WORKING PAPER

ITLS-WP-11-18

Analysis of a financial incentive to encourage safer driving practices.

By

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September 2011

ISSN 1832-570X

INSTITUTE of TRANSPORT and LOGISTICS STUDIES

The Australian Key Centre in Transport and Logistics Management

The University of Sydney

Established under the Australian Research Council's Key Centre Program.

NUMBER: Working Paper ITLS-WP-11-18

TITLE: **Analysis of a financial incentive to encourage safer driving practices.**

ABSTRACT: This paper reports on the behavioural response of motorists to a variable rate charging scheme designed to encourage safer driving practices and reduce exposure to crash-risk – specifically kilometres driven, night-time driving and speeding. The study involved a five-week 'before' period of GPS monitoring to establish how motorists drove normally, followed by a five-week 'after' period of GPS monitoring in which charges were levied and changes assessed. Incentives were paid to motorists for the difference in the charges between the two five-week periods. Vehicle kilometres travelled (VKT) were reduced by ten percent, although the sample was evenly split by those increasing VKT compared to those decreasing VKT. The proportion of distance speeding fell by 4.7 percent, which when coupled with decreases in VKT, implied a net reduction of kilometres spent speeding of over 40 percent. Three-quarters of the sample reduced their speeding. Exit interviews with a cross-section of participants highlighted the practical difficulties of reducing kilometres, but (more encouragingly) reinforced the potential to reduce speeding.

KEY WORDS: ***Road safety; speeding; behaviour change; kilometre-based charges.***

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Acknowledgement: The team at ITLS that assisted in what was a monumental GPS data collection effort, specifically, Richard Ellison, Russell Familiar and Dr Yun Zhang.

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DATE: September 2011

1. Introduction

Recent estimates suggest motor vehicle accidents cost the Australian economy around $17 billion per year (Connelly, and Supangan, 2006). While both the number of crashes and crash rates (crashes/kilometre) has reduced dramatically in the last thirty years, latest statistics show that 1,463 persons were killed on Australian roads in 2008, with 395 killed in the state of New South Wales alone (Australian Government, Department of Infrastructure, Transport, Regional Development and Local Government, 2009). More worryingly, it appears reductions may have stagnated in recent years, leaving policy-makers searching for other options that might lead to significant drops in crash rates. While engineering-based methods for both roadway infrastructure and vehicles, and regulation and enforcement will continue to play a critical role in future road-safety initiatives, an area of growing interest is the use of kilometre-based financial mechanisms to encourage safer driving practices (Litman, 2009). The notion here is that by linking what motorists are charged not just to the kilometres they drive and the circumstances under which those kilometres are driven (e.g., night-time driving, route choice, speeding), motorists will be directly incentivised to change behaviour, reducing the overall risk and societal costs of accidents (Zantema et al., 2008).

In 2009, an experiment was conducted in Sydney, Australia, which aimed to facilitate and detect changes in driving behaviour following the imposition of a kilometre-based charging regime focused around encouraging safer driving practices (Greaves et al. 2010). The charging regime was focused on reducing kilometres, night-time driving and speeding, all known correlates with increased crash-risk (Greaves and Fifer, 2010). The experiment involved a 10-week field study of 148 Sydney motorists in which driving patterns were monitored using Global Positioning System (GPS) technology before and after the implementation of the charging regime. Motorists were financially rewarded for any net reductions in vehicle kilometres of travel (VKT), night-time driving, and speeding in the after period relative to the before period. The current paper reports on the main findings of the experiment, with the focus on aggregate-level change in VKT, night-time driving and speeding. These quantitative measures of changes are supplemented by the findings of exit interviews designed to find out more about the reasons lying behind observed changes.

2. Literature review

Efforts to financially incentivise safer on-road driving behaviour are most visible through commercial pay-as-you-drive (PAYD) insurance options, in which premiums are differentiated to kilometres driven and in some cases time, location and speed (Litman, 2009). Technology has facilitated even more sophisticated offerings focused on *how* a vehicle is being driven or Pay-How-You-Drive (PHYD). For instance, the Co-operative Insurance company has recently launched a product that offers premium reductions for young drivers based on their braking and acceleration, cornering, speeding and time of driving[1]. These behaviours are monitored via a 'Smartbox', which transmits the information to a server that computes adjustments to the premiums based accordingly. Although not widely available in Australia as yet, PAYD schemes are available in various forms in the U.S., the UK, Australia and the Netherlands among others (Zantema et al., 2008). Commercial sensitivities (presumably) preclude details of how rates are set and while some aggregate indicators of the outcomes of the programs are provided, rarely is information provided on the before and after changes in driving. One exception to this was a recent government-sponsored trial of PAYD insurance in Dallas-Fort Worth (Reese and Pash-Brimmer, 2009). Here, motorists were monitored for 12 months (divided into two six month periods) before and after the imposition of a distance-based scheme that rewarded them at $US25 for each 5% percent reduction in miles driven up to a cap of $350 ($175 per period).

[1] http://www.co-operativebank.co.uk/

Various academic studies have focused on exploring how variable-rate pricing regimes might affect motorist behaviour, largely from the perspective of congestion-mitigation with few focusing on risk-reduction per se (Nielsen, 2004; Xu et al., 2009). The closest parallel to the current investigation was by Zantema et al. (2008) through a hypothetical investigation of the effects of various PAYD insurance schemes being proposed for young drivers in the Netherlands. The approach used was to set a base rate, which in this case was taken as the average insurance premium divided by the annual kilometres driven. The base rate was then adjusted upwards by factors (derived from various sources) reflective of higher accident risk, including driving at night versus driving during the day and driving on urban roads versus motorways. They concluded that the most 'aggressive' scheme, comprising obligatory time and road type differentiation could reduce crashes by over five percent. No published evidence is currently available on how this changed behaviour in reality.

