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# A combined GPS/stated choice experiment to estimate values of crash-risk reduction

**By**

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**TITLE:** **A combined GPS/stated choice experiment to estimate values of crash-risk reduction**

**ABSTRACT:** This paper details the development and application of a Stated Choice experiment designed to explore motorists sensitivities to a kilometre-based charging regime focused around crash-risk reduction. Hypothetical responses are gathered through a Stated Choice (SC) experiment that pivots off actual driving behaviour collected over a five week period using an in-vehicle Global Positioning System (GPS) device. This provision of greater reality using revealed preference (RP) information ensures that the alternatives in the SC experiment are embedded in reality, providing motorists with a more realistic context for their choices. The study demonstrates with the improved affordability, power and consumer familiarity with GPS devices, the integration of GPS recorded travel information with SC experiments is a now a feasible solution which can help enrich the quality of the reference alternatives in SC experiments in the future.

**KEY WORDS:** ***Choice modelling, survey methods, stated preference, revealed preference***

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# 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, recent statistics show that 1,463 persons were killed on Australian roads in 2008, with 395 killed in the state of New South Wales alone. 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 whether financial mechanisms that capture the variable risk effects of the kilometres driven can be used to encourage safer driving practices (Litman 2008). The notion here is that through incorporating correlates of increased crash risk (e.g., kilometres driven, night-time driving, speeding, road type) directly into a charging scheme, motorists will be incentivised to change behaviour reducing the overall risk and societal costs of accidents (Zantema, et al. 2008).

Arguably, the greatest innovations in this area have come through the commercial sector in the form of PAYD insurance products, in which premiums are differentiated to kilometres driven and in some cases time, location and speed (Litman 2008). The more elaborate schemes have used Global Positioning System (GPS) technology to track motorists and through integration with powerful back-end servers, automate the computation of insurance premiums (Norwich Union 2006). However, the motivations for these schemes are invariably commercial, little detail is provided on how the premiums are established, and while some aggregate indicators of the outcomes of such programs may be provided rarely are details provided on the changes in before and after driving.

Research efforts to understand motorist responses to kilometre-based charging schemes have taken both a hypothetical/stated choice (SC) and/or empirical/revealed preference (RP) approach. The primary focus of these investigations has been congestion mitigation with relatively few focusing on risk reduction per se (Zantema, et al. 2008; Nielsen 2004; Reese and Pash-Brimmer 2009). A recent exception to this was conducted in the Netherlands in which SC methods were used to investigate the response of young drivers to various pay-as-you-drive (PAYD) insurance schemes (Zantema, et al. 2008). Their conclusion was that a scheme comprising time and road type differentiation could reduce road crashes by five percent. However, no published evidence is available on how this changed behaviour in reality. The few RP investigations that have been done have largely focused on safer driving, primarily speeding (Mazureck and van Hattern 2006; Gunnar, et al. 2005). In the Beloniter speed trial conducted in the Netherlands, motorists were paid to stay within the speed limit and maintain a safe following distance (Mazureck and van Hattern 2006). 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.

Investigations that have combined SC/RP approaches have generally done so by using the hypothetical results to inform the design of the charging scheme used in the RP experiment (Nielsen 2004). However, these SC experiments have generally been framed as choices in hypothetical markets. More recently there has been a growing body of evidence on the merits of using reference alternatives in SC experiments to try and ground the choice task in a level of realism and relevancy (Gilboa, et al. 2002; Starmer 2000). It is argued that the use of reference alternatives will allow the respondent to more easily address the choice task by comparing to a known experience and thereby improve the reliability of the results (Hensher 2010).

Within this context, the current paper reports on a study into the hypothetical/stated response of motorists to a kilometre-based charging regime that incorporates elements of risk, specifically kilometres, night-time driving and speeding. Hypothetical responses are gathered through a Stated

Choice (SC) experiment that pivots off actual driving behaviour collected over a five week period using an in-vehicle Global Positioning System (GPS) device (Greaves, et al. 2010). This provision of greater reality using revealed preference (RP) information ensures that the alternatives in the SC experiment are embedded in reality, providing motorists with (in theory) a more realistic context for their choices. In the SC experiment, participants are asked to trade-off financial rewards against reductions in kilometres driven, night-time driving and speeding for different trip purposes. In turn, this information is used to estimate values of crash-risk reduction and help guide a proposed charging regime that will be used to empirically assess changes in behaviour later this year.

# 2. Study design

Motorists were recruited initially to undertake (so they were told) a twelve week study of driving in Sydney involving both a GPS and online survey component for which they would be given 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 contamination. The study encompassed four distinct phases, a 'before' period of GPS monitoring, the establishment of the charging regime, a stated choice component, and an 'after' period of GPS monitoring (Figure 1).

