35th ATRF Conference 2012

Name: Michael Roth, Genevieve Graves and Dr Ian Jeffreys

Organisation: RACQ

Email:michael.roth@racq.com.au

Phone: 61 7 3872 8650

Category: Future Proofing Transport

Abstract Title: Eco-driving in the Australian Context

Abstract Text:

Eco-driving is a way of driving that reduces fuel consumption, greenhouse gas emissions and crash rates. Eco-driving offers benefits to drivers including ongoing reduction in transport emissions, road crashes and motoring costs. Mass uptake of eco-driving has the potential to reduce fuel emissions immediately, with no cost or reduction in mobility for the individual.

The EcoDrive Research Study is funded jointly by the RACQ and the Queensland Government. The research is being conducted by the RACQ with methodological support and peer review from the QUT Centre for Accident Research and Road Safety Queensland.

The research was conducted over 18 months to July 2012 with 1,332 participants. It sought to understand which, if any, strategies were effective in supporting long term driving related behaviour change to increase fuel efficiency.

The research used an experimental approach to examine the efficacy of five different treatment options including: on-line learning; classrooms; driving lessons; classrooms plus driving lessons; and half day workshops incorporating monitored pre and post drives. The research examined how these different options affect the behaviour of drivers in all age cohorts and in urban and regional settings.

This research sought to understand whether the eco-driving strategies utilised in other international jurisdictions, and in commercial settings in Australia, have relevancy in a private motoring context in Australia and whether driver education could achieve a reduction in vehicle emissions.

The RACQ EcoDrive Research Study findings are that changes to driving behaviour will occur with training. The combined effect of all the eco-drive training across the whole sample was a statistically significant 4.6% reduction in fuel-use. This equates to an average reduction of 0.51 litres per 100km.

Importantly, the practical application of the results of this study would see online training tools and half-day workshops provide significant savings in both the cost of driving, and the impact on the environment of that driving.

This paper reports on the research and discusses the implications in public policy making. It provides an assessment of possible education opportunities and future greenhouse gas abatement and emissions reduction.

Introduction

RACQ has a long standing interest in eco-driving as a mechanism to help motorists reduce the impact of motoring on the environment and the hip pocket and as a strategy to reduce our dependence on oil.

To do this we have undertaken several research elements with our membership to understand more about their interest in fuel-efficient driving. The original research elements included a literature review, member focus groups and a phone survey exploring attitudes and behaviours. We have also developed material to educate members about eco-driving, intended for dissemination through a variety of channels.

In order to understand motivators to change, RACQ undertook a survey of our members in 2009. This survey established that a behaviour change strategy needs to respond to multiple motivators – motoring costs, the environment and safety benefits. It also identified that, while there are some eco-driving strategies easily understood, there is confusion or lack of knowledge about the most effective techniques. These require more detailed explanation and advice, with messaging customised to the individual or market segment. Cultural change was also identified to support mass adoption.

This paper focuses on our most recent study conducted with 1,332 participants over nine months of fuel monitoring to April this year. The study involved drivers who privately funded their own motor vehicle expenses.

The study built upon our earlier research. It was a randomised, controlled trial seeking to understand what strategies affect driving behavioral change, the extent of the reduction in fuel consumption and the most cost effective training intensity. The RACQ EcoDrive Research Study found that changes to driving behaviour will occur with training. The combined effect of all the eco-drive training across the whole sample was a statistically significant 4.6% reduction in fuel-use. This equates to an average reduction of 0.51 litres per 100km.

There are a number of others working in the eco-driving area including two papers presented at ATRF in 2011. The first of these sought to understand the efficacy of training in eco-driving while the other examined the effect of eco-driving on traffic flow. This paper does not address the paper presented on traffic flow, but it does build on the study conducted by Symmons, Rose, Rorke and Watkins which was focused on fleet drivers.

The paper commences with a brief definition of eco-driving, then details the study and discusses the results and policy implications.

What is eco-driving?

Eco-driving is defined as "a way of driving that reduces fuel consumption, greenhouse gas emissions and accident rates. Eco-driving is about driving in a style suited to modern engine technology: smart, smooth and safe driving techniques that lead to average fuel savings of 5-10%" (www.ecodrive.org).

The primary rationales for eco-driving are reducing greenhouse emissions in response to the need to deal with climate change, and reduction in motoring costs, in response to an expected long term increase in fuel prices.