Other studies have looked at specific methods of using financial mechanisms to change behaviour, primarily speeding. Mazureck and van Hatten (2006) detail a study in the Netherlands, in which motorists were paid to stay within the speed limit and maintain a safe following distance. Results indicated that speeding was reduced by around 20 percent based on a reward of 0.04 Euros for every 15 seconds spent not speeding – notably, once the rewards were removed, drivers largely reverted back to their original behaviour. In a similar study, the Swedish Intelligent Economic Speed Adaptation study involved directly linking incentives to actual speeding behaviour. In this study participants were paid a lump sum bonus and this bonus was reduced by a certain charge for every minute participants drove above the speed limit within the study period (Gunnar, 2009).

3. Study methods

While full details of the methods are provided in Greaves et al. (2010) and Greaves and Fifer (2011), for the benefit of the reader, the process is briefly described here. Motorists were recruited initially to undertake a ten week study of driving in Sydney involving both a GPS and online survey component for which they would receive a gift card worth AU$30. Note there was no mention of the potential to make money through changes in driving at the recruitment phase because of the potential for artificially influencing driving behaviour. The study encompassed five distinct phases: a five-week 'before' period of GPS monitoring (GPS 'Before'), establishment of the charging regime, a stated choice survey completed at the end of the GPS 'Before' phase (SC 'Before'), a five-week 'after' period of GPS monitoring (GPS 'After) and a stated choice survey completed at the end of the 'After' phase (SC 'After) (see Figure 1). To cross-check the VKT coming from the GPS device, three odometer readings were also taken at installation, after the GPS 'Before' phase and at the completion of the GPS 'After' phase. Finally, exit interviews were completed to gather participant thoughts on both the survey itself as well as questions designed to gather further evidence on whether any observed changes in behaviour were due to the charges or other factors.

Figure 1: Study overview

The purpose of the five-week before period of GPS monitoring was to establish a detailed profile of driving routines and patterns. A website was developed enabling participants to view their travel and add trip-specific information (e.g., who was driving, trip purpose) via a Google-map style interface developed by the project team. Concurrent with this was the development of the charging regime (Table 1), which was based on scientific (crash-cost and crash-risk analysis) as well as pragmatic (easily understandable, sufficient to encourage a change in behaviour, within the project budget) considerations (Greaves and Fifer, 2010). The information collected in the 'before period' was combined with the charging regime to establish a 'budget' for each motorist reflecting the combined effects of their kilometres driven, night-time driving and speeding. Motorists were then informed they could make money based on reductions in these measures relative to the before period. A further five week period of GPS monitoring (the GPS 'After' phase) followed to detect any changes made with participants notified on a daily basis via the website, how they were faring against the budget. At the end of the trial, participants received a financial payment corresponding to the money they had left – note, participants going over-budget were not obliged to pay.

Table 1: Final charging rates used in the GPS 'after' phase (Greaves and Fifer, 2010)

Age-Group	Day - Non Speeding	Day - Speeding	Night - Non Speeding	Night - Speeding
17-30 Male	$0.20	$0.60	$0.80	$2.40
17-30 Female	$0.20	$0.60	$0.80	$2.40
31-65 Male	$0.15	$0.45	$0.60	$1.20
31-65 Female	$0.15	$0.45	$0.60	$1.20

4. Recruitment and sample details

Participants were recruited via an online panel according to strict criteria that reflected the main aims of the study as well as practicalities about using the GPS equipment. In terms of the main aims of the study, only participants with a valid license from one-car households were recruited[2] and they needed to be the primary driver and drive more than two days per week on average. In terms of practicalities, cars needed a working cigarette lighter, which did not stay on when the engine turned off and drain the battery (a problem for a small proportion of high-end vehicles in Australia) and parked off-street at night. Unfortunately, the parking criterion was imposed following the pilot study in which two devices were lost in the first week because they were in vehicles that were parked on-street that were stolen and later dumped[3].

The original sample comprised 148 motorists, of which 119 were given the charging regime (the target group) and 29 were not (the control group). Of the 148 participants who started the experiment, 125 completed all phases with 116/119 (97 percent) of target participants and 9/29 (31 percent) of control participants complying respectively. Twelve dropped out due to loss of interest/fatigue (all in the control group) while two target group participants and four control group participants had incomplete prompted-recall data for the comparison time periods. Intuitively, the opportunity to make money kept the target participants interested while unfortunately control participants lost interest and motivation as the study extended well past the original ten weeks. In terms of other issues, despite incorporating screeners about the need for constant power from cigarettes lighters, three participants were still lost from the study due to this problem. Another two participants dropped out due to 'computer issues' meaning they could not visit the website.

[2] The proportions of one-car households in the selected suburbs were Chatswood (48%), Hurstville (46%), Parramatta (50%), Strathfield (35%), Randwick (51%) and Sutherland (52%).

[3] These were the only two devices out of 150 that were lost in the entire study.

Due to the higher than anticipated loss of sample those participants with eligible before data were invited back for a further five-week phase of charging (Phase II) that ran from Monday February 22nd, 2010 to Sunday March 28th, 2010. These included participants lost because they took extended holidays in the after period and a number of drivers who had participated during pilot testing of the experiment earlier in the year. This resulted in another 17 participants in the target sample giving a net total of 133 (116 + 17) for further consideration.

These 133 participants were then subjected to several data quality checks to verify to the maximum extent possible the changes were genuine. This resulted in the removal of 29 participants due to un-reconcilable differences between the GPS-based VKT estimates and the odometer-based VKT readings (15 participants) and those taking extended holidays in the after period (14 participants). Two of those taking holidays were invited back, leaving a final usable sample of 106 participants for further analysis (Table 2). While these final numbers (particularly young males) may seem low, it must be stressed that they are reflective of the number of vehicles included in the sample, not the number of drivers. The issue here is that 54/106 vehicles were in fact driven by more than one participant over the study period with a total pool of drivers of 181. While this captures the reality of what would happen if (say) a scheme of this nature were implemented, it is important to interpret results in this light.