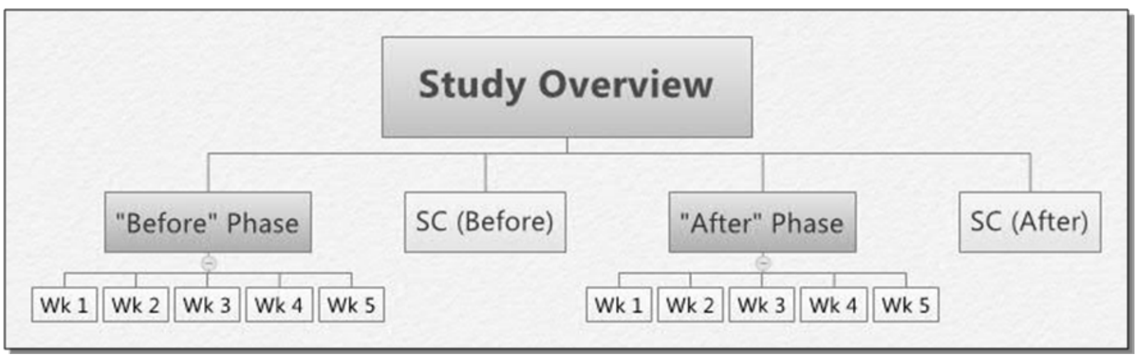


***Figure 1: Example of the prompted-recall interface***

## *2.1 The 'before' phase*

Following agreement to participate, motorists were provided with a small GPS device, installed via the cigarette lighter. The device collected key elements (position, time, speed etc), which were broadcast back in real-time to servers via GPRS where the information was processed into daily trip logs (Greaves, et al 2010). These data were then manipulated to provide the basis for an online survey in which motorists were prompted for further information on their trips, including who was driving, the purpose of the trip, number of passengers and whether any intermediate stops were made (see Figure 2).

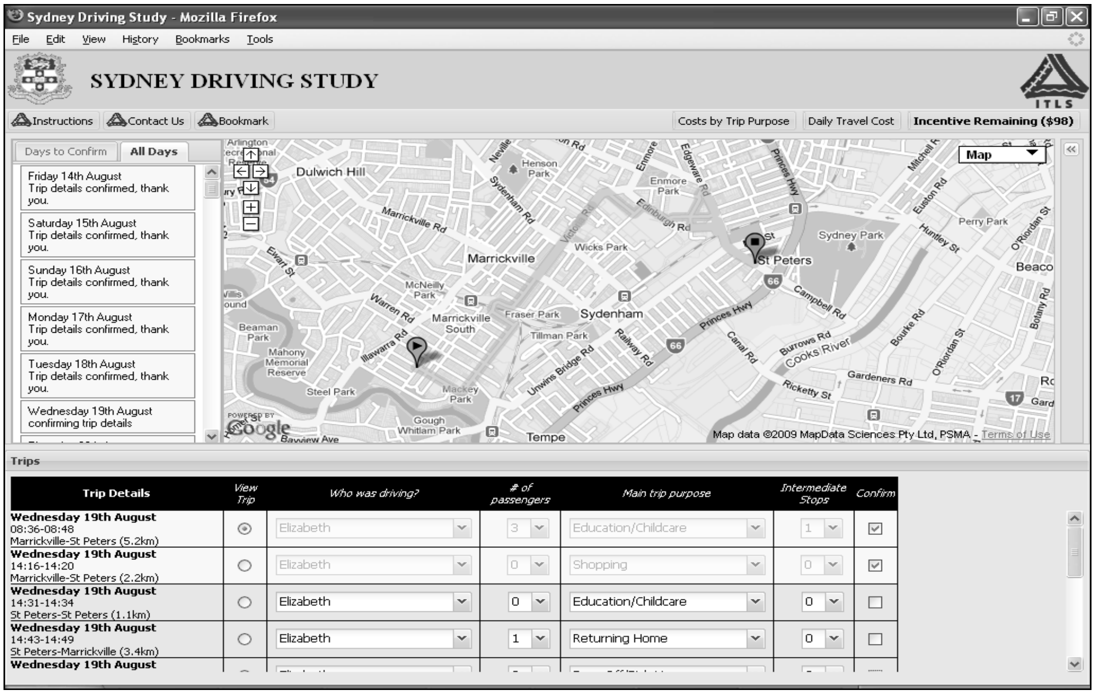


***Figure 2: Example of the prompted-recall interface***

In total, 148 motorists were recruited into the GPS-phase of the study. While full details of the GPS phase are provided by the authors in (Greaves, et al. 2010), the data were generally of a very high quality and of the original 148 drivers, only eight dropped out at the 'before' phase, of which four were due to technical problems with the GPS devices not working in their vehicles.