There is a direct correlation between fuel consumption and carbon dioxide emissions. Eco-driving reduces fuel use and carbon dioxide emissions for a given vehicle trip, thus reducing the emissions intensity of vehicle transport per kilometre. Eco-driving is part of a more comprehensive approach to reducing the transport sector's contribution to carbon dioxide emissions. The other components include:

- Improved vehicle fuel efficiency through new technologies and standards
- Pricing policies that reduce congestion or trip making
- Broader travel demand management activities that lead to mode change, trip chaining and less trip making, such as telecommuting
- Land use planning and transport integration that improves accessibility by multiple modes and reduces trip distances, and;
- Intelligent transport systems that support more efficient use of road and rail networks.

The basis of eco-driving is a change of habit by drivers in order to drive in a manner that minimises fuel consumption. Types of eco-driving behaviours fall into three categories – driving behaviours, trip planning and vehicle maintenance. The strategies taught to drivers in the research are provided in table 1:

Table 1: Strategies in eco-driving used through the study

Monitor your fuel consumption	If you don't monitor it, you can't manage it
Watch Ahead and Cruise Smoothly	Keep your car flowing rather than stopping and starting Look forward 100 to 200 metres or to the next intersection Ease off the accelerator and coast to avoid stopping where possible
Brake and Accelerate Gently	Accelerate smoothly from a stop and brake gently to conserve fuel Aggressive driving increases fuel use up to 40% without saving much time
Use the right gear for the conditions	Change up through the gears early
Reduce Your Highway Cruising Speed	Maintain a steady cruising speed, use cruise control
Don't Park and Idle	Minimise idling in traffic situations and turn off in non-traffic situations Don't idle to warm up the car, drive gently instead
Maintain tyre pressure	Maintain to recommended level, use a gauge rather than a visual inspection Check pressure near the start of a trip when your tyres are cold
Remove Excess Weight	Roof racks and spoilers increase wind resistance
Maintain your vehicle	Service your car to the manufacturer's schedule Keep the engine tuned and the wheels aligned
Plan Your Trip before You Cruise	Plan your journeys and activities – avoid duplication, find the shortest route, Consider public transport, walking or cycling, travel before or after peaks
Use Air Conditioning Only When Necessary	Open windows at low speed, use the fan on highways Park undercover or use window shades Open the windows when getting into a hot car to blow out the hot air
Refueling	Fill your fuel tank only to the first click of the fuel nozzle Consider alternative fuels if they suit your car (such as an ethanol blend) Refuel during off-peak times to avoid waiting and idling Refuel at the low point in the price cycle.

Research methods

The research employed a simple experimental design to assess the effectiveness of the eco-driving training interventions. Volunteer drivers were recruited through an on-line survey which assessed participant suitability and collected data on attitudes to various transport related questions. Suitability questions assessed whether the respondent was:

- The main driver of their vehicle
- At least 18 years old
- Agreeable to using a fuel-card for all their fuel purchases
- Agreeable to undertaking some driver training
- Not intending to sell or modify their vehicle.

In addition, there was a criterion ensuring that their vehicle was privately owned, as compared to being owned by a business.

The purpose of the research was masked in the survey and in other recruitment and participation activities prior to training so that individuals were blind to the study focus. The survey and study were referred to as the “Driving Costs, Attitudes and Behaviours Study” and the questions in the survey were broad and included questions about safety, stress and fuel purchasing. The survey collected attitude data on various transportation issues, as well as demographic data, data on the participants travel patterns and their contact details.

The amount of fuel used in litres per 100 kilometres (l/100km) was measured for the volunteer drivers, the drivers were then trained in eco-driving techniques and the pre-training and post-training fuel-use was compared. A minimum period of six weeks of fuel records pre-training and 13 weeks post-training was used to assess the before and after fuel use. To account for seasonal variations, the fuel-use of the trained drivers was compared with a control group of non-trained drivers.

The training was designed following a comprehensive review of the eco-driving and behaviour change literature. The training in eco-driving was delivered using four methods, bundled into five training interventions. The four methods were:

On-line learning– Participants received a brochure on eco-driving and were invited to undertake an on-line learning module of up to one hour in duration. All non-control group participants received access to the online tool. Participants in intervention one were only trained using the on-line learning module.

Classroom – Participants in interventions two and four were invited to attend a two hour classroom session in groups of up to 15. The classroom was conducted by one or two of the EcoDrive project team.

