accounted for by a linear trend term. The economy was measured by the Leading Index of Economic Indicators, which is a broad index of early activity in the 'business cycle' (rather than by Unemployment, as used by the MUARC researchers). The three factor model provided an excellent description of Melbourne total crash trends, without any reference to the TAC-funded countermeasures.

In a replication of the three factor model in New Zealand, quarterly numbers of road crash casualties, from 1990 to mid-1997, were satisfactorily described. These same casualty trends had previously been analysed by Cameron and Vulcan (1998) as part of an evaluation of the New Zealand Supplementary Road Safety Package (SRSP). However, Cameron and Vulcan failed to include a linear trend term in their model. When it was included, there was no longer any evidence that the SRSP (which had been modelled after the 'Victorian approach') had contributed to the fall in New Zealand casualties.

These findings do not necessarily imply that road safety enforcement or television advertising is ineffective. They simply mean that there has been a failure by Newstead et al. (1995) and Cameron and Vulcan (1998) to *demonstrate* any such effectiveness in Victoria or New Zealand. Given that MUARC consultancy advice has been in favour of very high levels of television advertising, that particular advice should now be considered to be unsubstantiated.

Argument (1): Crash Numbers Fell Before the Countermeasures were Implemented

Reports from some Victorian and overseas road safety agencies give the clear impression that the agencies believed that the TAC-funded enforcement and advertising campaigns were largely, if not entirely, responsible for *halting the increase* in crash numbers and for *initiating their decline*. Examples of such views are provided below.

A recent (December, 1999) item on 'Road Safety Initiatives' from the TAC internet web site (http://www.tac.vic.gov.au), makes the claim that:

> By December 1989, the rising road toll and cost of accidents sparked concern for both the number of lives being lost and the number of people being seriously injured. Since this time, the TAC, in conjunction with Victoria's other key road safety agencies, has developed a highly successful accident prevention program. … The *result of* this integrated approach has been a near halving of Victoria's road toll since 1989, with a corresponding drop in serious injuries of about 35% (1996). [*Italics added*.]

According to the police officer in charge of the Victorian speed camera program (Bodinnar, 1994, p. 206), the TAC-funded campaigns were responsible for *turning around* the worsening crash situation in Victoria:

> In 1989, 777 Victorians died and over 6 000 people suffered major injuries through road trauma, with the rate growing by an alarming 5 deaths per month. Something different had to be done to stop the carnage … Professional strategic partnerships were formed (involving the TAC, the Victoria Police and VicRoads) and a dynamic plan developed and implemented that has saved over 1 200 lives and prevented over 8 000 major injuries, *reversing the upward trend* … A remarkable 46% reduction in road crash death and injury in five years has proven the effectiveness of the Victorian model. [*Italics added*.]

Causes always precede their effects. Any evidence that crash numbers had started to decline *before* the TAC-funded enforcement or advertising campaigns had been launched would argue against the widespread view that the campaigns had been responsible for halting the increase in crash numbers and initiating the decline.

Three procedures were used to clarify visual presentations relating crash numbers to countermeasure levels. First, the crash data was de-seasonalised to reduce its variability (by using the crash residuals which remained after the individual months had been regressed against the original LAH crash variable). Second, the values of the crash, enforcement and advertising variables were converted to the same scale by the conventional standardisation procedure of converting to Z scores. Third, as the first three years of data (1983-1985) were un-informative for this purpose, they were 'filtered out' before the graphs were constructed.

Figure 1 (a) is the resulting sequence plot for LAH serious casualty crashes and speed camera TINs. Crash numbers peaked at 314 in May 1988 (month 65), and then fell steadily for two years, reaching a low value of 167 in May 1990 (month 89). Crash numbers then remained at low, but fluctuating, levels for the next two and a half years, with some months dipping below the low of May 1990. The major increase in speed enforcement levels did not occur until at least two years after crash numbers had started to decline; and not until after crashes had reached the first low point of May 1990. In the case of enforcement, it might be possible to argue for the existence of some 'anticipatory' effects, as the enforcement campaign had presumably received some advance attention from the print and TV news media. However, it is still not possible to argue in favour of a causal role for speed enforcement in the *turn-around* of monthly LAH crashes, which occurred before even the low-level trialing of the cameras had commenced.

Figure 1 (b) is a sequence plot for LAH crashes and speed and concentration TV advertising (Adstock). It is interesting to note that the TAC advertising was not launched until April 1990 (month 88), which was 23 months *after* the start of the decline in crash numbers, and only one month before the first crash low point in May 1990. In the case of TAC advertising, it is not possible to argue for the existence of 'anticipatory' effects. It is also worth noting that a levelling-out of LAH crashes occurred during 1991 and 1992 while TAC speed advertising continued at very high levels. It would therefore not be possible to argue in favour of a causal role for TAC speed advertising in the turn-around of monthly LAH crashes; and it would be very difficult to argue, from this graph, that the advertising had played *any* role at all.