## *2.2 Establishment of the charging regime*

The rationale behind the charging regime was that motorists would receive a financial incentive for 'improving' their driving behaviour in terms of correlates of crash risk (reducing kilometres, speeding, driving on particular roads etc) relative to how they drove before. Per kilometre rates were derived using crash-risk and crash-cost information for New South Wales (Greaves and Fifer 2010). In addition to the scientific evidence on crash risk, various pragmatic issues were factored in including motorist comprehension of the system, ensuring the rates were deemed substantial enough to warrant some change in behaviour, while staying within the available project budget. The result of this process was the per kilometre charging scheme shown in Table 1.

***Table 1: Per kilometre charging system (adapted from Greaves and Fifer, 2010)***

| Charging Rates | 17-30 Age-Group | 31-65 Age-Group |
|---|---|---|
| Day - Non Speeding | $0.20 | $0.15 |
| Day - Speeding | $0.60 | $0.45 |
| Night - Non Speeding | $0.80 | $0.60 |
| Night - Speeding | $2.40 | $1.20 |

These rates were combined with the relevant information from the GPS data for each motorist to establish a 'base incentive'. This base incentive represented the starting point (i.e., maximum amount they could make) from which money would be deducted according to changes in driving Of the 140 motorists who made it through the five-week 'before' period of data collection, 125 qualified for the charging phase (17 were retained as a control group). For these 125 motorists, the range of base incentives ran from AU$25 to AU$915, with an average of AU$300 (Table 2). For a five-week period, these were considered to be significant amounts of money that could potentially be made.

***Table 2: Driving characteristics of the sample and potential budgetary impacts***

| Age-Group | Sample | Average Daily VKT | % Night VKT | % Speeding (Day) | | % Speeding (Night) | | Starting Budget (based on 5 weeks) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Mean | Max | Mean | Max | Mean | Range |
| 17-30 Male | 9 | 24.7 | 26% | 11% | 17% | 12% | 44% | $355 | $85-$630 |
| 17-30 Female | 23 | 28.4 | 16% | 14% | 34% | 16% | 50% | $405 | $105-$815 |
| 31-65 Male | 47 | 32.2 | 12% | 13% | 44% | 13% | 45% | $305 | $30-$870 |
| 31-65 Female | 46 | 26.7 | 7% | 12% | 26% | 12% | 39% | $250 | $25-$915 |
| TOTAL | 125 | 29.0 | 12% | 13% | 44% | 13% | 50% | $300 | $25-$915 |

*Maximum budgetary impacts - $35,950

## *2.3 The stated choice experiment*

The purpose of the SC experiment in this study was two-fold. First, there was the desire to explore how respondents might hypothetically change their driving behaviour if they were participating in a kilometre based rewards scheme to estimate values of crash-risk reduction. Second, was the question of how the SC/hypothetical choices matched revealed preferences, generally referred to as hypothetical bias (Hensher 2010; Harrison 2006). The focus of this paper is the first issue – the second issue will be addressed in the future by comparing the SC results to what happens when the rewards scheme shown in Table 1 is implemented in the field.

The SC experiment was implemented for three different trip purposes; work/work-related business, shopping/personal business, and social/recreation. The experiments were based on a choice between maintaining existing trips (the current alternative) and alternatives involving changes to existing trips and receiving a reduced charge (e.g., cancelling trips, reducing speeding, changing time of day). In keeping with recent literature on referencing SC experiments to a known experience (Rose, et al. 2008; Rose and Bliemer 2009), the SC experiment was designed to pivot off actual trips taken from the GPS data collected during the five week 'before' period.

The integration of the GPS data with the SC experiment required some manipulation, primarily around how to assign VKT to one of the three trip purposes. The main issue here concerned trips that were coded as 'returning home', which constituted around one-third of trips. GIS-based routines were employed to first validate home locations provided by participants (i.e., look for a common location of trips designated as 'returning home') and second reclassify 'returning home' trips based on the primary purpose of the tour. A number of different options were considered for this reclassification, but ultimately the approach taken was to reclassify trips according to that used in the Sydney Household Travel Survey (Transport Data Centre 2007). Under this scheme, if any of the trips in the tour had a purpose of work, work-related business or education then the trips for which the purpose was “returning home” would be reclassified to the appropriate purpose. For tours where this was not the case (such as tours made up of social and shopping trips), the ‘returning home’ trip would be reclassified to the purpose where the most time was spent during the tour. The purpose of all other trips in the tour remained unchanged.