Table 2: Final sample breakdown for analysis

Original Target Sample + Phase II Sample	133
Extended holiday in before or after period	14*
Un-reconcilable differences in VKT	15
Final Vehicle Sample for Before and After Analysis	**106**
Demographics of Study Participant	
Male 17-30 years of age	5
Male 31-45 years of age	19
Male 46-65 years of age	20
Female 17-30 years of age	21
Female 31-45 years of age	24
Female 46-65 years of age	17
Vehicles with Multiple Drivers	**54**
Total Drivers in the Sample	**181**

*Two holiday participants completed the Phase II wave so are included in the 133.

5. Results

5.1 Aggregate comparisons

Of the 106 participants/vehicles who qualified for the before and after comparison, sixty five (61 percent) made money, while 41 (39 percent) did not and received nothing (to reiterate what was stated earlier, they did not have to pay back the additional amount). For those making money, payouts ranged from $2 to $619 with an average payout of $116 (median payout was $77). A pertinent question is whether the amount of the starting budget had any influence on the propensity of change as logic might suggest someone would be more motivated by making several hundred dollars than a few dollars. When viewed overall, the answer appears to be yes, with those making money starting with an average budget of $350 compared to $240 for those not making money. However, the correlation between starting amount and final payout ($r=0.59$) suggests this use of averages may not be telling the full story. This is confirmed by Figure 2, which suggests considerable intra-participant variability with some participants on very high starting amounts making little or no money. The implications here are that participants were

varied both in their capability and willingness to make changes for financial rewards computed from their actual driving.

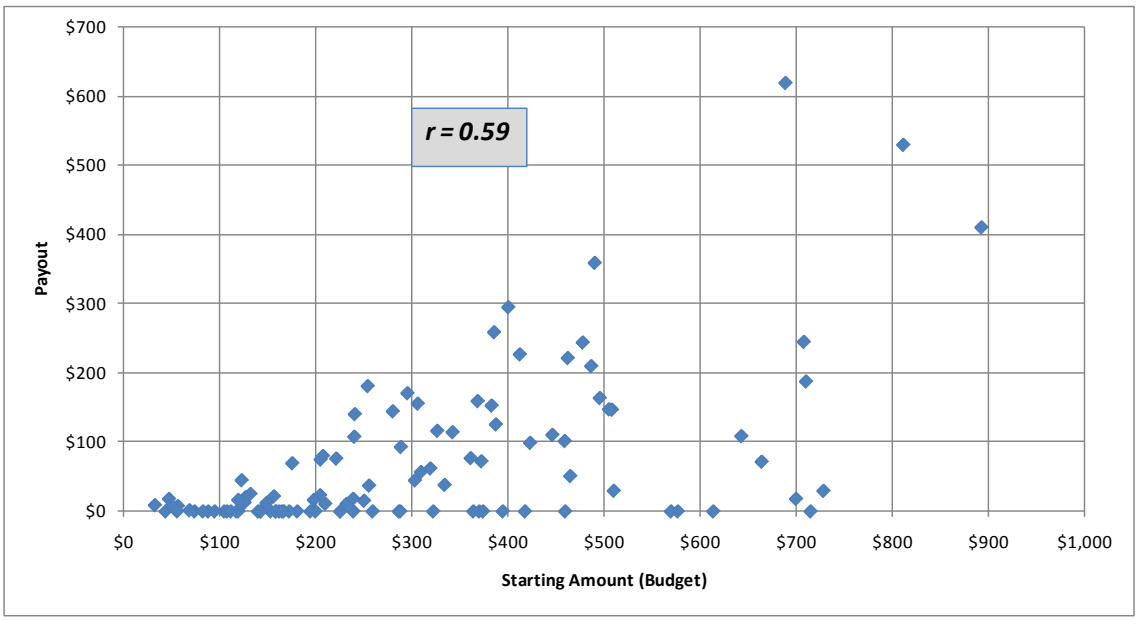

Figure 2: Comparison of starting amount and final payout by participant

Table 3 provides the overall changes in key travel characteristics across the sampling period. The 95 percent confidence limit was constructed using the approach advocated by Stopher and Greaves (2006) for assessing the significance of changes in behaviour from panel data. VKT was reduced by 113.7 km or 3.2 km/day, an average reduction of 9.8 percent. However, the sample was evenly split by those who increased their VKT compared to those who decreased VKT. Night-time kilometres increased marginally in the after period but the changes were not statistically significant ($p = 0.91$), although half the sample reduced their night-time VKT. The number of kilometres spent speeding decreased by 64.8 km (1.9 km/day) with three-quarters of the sample reducing their speeding. Overall the proportion of distance speeding fell by 4.7%, which coupled with the decrease in VKT, meant the proportion of kilometres spent speeding in the after period fell by 41.8%. The number of trips also fell, from 142.2 (4.1 trips/day) to 129.8 trips (3.7 trips/day), a reduction of 8.7 percent. Finally, the average time spent driving fell from around 62 minutes/day to 56 minutes/day, a drop of 9.7 percent.