Driving lesson – Participants in interventions three and four undertook a 50 minute lesson with an accredited and trained private driving instructor. All lessons were conducted in the driver’s own vehicle. Lessons were conducted from an agreed meet point or from the participant’s home. Driving instructors were trained in the eco-driving strategies and encouraged to assess the needs of individual drivers and ascertain which strategies were the most likely to benefit the individual. Common strategies included gear changing, coasting and showing participants how to fill their tyres with air.

Half-day workshop – Participants in intervention five attended a half-day eco-driving course, including in-car drives. This course involved a pre classroom drive on a set route in a vehicle fitted with advanced telemetry, classroom training and a post classroom drive in the same vehicle and on the same route as the pre-training drive. The telemetry was used to track GPS location and measure fuel-use (instantaneous, average and overall), duration of journey, average speed, maximum speed and vehicle movement (i.e. acceleration, steering, braking). It also provided a comprehensive report for comparison of driving technique and fuel consumption for each participant in their pre and post classroom drives.

The study used three methods for collecting fuel-use data. The largest group used the fuel card provided by RACQ. The second group of fuel card users formed the control group and were Queensland PAYE drivers who salary packaged their vehicle costs (i.e. privately funded their ongoing fuel and maintenance costs), through a large salary sacrifice provider. These drivers were not aware that they were in the study. The third group of drivers were actively recruited by RACQ and manually recorded their fuel-use. These participants recorded their fuel purchases and odometer readings on paper forms and posted them to RACQ.

Sample

Participants were selected to match the profile of the Queensland licence-holding population in several locations or study areas. The study areas were metropolitan Brisbane; Moreton and Logan; and Townsville and Toowoomba. The study areas were chosen to represent the drivers from the inner and outer metropolitan areas in South East Queensland, and drivers from Queensland's regional cities.

Recruitment occurred primarily through the RACQ membership, though this was not a requirement for participation. The younger cohort was additionally recruited through educational institutions in the study areas where there were initial difficulties in gaining enough participants.

While the study commenced with 1,547 participants, only 1,426 completed the study requirements. A number of these were not included in the final analysis, generally because there were inadequate fuel use records. For example, we required at least three fills prior to training and again after training and in some cases either the drivers did not use their vehicle enough or they did not provide enough accurate pre and post training information.

This is notable as it was a key issue raised in the paper presented last year by Symmons, Rose, Rorke and Watkins. Their experience in the fleet trial was that data was often inadequate because of a lack of driver compliance in reporting accurate odometer readings to the fuel station attendant. This is despite fleet managers' belief that their fleet records were correct.

The percentage of useful records in the fuel card group, at 98.6%, was high. The percentage of useful records in the manual monitoring group was lower, possibly reflecting a lower level of commitment to the study in this group.

The percentage of useful records in the fuel card control group was lower due to data quality issues. Many participants in this group appeared to fabricate their odometer readings, or provide a very rough estimate of the odometer reading. This group had an elevated number of low-mileage drivers, with the number of fills in the pre and post training periods often less than three.

At the end of the study, there were 1,056 participants who had completed all the training requirements of the study and provided enough fuel-use and distance travelled data to calculate sufficiently accurate fuel-use data. Table 2 provides a demographic profile of the Queensland licence-holding population and the final research sample differentiated by fuel-use monitoring methods.

Table 2: Demographic profile of Queensland licence-holding population and the final research sample differentiated by fuel-use monitoring methods

	QLD Licence-Holding Population	Fuel Card Holders	Manual Monitors	Queensland PAYE Control Group	Participant Total
Male	51.9%	52.5% (417)	54.2% (32)	56.2% (114)	53.3% (563)
Young (18-26)	7.0%	5.7% (45)	1.7% (1)	7.9% (16)	5.9% (62)
Mid (27-59)	32.8%	28.6% (227)	33.9% (20)	34.0% (69)	29.9% (316)
Older (60+)	12.1%	18.3% (145)	18.6% (11)	14.3% (29)	17.5% (185)
Female	48.0%	47.5% (377)	45.8% (27)	43.8% (89)	46.7% (493)
Young (18-26)	6.5%	8.2% (65)	5.1% (3)	6.4% (13)	7.7% (81)
Mid (27-59)	31.5%	33.0% (262)	33.9% (20)	29.6% (60)	32.4% (342)
Older (60+)	10.0%	6.3% (50)	6.8% (4)	7.9% (16)	6.6% (70)
Total	100.0%	100.0% (794)	100.0% (59)	100.0% (203)	100.0% (1,056)

The licence-holding population does not necessarily reflect the population of active drivers in Queensland, as persons may hold a licence but rarely drive. This became evident in the sampling task as some cohorts were under represented in the recruited sample. For example, there is an under representation of older females as this group tends to drive less, even if they retain their driver licence.