The choice scenario layout was designed to be simple and intuitive. A combination of symbols and colours were used to allow the respondent to quickly and easily process the relevant information and make decisions. An example screenshot of a choice situation for social trips is shown in Figure 3. Distance was presented as the total number of kilometres travelled in conjunction with the number of driving days during the five week period and was displayed graphically to facilitate easier comparisons between the alternatives. Both driving time of day and speeding were presented as percentages of occurrence throughout the five week driving period. The attribute travel time, which represents the average increase in travel time per trip, was included in the experiment after much discussion about respondent perceptions of speeding and the likelihood that they would choose the lowest speeding figure without considering any consequences to their daily driving. The charging component consisted of a base incentive, shown to represent the maximum possible amount of money participants could make, and a charge based on driving behaviour. The monetary incentive for participants to change their behaviour was calculated as the base incentive minus the charge. The incentive was structured this way rather than shown directly because this followed the fieldwork charging design.

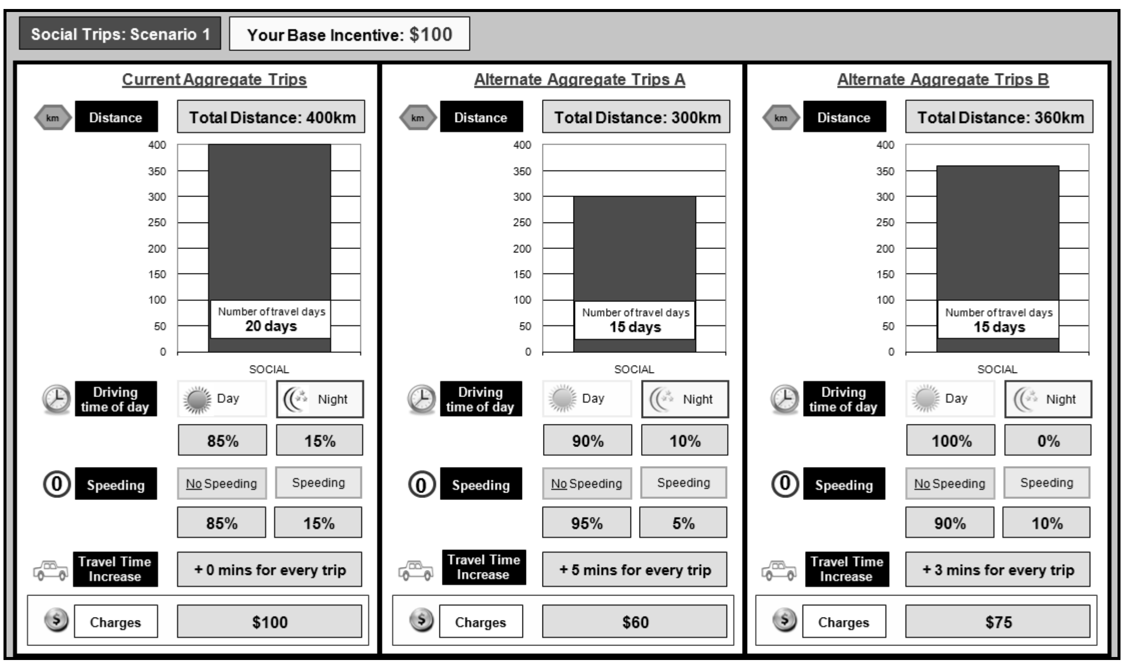


***Figure 3: Example screen from the stated choice survey***

Choice situations for the other trip purposes were identical to Figure 3, except the colours in the graphs were different. Respondents answered four choice situations for each of the three different trip purposes.

### *2.3.1 Experimental design*

A Bayesian efficient design for each trip purpose was generated. This experimental design method was used to produce lower standard errors and provide more reliable parameter estimates for a relatively small sample size (Rose and Bliemer 2009). The experimental designs were constructed in Excel, assuming a uniform distribution of prior parameters, given expected parameters signs. All prior parameters were assumed to be negative, except for distance (positive) and speeding which was allowed to vary from positive to negative due to the possibility that some participants preferred more speeding and some less speeding. The pivot levels for each of the attributes are shown in Table 3. These levels were selected to represent the possible range of driving responses to the charging regime. The number of days travelled was used for pivoting from the attribute distance in order to focus on changes to only whole days of travel. Given the linkage between travel time and speeding, travel time was constrained to be zero when speeding behaviour did not change (i.e., 0 percent level).