Table 3: Overall change in travel characteristics between the five-week before and after periods

n = 106	**Before**	**After**	**Change**	**95% Confidence Interval of the Change**	**Percent of Sample Reducing**
Average VKT	1,164.3	1,050.5	-113.7 (-9.8%) *(p = 0.02)*	-160.0 (-14%) to -84.8 (-6%)	50%
Night-time VKT	120.5 (10.4%)	121.7 (11.6%)	1.2 (1.0%) *(p=0.91)*	-10.0 (-8%) to 12.4 (10%)	50%
Speeding VKT	155.0 (13.3%)	90.2 (8.6%)	-64.8 (-41.8%) *(p = 0.00)*	-76.9 (-50%) to -52.8 (-34%)	75%
Trips	142.2	129.8	-12.4 (-8.7%) *(p = 0.00)*	-16.7 (-12%) to -8.1 (-6%)	61%
Travel Time (mins)	36:15:58	32:45:46	-03:30:12 (-9.7%) *(p = 0.02)*	-04:57:31 (-14%) to -02:02:53 (-6%)	47%

*Paired sample t-test

5.1.1 VKT/trip purpose

Analysing the changes in VKT by trip purpose (Table 4) shows that for work/work-related trips, VKT reduced by 10.5 percent, although this was not significant at the 95% confidence level. Half the sample reduced their work VKT, similar to the pattern for overall VKT. Shopping/personal business VKT marginally increased (not significant) while social/recreational VKT decreased by 17.6 percent (significant at the 95% confidence level). The results suggest that overall participants had most flexibility (not surprisingly) in reducing travel that might be considered more discretionary. Perhaps, more surprisingly is the lack of flexibility for shopping/personal business, suggesting that overall participants were unwilling/unable to change these patterns.

Table 4: Change in VKT/trip purpose

VKT Purpose (n = 106)	**Before**	**After**	**Change**	**95% Confidence Interval of the Change**	**Percent of Sample Reducing**
Work & Work-Related	324.4	290.3	-34.0 (-10.5%) *(p=0.16)*	-58.1 (-18%) to -10.0 (-3%)	50%*
Shopping & Personal Business	214.5	216.7	2.2 (1%) (*p=0.87*)	-10.9 (-5%) to 15.3 (7%)	54%
Social/ Recreational	293.1	241.5	-51.6 (-17.6%) (*p=0.02*)	-72.8 (-25%) to -30.3 (-10%)	60%

*12 participants recorded no work VKT in either the before or after phases, so this computation was based on the 94 participants who did.

5.1.2 Money makers

Analysing the results for the 65 participants making money shows (as expected) more marked changes in VKT and speeding as well as a substantial and statistically significant decrease in night-time driving (Table 5). VKT decreased by around 26 percent with 82 percent of the sample reducing, while the distance spent speeding decreased by around 62 percent, with 92 percent reducing..

Table 5: Overall change in kilometres, night-time driving and speeding between the five-week before and after periods (those who made money only)

n = 65	**Before**	**After**	**Change**	**95% Confidence Interval of the Change**	**Percent of Sample Reducing**
VKT	1288.3	951.0	-337 (-26.2%) *(p = 0.00)*	-395.9 (-31%) to -278.5 (-22%)	82%
Night-time VKT	148.1 (11.5%)	110.3 (11.6%)	-37.8 (-25.5%) *(p = 0.00)*	-47.7 (-32%) to -27.9 (-19%)	66%
Speeding VKT	168.7 (13.1%)	64.4 (6.8%)	-104.3 (-61.8%) *(p = 0.00)*	-121.1 (-72%) to -87.5 (-52%)	92%

5.1.3 Non-money makers

Focusing on the 41 participants who did not make money, Table 6 shows that overall there was a 25 percent increase in VKT and all increased their VKT in the after period. Night-time driving also increased (substantially) for this group. Speeding decreased marginally, although the change was statistically insignificant. Interestingly, though almost half the sample reduced their speeding VKT, suggesting that (perhaps) simply being made aware that speeding was being monitored was in itself an important factor affecting behaviour. This assertion is currently being further analysed by looking at speeding behaviour before and after the incentive ran out.

Table 6: Overall change in kilometres, night-time driving and speeding between the five-week before and after periods (those who did not make money only)

n = 41	Before	After	Change	95% Confidence Interval of the Change	Percent of Sample Reducing
Average VKT	967.6	1208.2	241 (24.9%) *(p = 0.00)*	214.0 (22%) to 267.1 (28%)	0%
Night-time VKT	76.9 (7.9%)	139.9 (11.6%)	63.0 (82.0%) *(p = 0.00)*	43.4 (56%) to 82.7 (108%)	24%
Speeding VKT	133.4 (13.8%)	131.1 (10.9%)	-2.2 (-1.7%) *(p = 0.83)*	-12.7 (-9%) to 8.2 (6%)	46%

5.2 Disaggregate comparisons

While the aggregate level comparisons indicate overall change across the sample, evidently there is considerable heterogeneity within the sample as might be anticipated for an experiment of this nature. It is also not clear from the evidence thus far as to *why* people might/might not have changed behaviour and to what extent this was due to the financial mechanisms. This section of the results takes a more disaggregate approach towards changes in the key parameters, namely VKT, speeding and night-time driving by considering both the numerical evidence as well as qualitative evidence coming from the exit interviews.

5.2.1 Vehicle kilometres travelled

Changes in VKT be participant are shown in Figure 3 – by way of interpretation, those falling to the right of the line reduced VKT, while those to the left of the line increased VKT. The picture re-enforces the earlier findings that while there is an even split in terms of those increasing/decreasing VKT, those decreasing VKT have done so by a substantially larger amount. Focusing on the largest reductions in VKT, the participant with the biggest net reduction from 2,590 km in the before period to 294 km in the after period clearly aroused the suspicion of the research team. Follow-up interviews revealed the participant (who drove a considerable distance to work in Western Sydney) had entered into an informal car-pooling agreement with a neighbour in which they agreed to use the neighbour's car for the majority of the five week after period and split the difference! The participant with the second largest reduction (2,520 km in the before period to 446 km in the after period) explained this was largely due to the fact that in the before period the car was shared with her daughter who drove a lot for work. During the after period, her daughter purchased her own car and stopped driving the participant's car. Ideally, a second GPS device would have been installed in the daughter's car, but clearly this was not possible.

