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Sustainability of voluntary travel behaviour change initiatives: A 5-year study.

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TITLE: **Sustainability of voluntary travel behaviour change initiatives: A 5-year study.**

ABSTRACT:

During the early part of the first decade of the 2000s, a number of localities in Australia introduced Voluntary Travel Behaviour Change (VTBC) initiatives, otherwise known as TravelSmart. These initiatives were all monitored in the short-term and suggested that there were reductions in person kilometres of travel (PKT) on the order of 6 to 18 percent. Beginning in 2007, the Institute of Transport and Logistics Studies (ITLS) was asked to undertake a 5-year study to determine if the effects of TravelSmart were sustained in the longer term. This paper describes the study methodology, which was a rotating panel drawn from the Australian Capital Territory, Queensland, South Australia, and Victoria, with panel members asked to carry a GPS device with them wherever they went for a period of 15 days in September-November each year from 2007 to 2012: six waves of panel data. All members of sampled households over the age of 14 were provided with a GPS device to carry with them. The paper reports on panel attrition and the make up for attrition. The panel covered 120 households per year, with approximately 40 households that had not participated in TravelSmart (the control group) and 80 households that had participated, with make up for attrition maintaining this split. Details of the sampling procedures are provided in the paper. The sample provided data on about 3,600 person days of travel in each wave or a total of about 20,000 person days of travel over the six waves. The paper reports on the year-by-year averages of PKT for each of the two groups and for each state and overall. It was found that, while there was some variation from year to year, in general, the treatment group continued to show lower PKT than the control group, suggesting that the changes were sustained over the study period. This is the first time that a longer-term monitoring of the effects of a VTBC has been undertaken, and is also the first one to use GPS measurements of travel to do this.

KEY WORDS: ***TravelSmart, long-term evaluation, GPS, panel study, sustainability.***

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1. Introduction

Over a period of approximately four years, the Australian jurisdictions of the Australian Capital Territory (ACT), Queensland, South Australia, and Victoria partnered with the Australian Government in an effort called the National Travel Behaviour Change Program (NTBCP). The main purpose of this program was to achieve reductions in greenhouse gas emissions from reductions in use of car that would contribute to Australia's goals under the Kyoto protocol. During the four-year period from 2004 to 2007, various projects were implemented in each of the four partner states, using one of two forms of voluntary travel behaviour change – social marketing and community development (Stopher and Stanley, 2013). These implementation projects aimed to provide better information to participant households about their travel options, with the goal of having households voluntarily reduce their use of car, either by ride sharing, or by using public transport, bicycling, or walking in place of the car. Potentially, there also could be reductions that would arise through an overall decrease in the amount of travel, through better trip chaining and also through substitution of nearer activity opportunities. The goal of the program was to see 186,000 households participate across these four states, and achieve reductions of about 3 billion car kilometres, producing a reduction in greenhouse gas emissions of 1 million tonnes, or the equivalent of 250,000 cars per year (Australian Government, 2008). In Australia, the program is generally referred to as TravelSmart, and this is the term that is used throughout this paper to refer to this program.

Longitudinal evaluation of VTBC is rarely done but is an important component to help assess the sustained benefits and support decision-making about continued resource investment (Bonsall, 2009). The project that is the subject of this paper was a longitudinal evaluation of the effects of these implemented projects over the five-year period from 2008 to 2012. Each implemented project in each jurisdiction was evaluated in the short term, usually comprising at least a before-and-after evaluation, but sometimes including a slightly longer period of short-term monitoring. One project, for example, in South Australia, called the Households in the West TravelSmart project was evaluated over a three-year period (Stopher et al., 2009; Stopher et al., 2013). Each of the projects undertaken under this program was evaluated by different means in the short-run. Some used self-administered surveys, some used interviewer surveys, and the South Australia project was evaluated using GPS, as was one of the ACT projects. Short-term evaluations provide useful measures of value-for-money and participant receptivity to different interventions but they alone cannot assess the 'stickiness' of VTBC programmes to reduce levels of car use (Taylor, 2007; Stopher et al., 2006).