Figure 1 (c) is the sequence plot for HAH serious casualty crashes and RBTs. Crash numbers peaked at 270 in December 1987 (month 60), fell gradually at first, and then fell sharply between mid 1989 and early 1991, reaching a low value of 122 in January 1991 (month 97). Crash numbers then remained at low, but fluctuating, levels for the next two and a half years, with some months dipping below the earlier low point. The drink drive enforcement campaign commenced in September 1989 (month 81), then quickly gained momentum. In the case of enforcement, it might be possible to argue for the existence of some 'anticipatory' effects, as the enforcement campaign had presumably received some advance attention from the print and TV news media. Nevertheless, it is not possible to argue in favour of a causal role for drink drive enforcement in the *turn-around* of monthly HAH crashes—which occurred well over a year earlier.

Figure 1 The temporal relationship between the monthly numbers of Melbourne serious casualty crashes and levels of the TAC-funded countermeasures:
(a) Speed Camera Traffic Infringement Notices (TINs)
(b) Speed Television Advertising
(c) Bus-Based Random Breath Tests (RBTs)
(d) Drink Drive Television Advertising

(a) (b)

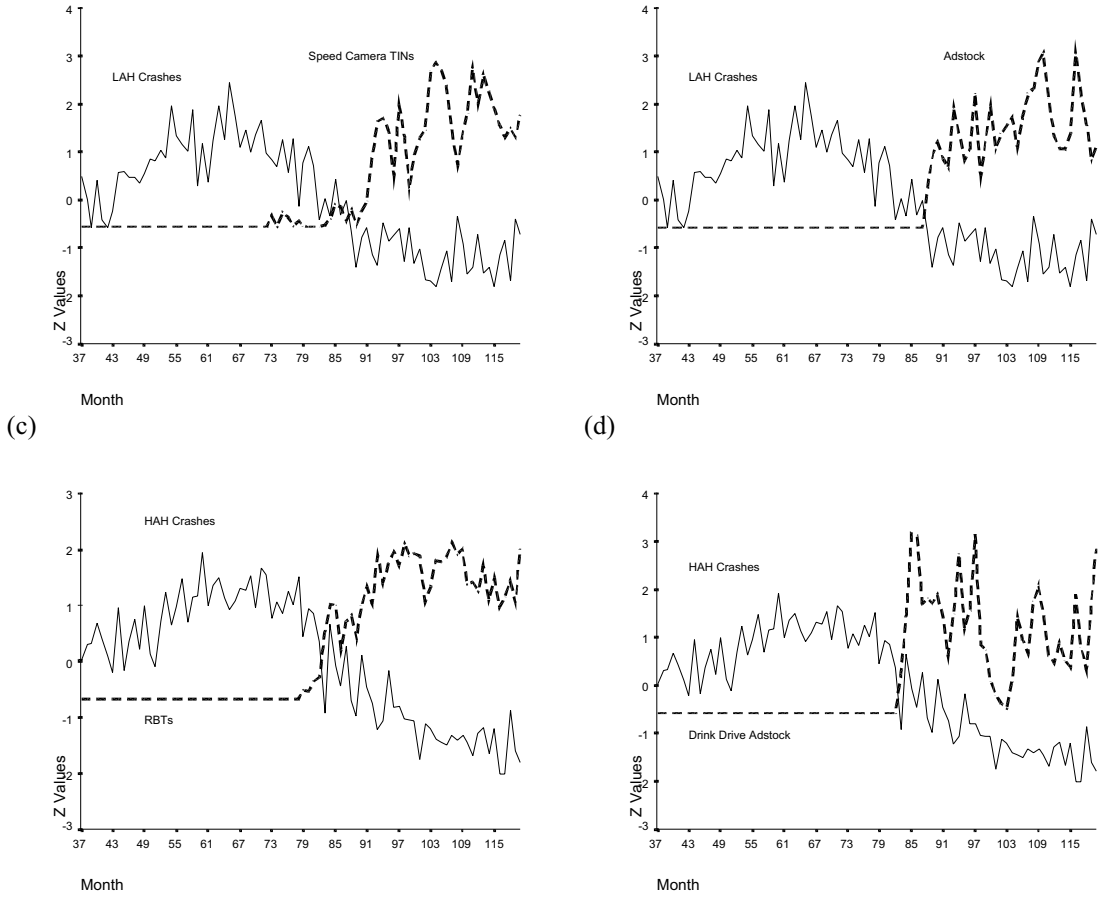

Figure 1 (d) is a sequence plot for HAH crashes and drink drive TV advertising (Adstock). The advertising was considered by Newstead et al. (1995) to have starting in November 1989 (month 83)—at much the same time as the sharp increase in bus-based RBT. TAC drink drive advertising did not commence until well over a year after the start of the decline in HAH crash numbers. In the case of advertising, it is not possible to argue for the existence of 'anticipatory' effects. It is also worth noting that a levelling-out of HAH crashes occurred during 1991 and 1992 while drink drive advertising continued at very high levels. Based on this evidence, it is obviously not possible to argue in favour of a causal role for TAC drink drive advertising in the turn-around of monthly HAH crashes.