***Table 3: Description of attributes and pivot levels***

| Attribute | Description | Pivot Levels (off the reference level) |
| --- | --- | --- |
| Distance | The total number of km you drive. The number of travel days driving for that purpose is also shown. | 0%, -15%, -30%, -75% |
| Driving Time of Day | The percentage (%) of your total driving in the 'Day' (5am - 8pm) and 'Night' (8pm - 5am). | 0%, -25%, -50%, -75%, -100% |
| Speeding | The percentage (%) of your total driving where you are 'Speeding' and 'Not Speeding'. | 0%, -25%, -50%, -75% |
| Travel Time | The average increase in travel time per trip (in minutes) if you were to reduce your speeding behaviour. | 0 mins, 2 mins, 4 mins, 6 mins, 8 mins |
| Charges | The amount of money you would pay (reduced from your base incentive) to drive for that trip option. | -10%, -20%, -30%, -50%, -75% |

### *2.3.2 Implementation*

The study was structured so that approximately half the sample completed the SC experiment prior to completing the “After” fieldwork stage (October 2009), with the other half completing the SC experiment at the completion of the “After” fieldwork stage (December 2009). This splitting of the sample was designed to test any differences in the order of completion and avoid any associated issues (e.g., do respondents do what they say they will do because they completed the hypothetical survey first). The samples were intended to be roughly equal, however due to the length of the study duration it proved more difficult to get participants to complete the SC experiment at the end of the study. In total, 105/123 motorists who completed the ‘before’ GPS data collection phase also completed the SC experiment.

The SC survey was administered online and built using PHP, HTML/CSS and a MySQL database. An email was sent to each participant, which contained a personalised link to the online survey. The survey was designed so that the participants could stop the survey at anytime and resume where they finished. An email and phone help line was established to field any problems participants had whilst completing the survey. On average, the survey took approximately 20-30 minutes to complete, with the SC component accounting for the greater part of this completion time. The final sample composition for the participants who completed the SC experiment can be found in Table 4.

***Table 4: Sample composition (stated choice survey)***

| Gender | Age | SC Before | SC After | Total |
|---|---|---|---|---|
| Male | 17-30 | 4 | 3 | 7 |
| | 31-65 | 25 | 16 | 41 |
| Female | 17-30 | 8 | 13 | 21 |
| | 31-65 | 25 | 11 | 36 |

### *2.3.3 Participant feedback*

Participant feedback on the survey was generally positive, with many reporting they found the experiment 'fun' and 'interesting' although several indicated a difficulty in changing behaviour. Two scales were used to quantitatively measure the survey response. One scale measured the ease of understanding the choice scenario games (where 0 was "Did not understand at all" and 10 was "Completely Understood"). The majority of participants indicated that they understood the task, with a median scale value of eight (Figure 4). The other scale measured the difficulty of completing the choice scenario games (where 0 was "Very Difficult" and 10 was "Very Easy"). Similarly most participants found the choice task relatively straightforward, with a median scale value of seven (Figure 5).