An evaluation of options was conducted to determine how best to evaluate the long-term changes in travel behaviour (Stopher et al., 2006). Travel diaries, interviews, data from national annual motor vehicle use surveys, passive measurement by GPS devices, and odometer surveys were evaluated, as were panel surveys versus repeated cross-sectional surveys, and various monitoring frequency regimes (see Stopher et al. (2006) for further details). On the basis of this intensive evaluation it was decided to undertake the five-year evaluation by using GPS and a five-year panel. Specifically, the design was to recruit from each jurisdiction a small sample of households, comprising both households that had participated in the TravelSmart program, and households that had not participated within the same geographic area. Each recruited households was asked to take GPS devices for each member of the family over the age of 14 and for each family member to carry the device with them whenever they were out of the home for a period of 15 days. The survey was conducted at approximately the same time each year, to avoid seasonality problems. Originally, it had been decided to use a rotating panel (Kish, 1965; Zumkeller et al., 2004), with no household participating in more than four waves (there were six waves in total, with the first wave being a benchmarking wave in 2007, followed by five further waves in 2008 through 2012, to measure change in travel behaviour). However, there was a sufficient level of annual attrition in each of the state samples that only a small amount of rotation was done in the fourth year (fifth wave) in 2011. No rotation was undertaken in the

final year, because the study needed to assess change in each year. Selecting new households to participate in the final wave would not have afforded an opportunity to assess change for those households.

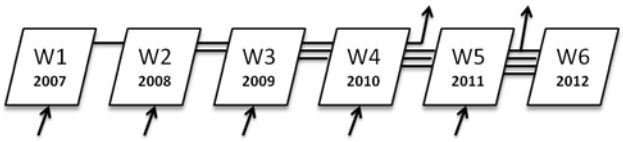

Figure 1: The pattern of rotation in this multi-wave panel

It is reasonable to ask what would have been expected from the longitudinal evaluation. There are two aspects to answering this. The first relates to just the tracking of personal kilometres of travel (PKT) by those who participated in TravelSmart. In all cases, the short-run evaluations had indicated a substantial drop in PKT at the household level as a result of households participating in TravelSmart. Following the short-term period, there are basically four possibilities:

- The daily average PKT could continue to fall, showing that participant households continued to find further ways to reduce the amount of car use after the initial intervention;
- The daily average PKT could remain more or less unchanged, showing that participant households maintained the reductions achieved in the immediate period following TravelSmart, and did not find reasons to increase PKT after that;
- The daily average PKT could increase after TravelSmart, but at no faster a rate, and possibly a slower rate than non-participant households, showing that TravelSmart households maintained the initial PKT savings, but then were subject to the same changes as all other households following the intervention;
- The daily average PKT would increase much faster after the TravelSmart intervention, with households returning to pre-TravelSmart levels of car use and changing from there similar to non-participant households, i.e., that the participant and non-participant households became non-distinguishable after a certain elapse of time.

Any of the first three outcomes would lead to a conclusion that TravelSmart had achieved sustainable change. Only the last outcome would suggest that TravelSmart was not sustained and that its effects were only temporary.

2. Sampling and sample methodology

From the evaluation of options (Stopher et al., 2006) that was undertaken prior to commencing this monitoring activity, it was recommended that GPS and a panel survey should be used. The ideal was determined to be a sample of about 200 households. However, budgetary limitations dictated that the sample size should be reduced to approximately 130 households, drawn from the three states and one territory. It was initially proposed that this sample should be drawn equally as about 30 households from each state or territory. However, for a variety of reasons, Victoria asked to have their sample size reduced to around 15 households. The final decision was to draw 30 households from the ACT, 40 from Queensland, 40 from South Australia, and 20 from Victoria. For various reasons, (e.g., households that were found to have not complied with the survey task, households that dropped out after the end of recruitment, etc.) the actual samples differed somewhat from this and the samples by wave are shown in Table 1.

As is also shown in Table 1, the sample comprised both participating (TS) and non-participating (Non-TS) households, with the sample size for the former always being larger than the latter.

For the ACT, South Australia and Victoria, the states provided a list of households that had been approached for the TravelSmart intervention, together with information as to whether or not each household had voluntarily engaged in TravelSmart. From these lists of households, a random drawing was made of participating and non-participating households, and these were used as the samples for recruitment in each case. For Queensland, however, no list was provided. In this case, the suburbs in which the projects had been undertaken were provided and a random telephone survey was first conducted, asking households about their awareness of a number of programs of state and local governments, one of which was TravelSmart. If a household indicated recognition of any program, they were then asked if they had participated in that program. From this, households could be identified as either participant or non-participant households from the Queensland jurisdictions.