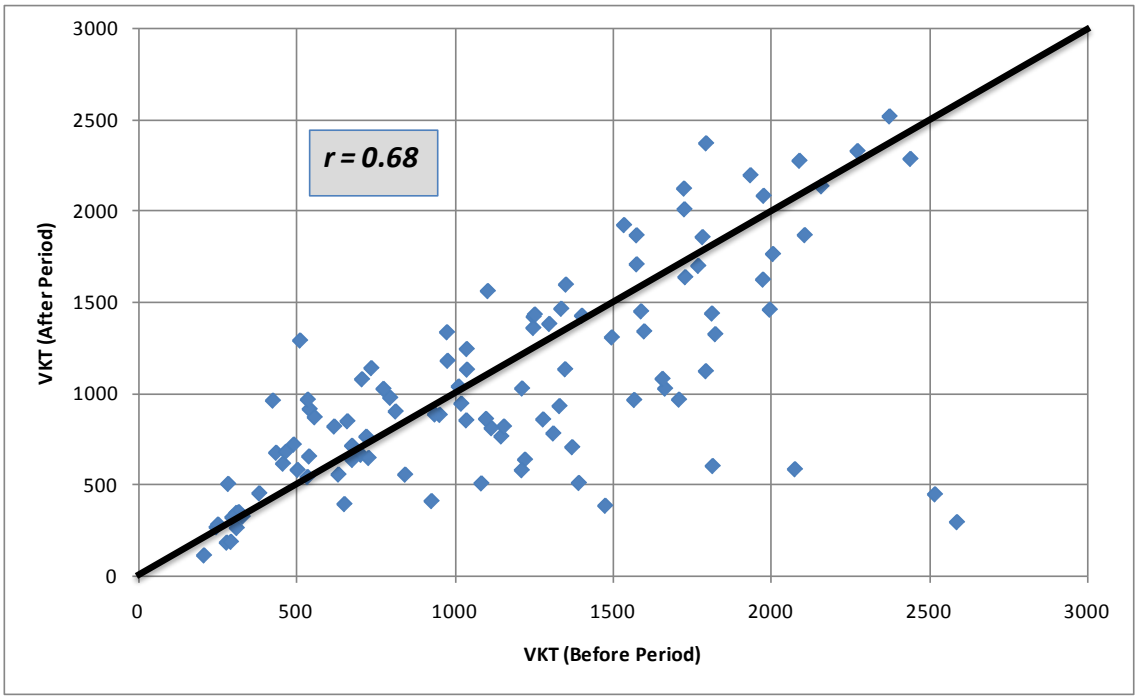

Figure 3: Changes in VKT in the before and after periods

While detailed analysis of the exit interviews is currently underway, it is useful to give some preliminary sense of changes in personal circumstances that might have affected driving during the study period. Ten percent of participants indicated a major change in personal circumstances in the before period, 20 percent for the interim period, and 25 percent in the after period. Among the reasons provided were giving birth, being hospitalised for some reason, death/serious illness in the family, moving house, changing jobs, someone else using the car more (or less). Whatever the precise reason, the issue is that even within a relatively short time-period (three months), a significant number of participants faced events that impacted driving (arguably) above and beyond the imposition of the charging regime.

To gain more insight on this issue, participants were also asked about whether they reduced driving per se by travel purpose to earn financial rewards – the results are shown in Figure 4. In terms of work-related travel, over 80 percent of participants said they did not reduce work-related driving because of the money with the charts suggesting that the incentive needed to be substantially higher to see a meaningful change. This does not seem to support what was found in the observational data, where there was a substantial reduction in work-related VKT and a roughly 50:50 split in terms of those reducing. The results for social/recreational trips are more aligned with what was seen in the GPS data, re-enforcing the notion that participants generally have more latitude and flexibility to change discretionary travel. The shopping/personal business graphs mirrored the social/recreational trends more closely. This supported the empirical findings in terms of the proportions reducing shopping/personal business VKT, even if there was no net reduction in overall shopping/personal business VKT across the sample.