The general inclination to participate in research projects affected the age and gender profile of the sample. This was evident in an under representation of young males. This cohort is difficult to recruit and retain in research projects.

Table 3 provides the participant numbers by location.

Table 3: Participant Numbers by Location

	Brisbane	Townsville & Toowoomba	Moreton and Logan	Total
Male	53.3% (353)	51.1% (70)	54.5% (140)	53.3% (563)
Young (18-26)	5.7% (38)	5.8% (8)	6.2% (16)	5.9% (62)
Mid (27-59)	31.4% (208)	28.5% (39)	26.8% (69)	29.9% (316)
Older (60+)	16.2% (107)	16.8% (23)	21.4% (55)	17.5% (185)
Female	46.7% (309)	48.9% (67)	45.5% (117)	46.7% (493)
Young (18-26)	8.0% (53)	5.8% (8)	7.8% (20)	7.7% (81)
Mid (27-59)	32.6% (216)	33.6% (46)	31.1% (80)	32.4% (342)
Older (60+)	6% (40)	9.5% (13)	6.6% (17)	6.6% (70)
Total	100.0% (662)	100.0% (137)	100.0% (257)	100.0% (1,056)

The number of participants in Townsville and Toowoomba is lower than the other areas to match the population demographics of those areas. However, the smaller samples were still sufficient for the analysis.

Table 4 provides the participant numbers by training intervention.

Table 4: Participant Numbers by Training Intervention

	Intervention 1: On-line Learning	Intervention 2: Classroom	Intervention 3: Driving Lesson	Intervention 4: Classroom and Driving Lesson	Intervention 5: Half-day Workshop	Control	Total
Male	51.1% (94)	51.3% (101)	55.9% (114)	53.7% (108)	47.8% (32)	56.2% (114)	53.3% (563)
Young (18-26)	3.8% (7)	5.6% (11)	5.4% (11)	6.0% (12)	7.5% (5)	7.9% (16)	5.9% (62)
Mid (27-59)	29.3% (54)	29.4% (58)	29.4% (60)	27.9% (56)	28.4% (19)	34% (69)	29.9% (316)
Older (60+)	17.9% (33)	16.2% (32)	21.1% (43)	19.9% (40)	11.9% (8)	14.3% (29)	17.5% (185)
Female	48.9% (90)	48.7% (96)	44.1% (90)	46.3% (93)	52.2% (35)	43.8% (89)	46.7% (493)
Young (18-26)	8.7% (16)	9.1% (18)	6.9% (14)	6.5% (13)	10.4% (7)	6.4% (13)	7.7% (81)
Mid (27-59)	35.3% (65)	33% (65)	30.4% (62)	33.3% (67)	34.3% (23)	29.6% (60)	32.4% (342)
Older (60+)	4.9% (9)	6.6% (13)	6.9% (14)	6.5% (13)	7.5% (5)	7.9% (16)	6.6% (70)
Total	100.0% (184)	100.0% (197)	100.0% (204)	100.0% (201)	100.0% (67)	100.0% (203)	100.0% (1,056)

Intervention 5 had a smaller sample size as this was the most expensive training. All of the Half-day Workshops were conducted at RACQ's Brisbane headquarters.

In terms of the vehicles driven in the study, four main characteristics considered were transmission type, engine size, fuel type and age of vehicle. All vehicles' fuel consumption was matched with their Green Vehicle Guide rating to provide a standardised benchmark of consumption. While there were only minor differences amongst vehicle profiles across the study, males were more likely than females to:

- Drive large engine vehicles, both in terms of displacement and number of cylinders
- Drive cars with a higher GVG fuel-use rating
- Drive vehicles with automatic transmission
- Drive diesel powered cars and
- Consume more fuel per distance travelled.

Most of the difference can be attributed to the number of older males driving large diesel vehicles.

The sample participants provided a good demographic match with the population of Queensland car drivers and were distributed in a balanced manner across locations and interventions.