Table 1: Sample sizes in households by jurisdiction for the six waves

Wave	ACT		Queensland		South Australia		Victoria	
	TS	Non-TS	TS	Non-TS	TS	Non-TS	TS	Non-TS
1	15	10	21	17	37	13	9	4
2	20	12	28	16	28	17	12	6
3	20	12	28	15	28	18	13	6
4	20	12	28	15	28	17	14	5
5	20	12	28	14	28	17	14	5
6	16	10	22	11	21	12	10	2

In the case of South Australia, the final wave of the short-term evaluation of the Households in the West project took place at the same time in 2007 as the initiation of the NTBCP long-term monitoring project. As a result, the final wave of that evaluation was used as the benchmark wave for the long-term evaluation. A subsample of households in South Australia had been using GPS initially for a 28-day period, and then for a 15-day period. These households, together with some of the 7-day households were used as the first wave of the long-term evaluation and comprised approximately 50 households. The remainder of the panel in South Australia was using the GPS devices for only 7 days. However, when it was necessary to make up for sample attrition in subsequent waves, households in South Australia were drawn from the entire short-term evaluation panels. For the other three states, households may or may not have participated in the short-term monitoring, this information not being available for the long-term evaluation project.

Within the geographic regions in the three states and one territory, the samples were always drawn at random, whether for the initial recruitment, or for replacement of attrition. As can be seen from Table 1, in waves 2 through five, the samples were maintained at 32 households from the ACT, 42-44 households in Queensland, 45 in South Australia, and 18-19 from Victoria. Only in the final wave did the sample size decrease significantly, because no replacement for attrition was made in this final wave.

In the sampling and recruitment process, great care was taken to try to divorce this study from the TravelSmart program itself. For the ACT, South Australia and Victoria, the survey was described to participants as a new method of measuring travel behaviour that was designed to assist the states in learning more about changes over time in people's travel. No mention was made of TravelSmart. In the case of Queensland, it was necessary to mention TravelSmart, but

it was mentioned only as one of a number of state initiatives aimed at such things as reducing water use, increasing recycling, etc. and the subsequent recruitment was done identically to the other three states, with no mention of TravelSmart.

3. Attrition and replacement

All panel surveys suffer from some level of attrition (Kish, 1965). Attrition is caused by several factors. Panel members may move away and no longer be eligible to participate in the survey. Panel members may move, but become uncontactable, because their new contact details are not made available. In a household panel, the household may dissolve due to death, divorce, or other life events. Finally, some panel members may decide that they are no longer interested in or willing to continue to participate. This panel was no different in these respects, and attrition occurred each year. Table 2 documents the results of each year of the survey, showing the number of households lost from each state through attrition on each wave of the survey, as well as the number of households that were recruited, the number that completed the survey and the number that dropped out during the survey. The households recorded as dropping out all agreed to the initial recruitment. However, either upon receiving the GPS devices, they decided not to proceed and returned the devices unused, or they returned devices with no data recorded at the end of the survey period.

There were slight adjustments to sample sizes in most years. Households that had been recruited in a previous wave but which did not respond in the last wave were contacted again, so that the attrition does not always match the difference in recruited households from one wave to the next.

Attrition was always replaced by a random sampling from the available lists of households, and by further random sampling, when necessary from the Queensland suburbs under study. As shown in Table 2, where attrition is indicated by the line labelled “Lost to Attrition”, between waves 1 and 2, 19 (23 percent) of TravelSmart households were lost to attrition, and 22 (49 percent) of non-TravelSmart households were lost to attrition. Overall, this represented a loss of 32 percent of households, which is about the expected loss due to attrition from an annual panel survey. Between waves 2 and 3, the attrition was 27 (30 percent) of TravelSmart households and 9 (18 percent) of non-TravelSmart households. As expected, overall these figures show a decrease in attrition for the third wave, where the total attrition was 26 percent. However, attrition increased markedly between waves 3 and 4, perhaps indicating an increasing level of loss of interest in the panel survey. In this case, attrition amounted to 31 (34 percent) TravelSmart households and 23 (44 percent) of non-TravelSmart households (a total loss of 38 percent). This high level of attrition was encountered again between waves 4 and 5, with a loss of 28 (31 percent) of TravelSmart households and 15 (31 percent) of non-TravelSmart households, giving an overall loss of 31 percent. Finally, between waves 5 and 6, the loss of households to attrition decreased, with a loss of 18 (20 percent) of TravelSmart households and 10 (21 percent) of non-TravelSmart households, giving an overall loss of 20 percent.