The general argument presented above is not that the sequence plots *prove* that the crash countermeasures were totally ineffective, but that the plots are strongly indicative that the countermeasures could not have been involved in halting the increase in crash numbers, or in initiating the sharp fall. It is still quite possible that fluctuations in countermeasure levels in the last three or so years of the study period could underlie the fluctuating crash numbers during that period.

However, a further argument in White et al. (2000) seriously challenges the view that there was *any* relationship between fluctuating monthly countermeasure levels and monthly numbers of serious casualty crashes. That argument is presented below.

Argument 2: There is not a Quantitative Relationship Between the Countermeasure and Crash Variables

Figure 2 Trends in Advertising Levels from 1983 to 1992:
(a) Log Speed and Concentrate Television Advertising (Adstock)
(b) Log Drink Drive Television Advertising (Adstock)

(a) (b)

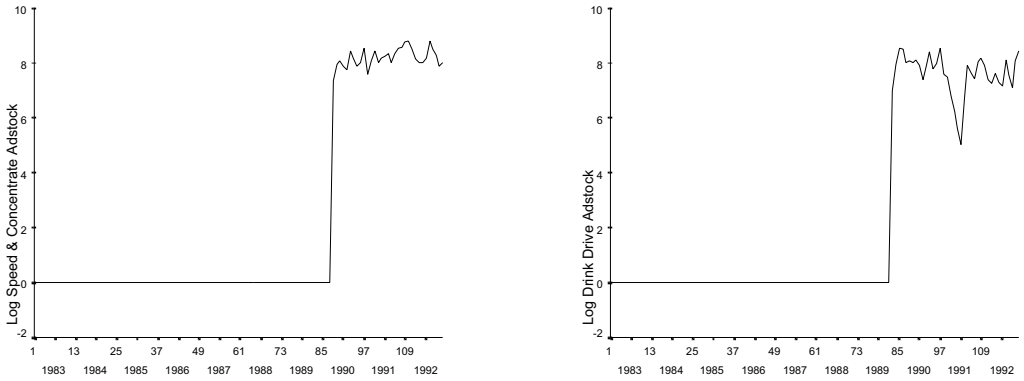

Figure 2 shows the change over time (from 1983 to 1992) in the variables used by Newstead et al. (1995) to measure levels of road safety television advertising. These variables were treated by Cameron et al. (1993) and Newstead et al. (1995) as though they were quantitatively related to monthly crash numbers. However, inspection of Figure 2 indicates that the variables might have been behaving in the MUARC analyses as though they were no more than two-value step-functions. Graphs of the enforcement variables (not presented here) also show a step-function shape.

A test for a quantitative (or, dose-response) relationship between the countermeasure and crash variables may be performed as follows. Dichotomised versions of the advertising and enforcement variables can be constructed. Such variables take the value zero when the corresponding intervention variable is zero, and 1 otherwise. The dichotomised variables can be introduced into the multiple regression model, and the hypothesis that the original variables can be removed without detriment to the model can then be tested.

The result of fitting this regression model to the LAH crashes was shown in White et al. (2000) Table 10.1 (right). In this model, neither of the original intervention variable coefficients was significantly different from zero. The F-statistic for the hypothesis that both the advertising and enforcement coefficients are zero is 0.58, and the resulting p value is 0.56. Hence, in the context of the regression model reported in Newstead et al. (1995) for the LAH crashes, it would appear that there is no real evidence for a quantitative effect of either speed advertising or speed enforcement.

The same steps can also be applied to the HAH crashes. The results were shown in White et al. (2000) Table 10.2 (right). In this model, neither of the original intervention variable coefficients is significantly different from zero. The F-statistic for the hypothesis that both the advertising and enforcement coefficients are zero is 0.54, and the resulting p value is 0.58. Hence, in the context of the regression model reported in Newstead et al. (1995) for HAH crashes, it would likewise appear that there is no real evidence for a quantitative effect of either drink drive advertising or drink drive enforcement.

In contrast to the assumptions of Cameron et al. (1993), the re-analyses described above have failed to demonstrate any evidence for a quantitative, or dose-response, relationship between any of the intervention variables and the crash variables, for either the LAH or the HAH crashes. That fact has two important implications.

First, the presence of a dose-response relationship would have provided important evidence that the previously reported associations between the intervention variables and response variables were not spurious. The data do not provide that evidence.

Second, it is very difficult to see how the data can justify a recommendation to increase levels of TV road safety advertising in the absence of any demonstrable dose-response effect.

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