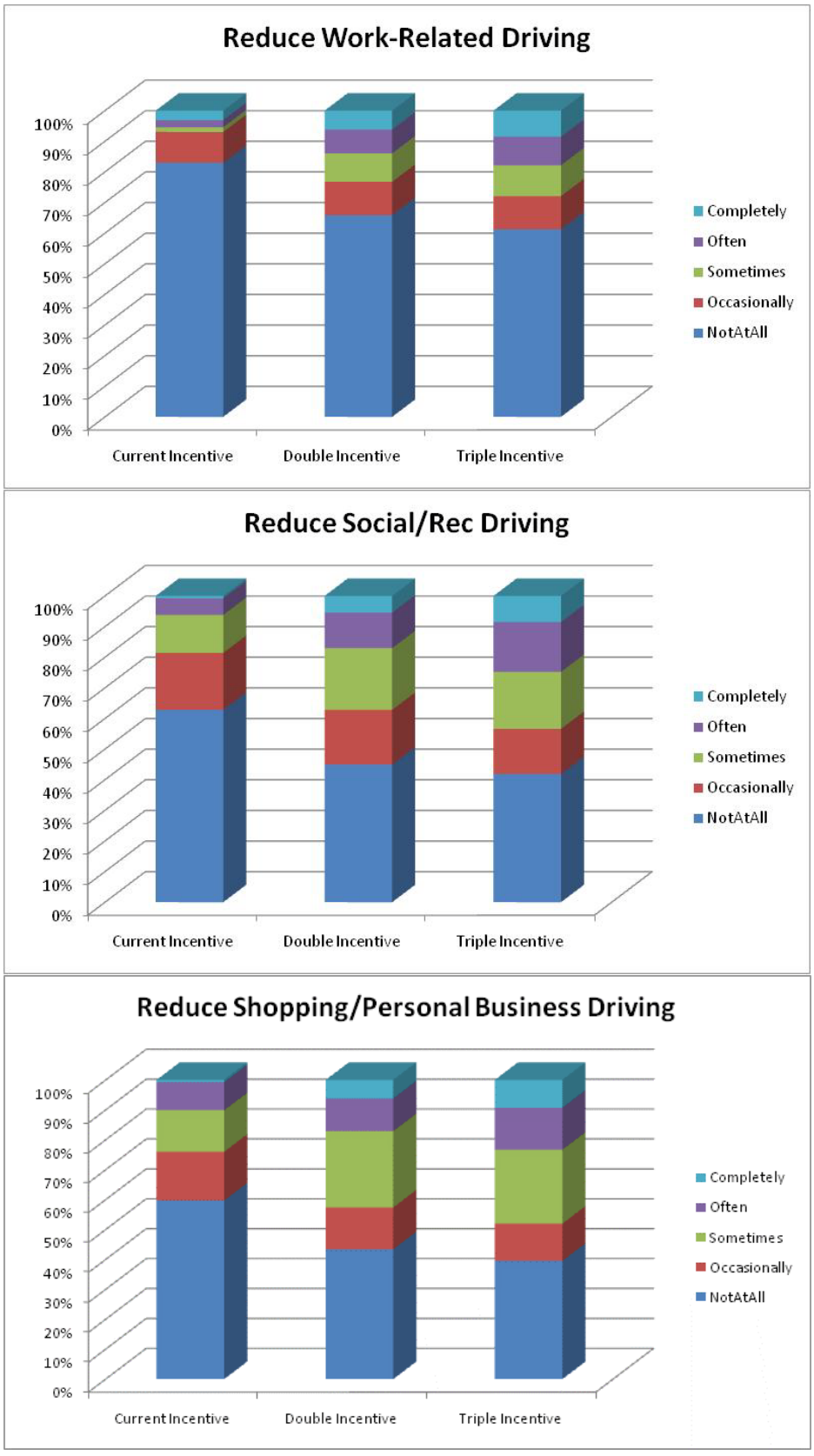

Figure 4: Exit interview responses to the question "During the charging phase did you reduce a)work-related driving, b) social/recreational driving, and c) shopping/personal business driving to earn financial rewards and to what extent would you reduce them if the reward was increased?"

5.2.2 Speeding

The overall results for speeding, while impressive, necessitate a closer look to establish where these reductions are coming from. Figure 5 presents an overall picture of speeding across the 106 qualifying participants (it should be noted, the highest speeder was recorded at 60 percent, but they did not qualify for the intervention for other reasons so are not included here). The most pertinent issues to take away are that i) at some point, all participants sped, ii) two-thirds of participants sped less than 15 percent of the distance (arguably inadvertent speeding), and iii) one-third of participants sped more than 15 percent of the distance driven, indicative of more systematic/deliberate speeding behaviour. Clearly, the magnitude of speeding must also be factored in, and issue that thus far has only been analysed for the before period (Greaves and Ellison, 2011).