Table 2: Sample disposition by wave across the four jurisdictions

Wave	Disposition	ACT		Queensland		South Australia		Victoria		Total	
		TS[1]	Non-TS[2]	TS	Non-TS	TS	Non-TS	TS	Non-TS	TS	Non-TS
1	Recruited	17	11	23	17	37	13	11	7	89	48
	Completed	15	10	21	17	37	13	9	5	83	45
	Dropped Out	2	1	2	0	0	0	2	2	6	3
2	Lost to Attrition	6	5	13	10	0	0	0	7	19	22
	Recruited	20	12	28	16	29	17	12	6	89	51
	Completed	20	12	28	16	29	17	12	6	89	51
	Dropped Out	0	0	0	0	0	0	0	0	0	0
3	Lost to Attrition	8	1	6	5	10	3	3	0	27	9
	Recruited	21	12	29	15	28	18	12	7	90	52
	Completed	21	12	29	15	28	18	12	7	90	52
	Dropped Out	0	0	0	0	0	0	0	0	0	0
4	Lost to Attrition	10	7	8	8	10	6	3	2	31	23
	Recruited	21	12	28	16	28	17	15	5	92	50
	Completed	20	12	28	15	28	17	14	5	90	49
	Dropped Out	1	0	0	1	0	0	1	0	2	1
5	Lost to Attrition	10	6	4	4	9	4	5	1	28	15
	Rotated Out	4	3	0	0	0	0	3	0	7	3
	Recruited	20	12	28	15	29	17	15	5	92	49
	Completed	20	12	28	14	28	17	14	5	90	48
	Dropped Out	0	0	0	1	1	0	1	0	2	1
6	Lost to Attrition	4	1	6	3	6	3	2	3	18	10
	Recruited	16	11	22	11	22	14	12	5	72	41
	Completed	16	10	22	11	21	12	12	5	71	38
	Dropped Out	0	1	0	0	1	2	0	0	1	3

[1] TravelSmart households

[2] Non-TravelSmart households or control

In all, over the six waves of the study, 291 households provided usable data in one or more waves. A breakdown of the households by state and by participation in TravelSmart is shown in Table 3.

Table 3: Number of households completing multiple waves by jurisdiction

Number of Waves	ACT		Queensland		South Australia		Victoria		All		Total
	TS	Non-TS	TS	Non-TS	TS	Non-TS	TS	Non-TS	TS	Non-TS	
1 Only	19	9	13	14	19	10	4	3	55	36	91
2	17	11	8	11	17	10	14	3	56	35	91
3	10	5	9	5	12	6	4	2	35	18	53
4	5	2	7	0	5	3	3	2	20	7	27
5	0	0	6	4	2	3	0	0	8	7	15
6	0	0	4	1	7	2	0	0	11	3	14
Total	51	27	47	35	62	34	25	10	185	106	291

As Table 3 shows, even with the fairly significant attrition each year, 14 households (11 TravelSmart and 3 non-TravelSmart) were measured in all six waves, and 109 households out of 291 were measured in three or more waves, climbing to 200 households that were measured in at least two waves. Although not useful for the analysis of year-by-year change, the households measured in only one wave contribute to the overall aggregate analysis. Households were rotated out in the ACT and Victoria, with the intent of ensuring that households in the sample were not asked to complete more than four waves. Hence, there are no households in those two states that were measured more than four times. It is clear that this study provides rich data for the assessment of behaviour change over a significant period of time.

4. Results

The analysis of the results at an aggregate level was done by averaging across all days of the week, weekdays only, and weekend days only at the person level, and then aggregating across all persons in each household and then averaging across all days of the week, weekdays only, and weekend days only. The most important variable of concern in the analysis was the total person kilometres of travel (PKT) by car. The expectation was that the first wave would generally show average PKT per day per person and per household to be lower for TravelSmart households than for non-TravelSmart households. It is important to note that only the South Australia sample was monitored in the same way for the short-term evaluations as for the long-term, while the other three jurisdictions used various, non-GPS methods for short-term evaluation. Therefore, only South Australia can provide a comparable pre-intervention set of figures and a short-term post-intervention set.