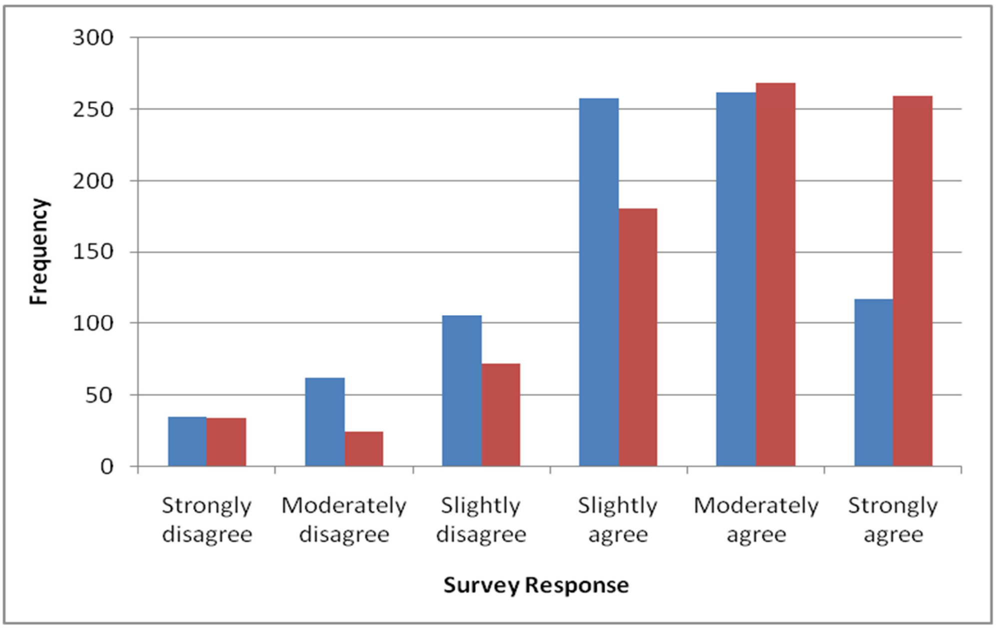
Findings

1. Attitude Change

All of the participants in the recruitment and exit surveys were asked a series of attitude questions. The majority of these questions were designed to mask the main focus of the study. One question was used to assess whether participants believed they could affect change in their CO_2 emissions and fuel-use by changing their driving behaviour.

Participants were asked the degree to which they agreed with the statement: *I can reduce my vehicle's emissions if I change my driving style.* Figure 1 shows the distribution of responses. The frequency of responses from the recruitment survey is indicated by the blue bars and the exit survey by the red bars.

Figure 1: Distribution of responses to the statement "I can reduce my vehicle's emissions if I change my driving style."



As can be observed in Figure 1, there was a substantial increase in the number of participants that strongly agree. In addition, the overall number of "agree" responses increased from 75.8% in the recruitment survey to 84.5% in the exit survey.

The frequency of the strongly disagree responses remained stable at 4%. This suggests that there is a small group of participants that firmly do not believe they could reduce their fuel-use.

The trend of increased participant belief in their ability to reduce vehicle emissions is common across all cohorts, with the exception of age group, with the younger age group providing an unclear result. The change in participants' attitudes was common across all the interventions.

2. Change in fuel use

Two measures are used for assessing the change in fuel-use pre and post training. The first is the absolute reduction in fuel-use. This is measured in litres per 100 km, and is the fuel-use in the pre-training period less the fuel-use in the post-training period. The change in fuel-use for each group is measured as the average value of the change in fuel-use for each participant. The second measure used is the percentage change in fuel-use.

Table 5 presents the mean absolute change in fuel-use of the participants differentiated by active versus control groups.

Table 5: Absolute reduction in fuel-use differentiated by active versus control

	Fuel-Use Reduction (L/100km)	Number	Standard Deviation
Control	-0.124	203	0.984
Active	0.386	853	1.311
Total	0.288	1,056	1.271

The ANOVA results show that the differences in change in fuel-use between the active and control group are statistically significant, $F(1, 1{,}054) = 25.045$, $p < 0.001$.

Table 6 presents the mean fuel-use reduction differentiated by intervention.