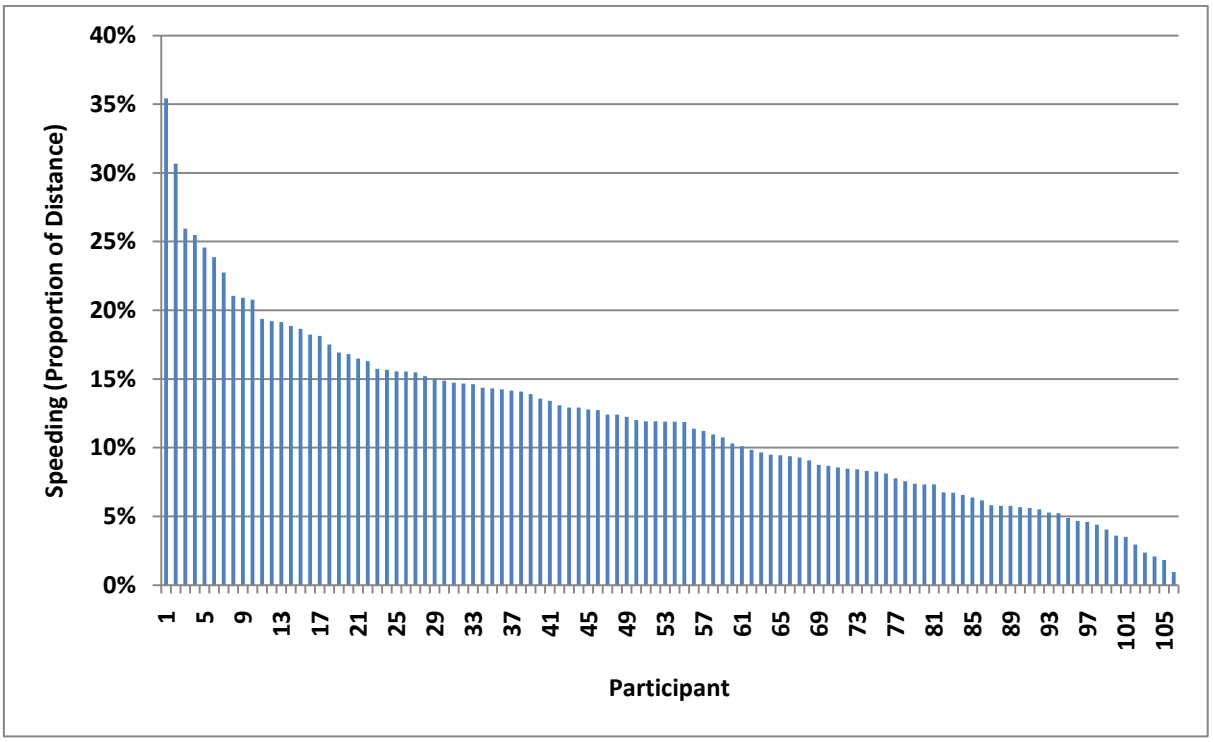

Figure 5: Overall distance speeding by participant in the before period

The change in overall speeding by participant is presented in Figure 6 – by way of interpretation, those falling to the right of the diagonal line reduced speeding, while those to the left increased speeding. In addition to re-enforcing the aggregate comparisons provided earlier, it is particularly notable that some of the highest speeders reduced speeding substantially – for instance, the highest speeder in the before period at 35 percent, reduced their speeding to 3 percent in the after period. Overall, only 10 percent of participants now sped more than 15 percent of the distance driven although it is still concerning that 25 percent of participants actually increased their speeds in the charging phase, suggesting no impact of the money or the fact they were being monitored.

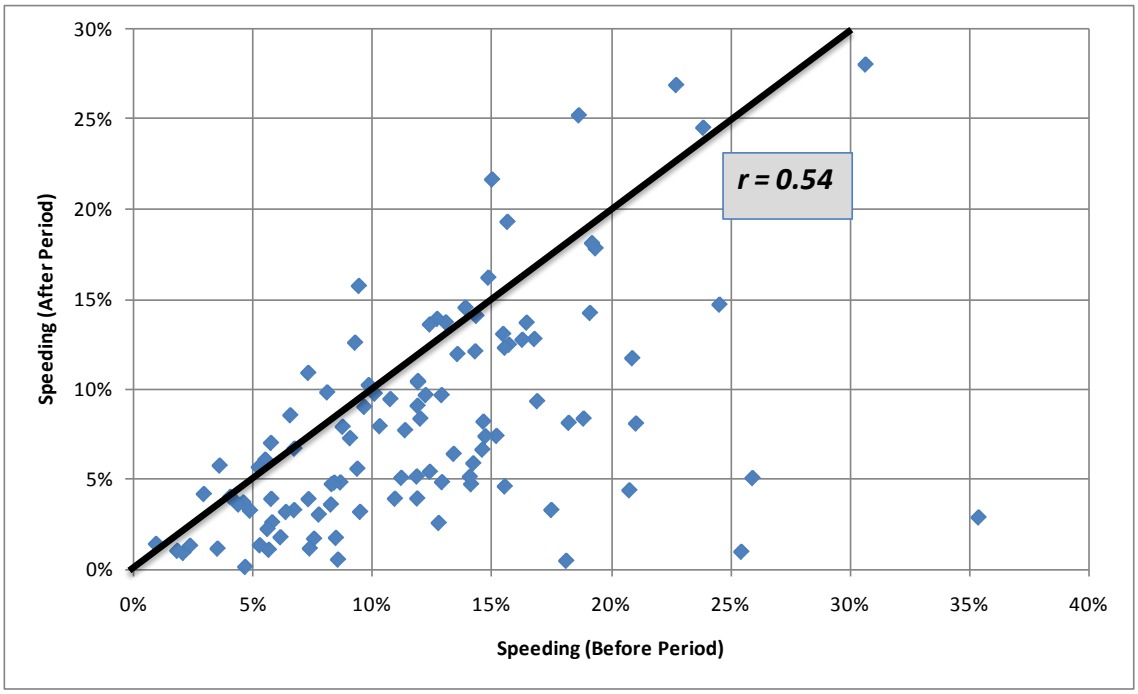

Figure 6: Changes in speeding in the before and after periods

Exit interview results asked participants if they reduced speeding to earn financial rewards and to what extent increases in the money would have encouraged further reductions in speeding. The results (Figure 7) suggest that around half of the participants were heavily influenced by the charge (proxied by the response of 'completely' or 'often'). As the incentive increases, clearly the influence of the money grows, but it is (arguably) of more interest that there is a 'hard core' of just over 20 percent of motorists who apparently will not reduce speeding for financial reasons. This is similar to what was observed in the empirical data, where 23 percent of motorists did not decrease speeding in the after period.