The results for South Australia are shown in Figures 2 and 3, which are for persons and households, respectively. Wave S1 in these two figures refers to the first short-term wave, which was undertaken prior to the TravelSmart intervention. Wave S2 is also from the short-term study and occurred one year after wave S1 when TravelSmart was partially implemented. At this time, some TravelSmart households had not yet been recruited to the intervention. Wave

S3 refers to the third wave of the short-term study and occurred one year after wave S2, by which time the TravelSmart intervention was fully implemented. Wave 1 is actually a subset of wave S3, and represents those households that were subsequently asked to continue into the long-term study. The means shown in these figures are from aggregating all persons who responded within a wave, and all households that responded within a wave. The results do not compare directly to tracking the same individuals from wave to wave, because of attrition between the waves.

At a person level, it appears that TravelSmart participants actually showed an increase in car PKT over the short-term study, although the household data show a decrease between waves S2 and S3. Non-TravelSmart participants show mixed results over the last two short-term waves. Comparing wave 1 and wave 6 for participating persons, however, there is a decrease of about 5-6 kilometres per day per person. Non-participants show a decrease of about 7 kilometres per day over all days of the week, with a more substantial drop on weekdays, but a substantial increase on weekend days. Similar findings are apparent for households, also, looking at the contrast between waves 1 and 6.