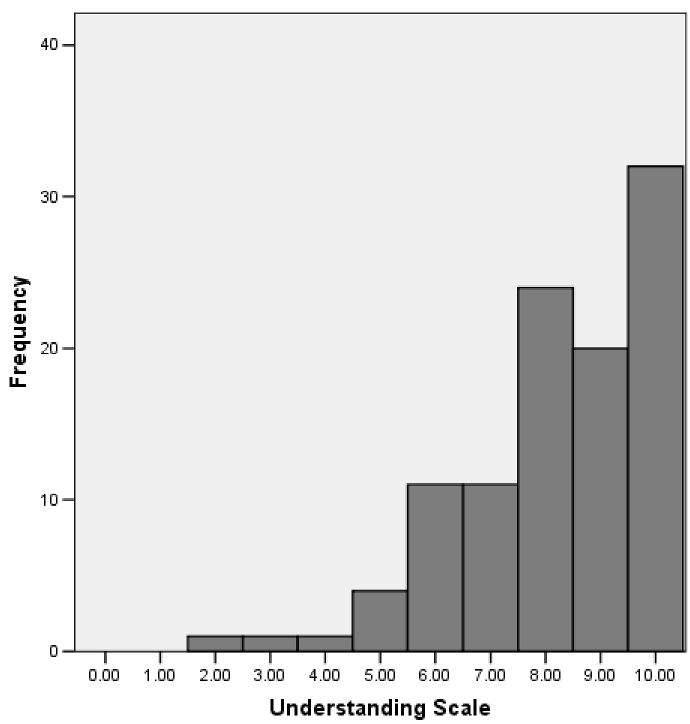


***Figure 4: Understanding scale distribution***

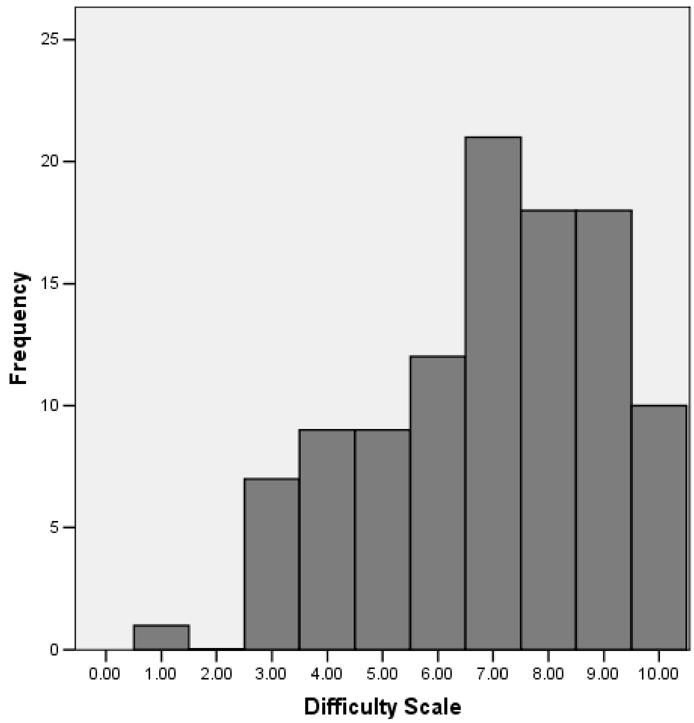


***Figure 5: Difficulty scale distribution***

## *2.4 The stated choice experiment*

The 'after' phase (only recently completed) involved a further period of GPS monitoring in which the charging scheme presented in Table 1 was implemented. Motorists were able to log on to the website where they would now see how much of their base incentive they had left (Figure 6). Any money remaining at the end of the five-week period was paid out to motorists – note they did not pay if they exceeded their base incentive. Preliminary results show that around half of the motorists made money (i.e., they reduced kilometres and/or night-time driving and/or speeding relative to the five week before period). For those making money, they average payout was $82 with the highest payout $563. VKT was reduced by eleven percent, the proportion of night-time driving marginally increased, and speeding was reduced by 4.3 percent during the day and 4.8 percent at night. Focusing only on those who made positive changes, VKT was reduced by 35 percent, night-time driving by 5.4 percent and speeding by over nine percent. Exit interviews with a cross-section of participants highlighted the practical difficulties of reducing kilometres for many participants because of a perceived lack of realistic alternatives to the car. However, (arguably the most encouraging outcome) most participants indicated that it had motivated them to become more aware of and actively their reduce speeding.

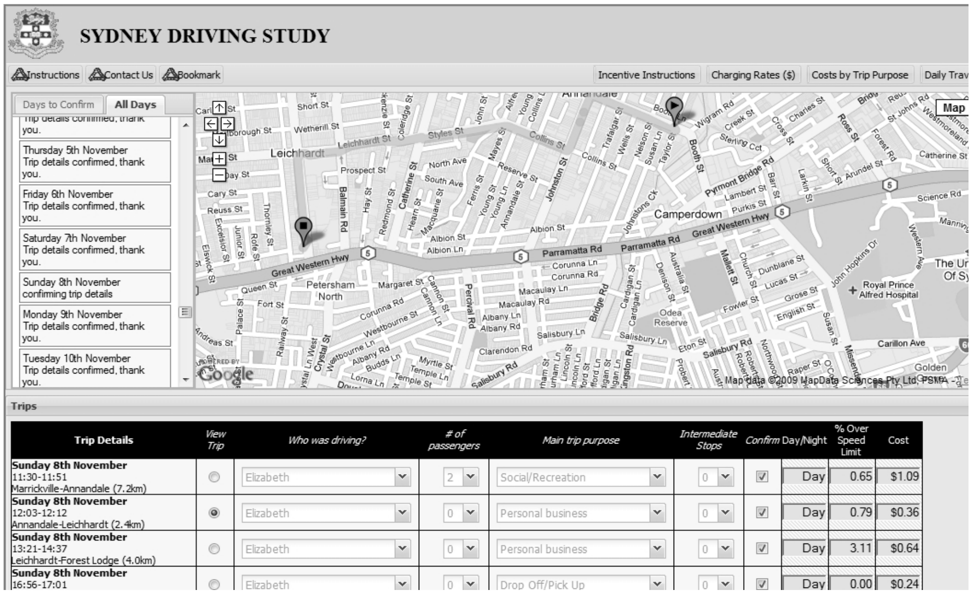


*Figure 6: Prompted-recall survey interface (charging phase)*

# 3. SC results

The standard 'workhorse' model for choice modelling is the Multinomial Logit (MNL). In keeping with standard notation the utility $U_{nsj}$ can be written as the sum of the observable component (otherwise referred to as the systematic component, $V_{nsj}$, expressed as a function of the attributes presented (for alternative j by respondent n in choice situation s), an unobserved component of utility, $\eta_{nsj}$ and a random or unexplained component, $\varepsilon_{nsj}$ as shown in equation (1).

$$U_{nsj} = V_{nsj} + \eta_{nsj} + \varepsilon_{nsj} \qquad (1)$$

$V_{nsj}$,' in its simplest form, is typically assumed to be a linear relationship of observed attribute levels and the corresponding parameter weights.