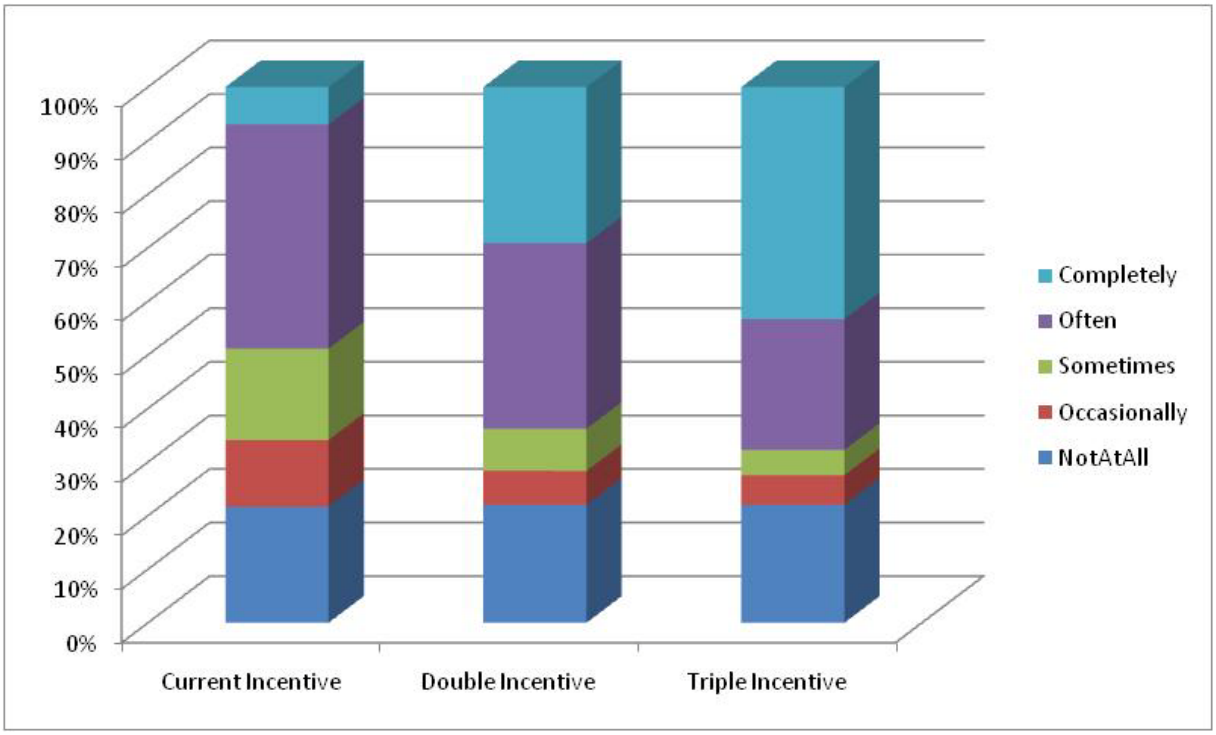

Figure 7: Exit interview responses to the question "During the charging phase did you reduce speeding to earn financial rewards and to what extent would you reduce speeding if the reward was increased?"

6. Conclusions

While a number of investigations have been conducted into motorist responses to various types of charging regimes, few have focused on driving behaviour per se. This paper reports on the behavioural response of motorists to a variable rate charging scheme designed to encourage safer driving behaviour and reduce their exposure to crash-risk – specifically kilometres driven, night-time driving and speeding. Overall, while participants made money, a substantial proportion (39 percent) did not suggesting they were unwilling/unable to change for the monetary incentives on offer. Speeding (which was the easiest thing to change) was reduced substantially following imposition of the charging scheme although a 'hard core' of perennial speeders remain. It is *not* conclusive to what extent this was due to the money or the monitoring, but is likely a function of both, judging from exit interviews. VKT was reduced by ten overall, a large reduction. However, the sample was equally split on those decreasing/increasing VKT, highlighting for many the difficulties involved in reducing car-dependency an assertion again corroborated by the exit interviews.

Clearly, as with any study of this nature, there are caveats relating to the sample size and composition, the technology, the regime used etc. However, the crucial issue is that it has been demonstrated that it appears possible to significantly change aggregate behaviours (particularly speeding) of a segment of the motoring public through financial leverages based on (in effect) rewarding better behaviour. Such a notion is being taken up through the previously-discussed Pay-How-You-Drive (PHYD) products being increasingly offered through the commercial insurance sector. While undoubted challenges remain, GPS technology opens up the possibility for developing greater equity in charging systems that reflect not just the kilometres driven but when, where and how they are driven.

References

Australian Government, Department of Infrastructure, Transport, Regional Development and Local Government (2009). Road Deaths Australia 2008 Statistical Summary. Available at:

http://www.infrastructure.gov.au/roads/safety/publications/2009/rsr_04.aspx Accessed Jun. 1, 2009.

Connelly, L.B. and R. Supangan. The Economic Costs of Road Trauma: Australia, States and Territories, Accident Analysis and Prevention , Vol. 38 No.6, 2006, pp. 1087-93.

Greaves, S. P. & Fifer, S. (2010) Development of a Kilometre-Based Charging Regime to Encourage Safer Driving Practices. *Transportation Research Record: Journal of the Transportation Research Board,* 2182, 88-96.

Greaves, S. P., Fifer, S., Ellison, R. & Germanos, G. (2010) Development of a Global Positioning System Web-Based Prompted Recall Solution for Longitudinal Travel Surveys. *Transportation Research Record: Journal of the Transportation Research Board,* 2183, 69-77.

Gunnar, L., H. Lars, N. Jan-Eric and T. Fridtjof. Pay-as-you-speed: Two Field Experiments on Controlling Adverse Selection and Moral Hazard in Traffic Insurance (2005). The Field Experiments Website. Available from http://www.fieldexperiments.com Accessed Jun. 1, 2009

Litman, T. Pay-As-You-Drive Pricing For Insurance Affordability. Available for download from http://www.vtpi.org/payd_aff.pdf Accessed Jun. 1, 2009.

Mazureck, U. & Van Hattern, J. (2006) Rewards for Safe Driving Behaviour: Influence on Following Distance and Speed. *Transportation Research Record: Journal of the Transportation Research Board,* 1980, 31-38.

Nielsen, O.A. Behavioural responses to pricing schemes: Description of the Danish AKTA experiment, Journal of Intelligent Transportation Systems, Vol 8(4), 2004, pp. 233-251.

Reese, C.A. and A. Pash-Brimmer, North Central Texas Pay-as-You-Drive Insurance Pilot Program. Proceedings of the Transportation, Land Use, Planning and Air Quality Conference, Denver. July 28-29, 2009.

Stopher, P. R. & Greaves, S. P. (2006) Guidelines for Samplers: Measuring a Change in Behaviour from before and after Surveys. *Transportation,* 34, 1-16.

Xu, Yanzhi, L.I. Zuyeva, D. Kall, V. Elango and R. Guensler. Mileage-Based Value Pricing: Phase II Case Study Implications of Commute Atlanta Project. CD-ROM proceedings of the 88th meeting of the Transportation Research Board, Washington DC, January 2009.

Zantema, J., Van Amelsfort, D. H., Bleimer, M. C. J. & Bovy, P. H. L. (2008) Pay-as-You-Drive Strategies: Case Study of Safety and Accessibility Effects. *Transportation Research Record: Journal of the Transportation Research Board,* 2078, 8-16.