Table 6: Absolute reduction in fuel-use differentiated by intervention

	Fuel-Use Reduction (L/100km)	Number	Standard Deviation
Control	-0.124	203	0.984
Intervention 1	0.341	184	1.191
Intervention 2	0.340	197	1.240
Intervention 3	0.419	204	1.439
Intervention 4	0.285	201	1.288
Intervention 5	0.673	67	1.473
Total	0.288	1,056	1.271

The ANOVA results show that the differences in change in fuel-use between the interventions are statistically significant $F(5, 1{,}050) = 6.455$, $p < 0.001$. The post hoc test showed a significant difference between the control group and all the interventions, but no statistically significant differences between the individual interventions.

These analyses show that each intervention provides a reduction in fuel-use not seen in the control. This reduction in fuel-use is a result of the training interventions. Without the training, the data suggests that fuel-use would have increased, as it did in the control group. Because the difference between the active group and control group is statistically significant, it suggests that the increase in fuel-use in the control group was caused by environmental factors, not random changes in the group.

Table 7:Average absolute and percentage reduction in fuel-use compared with control group

	Percentage Reduction in Fuel-use (%)	Absolute reduction in Fuel-use (litres per 100km)
Intervention 1: On-line learning	4.52	0.47
Intervention 2: Classroom	4.73	0.46
Intervention 3: Driving lesson	4.33	0.54
Intervention 4: Classroom and Driving Lesson	4.02	0.41
Intervention 5: Half-day Workshop	7.40	0.80
All Interventions – the combined effect*	4.63	0.51

* Note: the combined effect is the average change of all the participants who completed training, not the average effect of the totals for each intervention type.

As can be seen in table 7, substantial reductions were achieved across the whole sample trained in eco-driving. The degree of fuel-use reduction appears to be similar for the first four training interventions, but there was a greater fuel-use reduction for intervention 5 – the most intensive training intervention. However, the post hoc tests revealed no significant differences between the interventions. It is possible that the sample size was too small to ascertain whether the difference in fuel-use was significant.

In terms of the distribution of fuel-use reduction, the participants in the top 15.9% (the mean fuel-use reduction plus one standard deviation) achieved a fuel-use reduction of more than 15.1% (or 1.7 L/100km).

3. Change in Carbon Dioxide Emissions

The reduction in emissions is an important public policy goal nationally and internationally. Eco-driving is one of the few short-term mechanisms available to reduce emissions in the transport sector. Table 8 provides the annual CO_2 reductions by intervention based upon the Queensland average 14,400 km travel per year (ABS, 2011a).

Table 8: Annual CO_2 reductions per participant.

	Average annual reduction in CO_2 per driver (kg)
Intervention 1: On-line learning	155.6
Intervention 2: Classroom	152.4
Intervention 3: Driving lesson	178.8
Intervention 4: Classroom and Driving Lesson	135.8
Intervention 5: Half-day Workshop	265.0
All Interventions – the combined effect*	169.0

As can be seen in table 8, substantial CO_2 reductions can be achieved across the whole sample after training in eco-driving. On average, individuals would reduce their CO_2 emissions by 169 kg per year. Some individuals could achieve substantially higher reductions.

In 2011 there were 3,100,000 passenger and light commercial vehicles registered in Queensland (ABS 2011b). Widespread eco-drive training could reduce Queensland's annual emissions of CO_2 by over 523,000 tonnes. Queensland's total transport related CO_2 emissions in 2009 were 20 million tonnes (Queensland Government, 2011). Widespread application of eco-drive training could reduce this total by 2.6%.

4. Cost effectiveness analysis

The study undertook a cost effectiveness analysis on the basis of a commercial service delivery model with participants receiving email reminders throughout a three year program. The costs incorporate delivery but not any marketing of the program. The calculations assume the reduction in fuel use is maintained over the three years. The comparison is calculated as a benefit-cost ratio, with the annual benefit in fuel savings divided by the delivery cost.

Benefits from a successful eco-driving program accrue to the individual and to the environment. Benefits are measured in savings to the consumer on the basis of litres of fuel saved per year at the average 2011 fuel price for Brisbane. Table 9 displays the benefit-cost ratios differentiated by training intervention.