$$V_{nsj} = \sum_{k=1}^{K} \beta_{jk}\, x_{nsjk} \qquad (2)$$

The MNL has certain restrictive assumptions which have led to the development of more advanced models, including the Mixed Multinomial Logit (MMNL) and Error Components (EC) model. The modelling of the data for this paper will focus on the EC model. The EC model is similar to Mixed Multinomial Logit Model (MMNL), except the random parameters are associated with alternative j, not attribute x. These random variables are represented as $\eta_{nsj}$ in equation (1). $\eta_{nsj}$ capture common error variances in the sets of alternatives constructed. The random parameters for the EC model were estimated using 500 halton draws. All models were estimated using the software Nlogit 4.0.

The results comparing the basic MNL with an EC model for each trip purpose are presented in Table 5. The EC model was chosen because it is a more flexible and superior model compared to the standard MNL. The EC model allows for repeated choice observations as well as accounting for correlation in the errors of the alternatives. The 'Before' sample and 'After' sample were pooled for analysis. However, separate constants were estimated for the current alternative and also separate error components were estimated for the hypothetical alternatives to account for any error differences between the hypothetical and the reference alternatives across the two samples (Scarpa, et al. 2005).

***Table 5: Model results***

| | Work / Work related Business | | | | Social / Recreational | | | | Shopping / Personal Business | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MNL | | Error Components | | MNL | | Error Components | | MNL | | Error Components | |
| **Attributes** | *Parameter* | *(t-ratio)* | *Parameter* | *(t-ratio)* | *Parameter* | *(t-ratio)* | *Parameter* | *(t-ratio)* | *Parameter* | *(t-ratio)* | *Parameter* | *(t-ratio)* |
| Constant (Current alt - Before) | -0.510 | -2.200 | -0.873 | -1.740 | -0.613 | -2.690 | -1.234 | -2.270 | -0.896 | -3.900 | -1.488 | -3.120 |
| Constant (Current alt - After) | -0.374 | -1.510 | -1.027 | -1.710 | -1.157 | -4.140 | -1.960 | -3.430 | -0.996 | -3.700 | -1.533 | -2.780 |
| Distance | 0.005 | 6.640 | 0.006 | 5.670 | 0.005 | 6.060 | 0.006 | 9.310 | 0.007 | 5.850 | 0.008 | 8.600 |
| Time of Day (Night) | 0.007 | 0.550 | - | - | 0.036 | 3.600 | 0.043 | 2.860 | 0.026 | 1.420 | - | - |
| Speeding | -0.028 | -1.800 | -0.026 | -1.760 | -0.026 | -2.060 | -0.031 | -1.900 | -0.049 | -2.780 | -0.041 | -2.600 |
| Travel time | -0.001 | -0.030 | - | - | -0.051 | -1.710 | -0.059 | -1.860 | -0.059 | -2.090 | - | - |
| Charge | -0.002 | -0.970 | - | - | -0.010 | -3.980 | -0.012 | -3.700 | -0.021 | -4.110 | -0.024 | -5.680 |
| ***Error Components*** | | | | | | | | | | | | |
| (Alternatives 1 & 2 - Before) | | | 1.371 | 9.850 | | | -2.141 | -4.490 | | | -2.018 | -3.410 |
| (Alternatives 1 & 2 - After) | | | 1.940 | 5.230 | | | 1.932 | 3.510 | | | 1.894 | 3.480 |
| **Model Fit** | | | | | | | | | | | | |
| Sample | 82 | | 82 | | 99 | | 99 | | 105 | | 105 | |
| Observations | 328 | | 328 | | 396 | | 396 | | 420 | | 420 | |
| Log likelihood (0) | -360.189 | | -587.697 | | -427.261 | | -709.537 | | -438.059 | | -752.539 | |
| Log likelihood (B) | -329.163 | | -313.832 | | -395.409 | | -367.695 | | -403.451 | | -386.044 | |
| AIC | 2.050 | | 1.950 | | 2.032 | | 1.903 | | 1.955 | | 1.872 | |
| McFadden Pseudo R-squared | 0.086 | | 0.466 | | 0.075 | | 0.482 | | 0.079 | | 0.487 | |

The model fit results demonstrate that the EC model provides a better fit to the data than the standard MNL model. Insignificant parameters were removed from the final EC model. Results from the work trip purpose model suggest that participants were mainly concerned with the ability to drive and were reluctant to change. Interestingly participants also preferred driving options with less speeding irrespective of any time penalties incurred. These results are in line with anecdotal evidence gathered during pilot interviews which revealed that the work commute would be the least likely trip purpose to be altered during the charging phase. All parameters for the social / recreational trip model were significant and of the expected signs. The interpretations for the distance and speeding parameters are the same as for work trips, namely that participants prefer to use their car to drive to social / recreations activities and also desire to speed less. As might be anticipated, participants prefer to maintain their night driving for social / recreation trips and are more travel time sensitive (i.e., they dislike extra travel time per trip). Unlike work trips, the charging regime had a significant impact on driving choices for social / recreations trips. Participants preferred to choose trips options with lower charges and were willing to change some of their current driving behaviour to reduce the charges and hence make some money. Similar significant results were achieved for the shopping model with the exception of driving time of day and travel time.

Willingness to Pay (WTP) measures were computed to further understand and compare the impact each attribute has on behavioural change and the relationship with the charging regime. WTP is simply the marginal utility of a particular attribute divided by the marginal utility of the charge (i.e., the ratio of the two coefficients) and enables comparison across models because they are not influenced by the scale factor. WTP calculations for social / recreational trips and shopping / personal business trips are shown in Table 6 and Table 7 respectively. WTP values for work trips are not presented because the charge parameter was not significant. Confidence intervals were calculated using the Delta method (Greene 2000). For social/recreational trips participants are on average willing to pay $0.53 for an additional kilometre of travel. The importance of night driving for social / recreational trips is highlighted in the high WTP value. Participants are willing to pay $3.53 for an additional percentage of driving at night. Despite significant parameter estimates for speeding and travel time, the WTP ratios were not significant. The WTP for distance was also significant for shopping trips, although participants were not willing to pay as much as social trips for an additional kilometre. Surprisingly the WTP for speeding was also significant for shopping trips. On average participants are willing to pay $1.68 to reduce their speeding behaviour. The fact that participants are willing to pay money to reduce this behaviour is somewhat counterintuitive given the nature of the charging regime (i.e., charges levied for speeding not vice versa). This highlights the negative perceptions of speeding held by the sample.

***Table 6: WTP – social / recreational trips***

| Social / Recreational | WTP | s.e. | (t-ratio) | Lower 95% CI | Upper 95% CI |
|---|---|---|---|---|---|
| Distance | $0.53 | 0.151 | 3.500 | $0.23 | $0.83 |
| Time of day - Night | $3.53 | 1.660 | 2.126 | $0.27 | $6.78 |
| Speeding | $2.59 | 1.532 | 1.694 | - | - |
| Travel time | $4.86 | 3.218 | 1.509 | - | - |

***Table7: WTP – shopping / personal business***

| Shopping / Personal Business | WTP | s.e. | (t-ratio) | Lower 95% CI | Upper 95% CI |
|---|---|---|---|---|---|
| Distance | $0.34 | 0.083 | 4.165 | $0.18 | $0.51 |
| Speeding | $1.68 | 0.705 | 2.386 | $0.30 | $3.06 |

# 4. Conclusions

This paper details the development and application of a SC experiment designed to explore motorists sensitivities to a kilometre-based charging regime focused around crash-risk reduction. The contributions of the paper are as follows. First, it represents the first effort in Australia to focus specifically on charges based on risk-exposure as opposed to congestion-based charges or just kilometre-based charges. Second, it represents (to our knowledge) the first world-wide effort to apply jointly a Stated Choice (SC) experiment with a GPS experiment, where the GPS experiment is able to provide the context for the SC, and is subsequently able to take advantage of the information obtained in the SC experiment to guide a simulation of the actual charging procedure. We argue, this offers many advantages over transportation-based SC experiments which typically rely on asking participants what they did on a 'typical' trip and using that to form the reference alternative. People are notoriously bad at recollecting trip details, particularly over extended periods of time, which was the requirement for this study. In addition, people are very unreliable when it comes to the reporting of sensitive issues, particularly speeding (Greaves and Ellison, A 2010). Third, the paper demonstrates that values of crash-risk reduction and WTP vary quite markedly by the purpose of the trip. The findings suggest that for non-work trips people are sensitive to a risk based charging regime and are willing to change their driving behaviour in order to save money. In particular people are WTP substantial charges to maintain their driving behaviour, including overall distance (social / recreational and shopping / personal business trips), night driving (social / recreational trips only) and limiting driving time (social / recreational trips only). The WTP results for speeding reinforce the negative perceptions of speeding.

It is most likely that the reason GPS data has not been readily utilised in SC experiments (where applicable) is because collecting GPS data is a lengthy and costly process. Given the complex nature of this study, we believe that the benefits of integrating the data in this way largely outweighed any negatives. GPS devices are increasingly being used in many travel surveys to advance the accuracy of travel information (Stopher and Greaves 2009). With the improved affordability and consumer familiarity with GPS devices, the integration of GPS recorded travel information with SC experiments is a now a feasible solution which can help enrich the quality of SC experiments.

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