Table 9: Summary of individual benefit-cost ratios for all participants split by training intervention

		Number	Benefit-cost Ratio	Standard Deviation
Benefit-cost Ratio – Year 1	**Intervention 1: On-line learning**	194	3.380	12.137
	Intervention 2: Classroom	207	0.993	3.166
	Intervention 3: Driving lesson	212	1.122	3.937
	Intervention 4: Classroom and Driving Lesson	208	0.397	1.825
	Intervention 5: Half-day Workshop	76	0.590	1.391
	Total	897	1.367	6.309
Benefit-cost Ratio – Years 1 to 3	**Intervention 1: On-line learning**	194	5.0694	18.206
	Intervention 2: Classroom	207	1.9859	6.332
	Intervention 3: Driving lesson	212	2.4041	8.436
	Intervention 4: Classroom and Driving Lesson	208	0.9324	4.290
	Intervention 5: Half-day Workshop	76	1.4859	3.505
	Total	897	2.4650	10.237

Intervention 1 is the most cost effective, with a benefit-cost ratio of over three for the first year and over five for the full program. Over three or more years, interventions 2, 3 and 5 are also worthy of consideration. With a longer time period over which to spread the relatively higher cost of these interventions, the benefit-cost ratios improve.

Policy Implications and Conclusions

The research demonstrates that motorists will change their behaviour when provided with eco-driving training. This study addresses the limitations in the body of knowledge, in providing a randomised, controlled study in eco-driving behaviour change.

A 4.6% reduction in fuel use and emissions is achievable in the whole passenger vehicle fleet. This is a meaningful saving for an individual driver in terms of emissions and fuel costs. Savings would be higher in households where there are a number of vehicles and trained drivers, or where distances travelled are greater than average.

The reduction in fuel use is a conservative estimate of the savings. The study was a blind experiment and hence the participating cohort included people who were interested in fuel efficiency and those who were not at all interested. There is potential for greater savings with drivers who self select for eco-driving training because they want to experience the benefits of the training. It is notable that the participants in the top 15.9% (the mean fuel use plus one standard deviation) achieved a reduction of at least 15.1% or 1.7L/100km. The measurement also takes no account of transport mode shift and the resulting reduction in vehicle kilometres travelled as a result of training.

A 4.6% or 0.5 L/100km fuel-use reduction can be achieved through the use of the on-line learning tool. If sustained, this would account for an average yearly fuel saving of about $100 for each individual, with greater savings achievable for drivers of larger vehicles and travelling longer distances. In CO_2 reduction terms, this equates to a saving of 156 kg per vehicle per year. For the 15.9% of drivers with the highest fuel-use reduction, it is possible to save $355 and 523 kg CO_2 per year.

The on-line tool is the cheapest and easiest option to implement on a mass scale. This training has the highest benefit-cost ratio at five over three years. It could also be incorporated into learner driver training.

Similar savings are achieved by attending the classroom or driving lessons. While this delivery mode is more expensive, it is useful for the section of the community who is unable or unwilling to access the online learning.

A 7.4% or 0.8 L/100km fuel-use reduction can be achieved through completion of the half-day workshop. This would account for an average fuel saving of $167 and 265 kg of CO_2 per driver per year. This option is most appropriate for high mileage drivers as the benefits are more substantial to weigh against the higher training cost. This option is also relevant for fleet drivers as the business costs can be reduced through taxation accounting.

The reduction in fuel consumed also has benefits to society in terms of our reliance on liquid fuels. An overall 4.6% reduction in fuel consumption for passenger vehicles would improve Australia's energy security, as it would reduce our dependence on fuel imports and our exposure to supply disruptions. In addition, a mass campaign in fuel efficient driving would provide drivers with access to the knowledge to reduce their fuel consumption immediately if a supply disruption were to occur.

References

Australian Bureau of Statistics (ABS), (2011a), *Survey of Motor Vehicle Use*, ABS, Canberra. http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/9208.0Main+Features112%20months%20ended%2031%20October%202010?OpenDocument, retrieved on 20 July 2012

Symmons, M., Rose, G., Rorke, J. and Watkins, C., (2011), *EcoDriving: Insight from a Real World Field Based Trial.* Paper presented at the Australasian Transport Research Forum, Adelaide.

Australian Bureau of Statistics (ABS), (2011b), *Motor Vehicle Census*, ABS, Canberra. http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/9309.031%20Jan%202011?OpenDocument, retrieved on 20 July 2012

Queensland Government, (2011),*Queensland's Emissions Profile: National Greenhouse Gas Inventory.*: http://www.ehp.qld.gov.au/climatechange/pdf/qld-emmission-profile.pdf retrieved on 20 July 2012