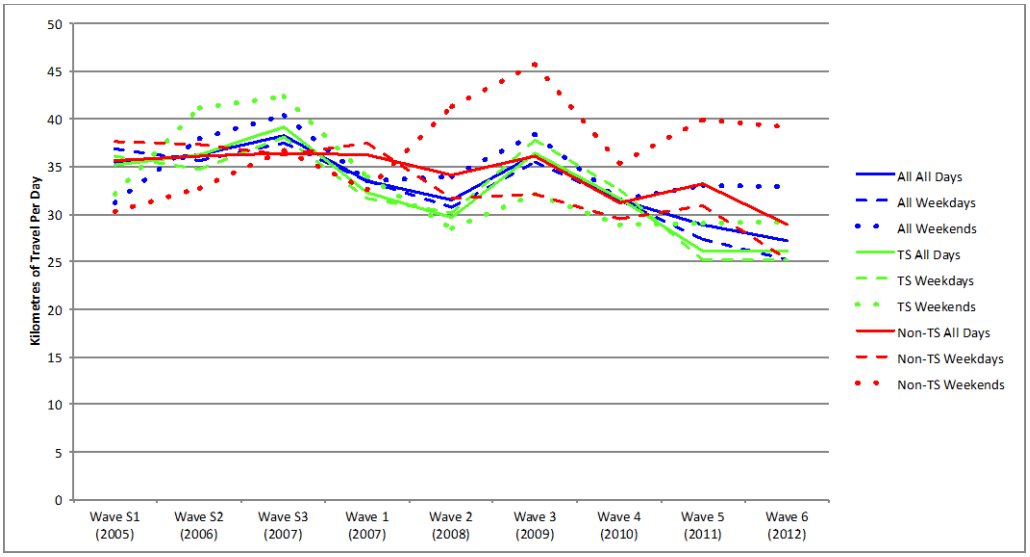

Figure 2: Mean car distance (kms) per person per day for South Australia

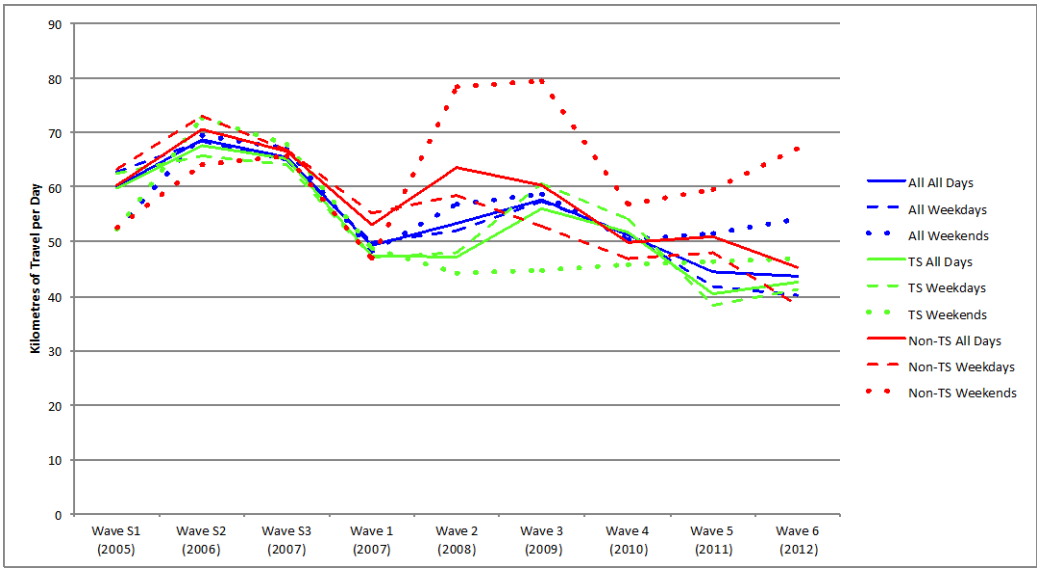

Figure 3: Mean car distance (kms) per household per day for South Australia

Similar graphs can be examined for each of the other three jurisdictions, and somewhat varied results are shown by each of these. However, for sake of brevity in this paper, we present one other set of results for Queensland in Figure 4 for persons and Figure 5 for households and then the overall aggregate plots in Figure 6 for persons and Figure 7 for households.

For Queensland, there is a clear overall decline in PKT by car for TravelSmart persons and households from wave 1 to wave 6. Non-TravelSmart households and persons show much more dramatic change over the period, although they reach about the same average daily PKT per person and per household in wave 6 as the TravelSmart households, while having started from a higher figure (persons) or a lower figure (households) in wave 1. Non-TravelSmart persons and households showed a sharp drop from 2008m to 2009 (waves 2 to 3), followed by a huge increase in 2010, with a rapid decline over 2011 and 2012. TravelSmart persons and households showed much less dramatic changes over these periods, with generally only weekend travel; increasing in 2008 to 2009, followed by decreases across most of the remaining waves.

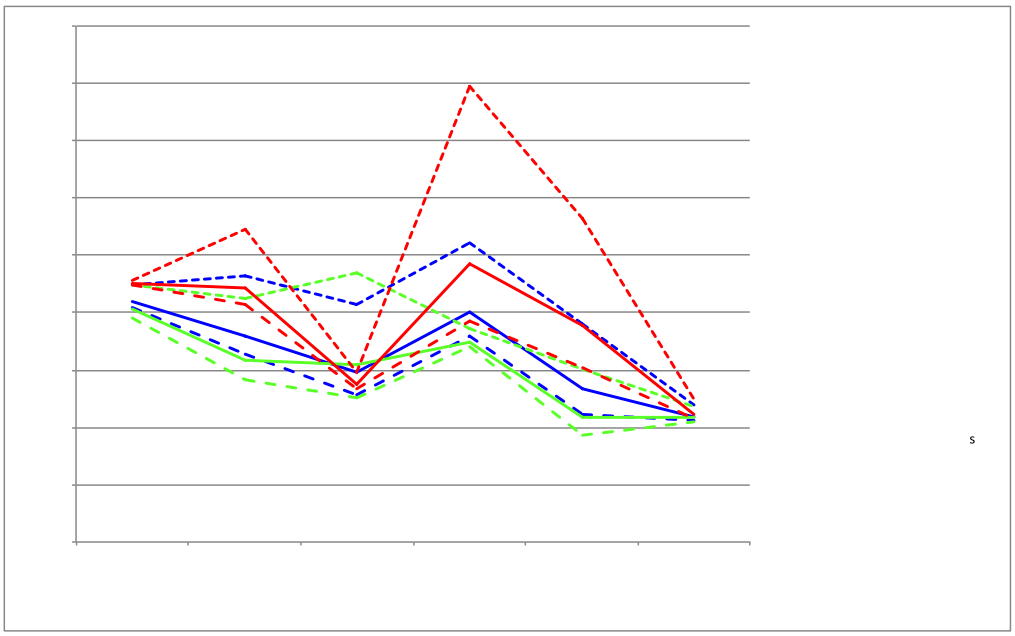

Figure 4: Mean car distance (kms) per person per day for Queensland

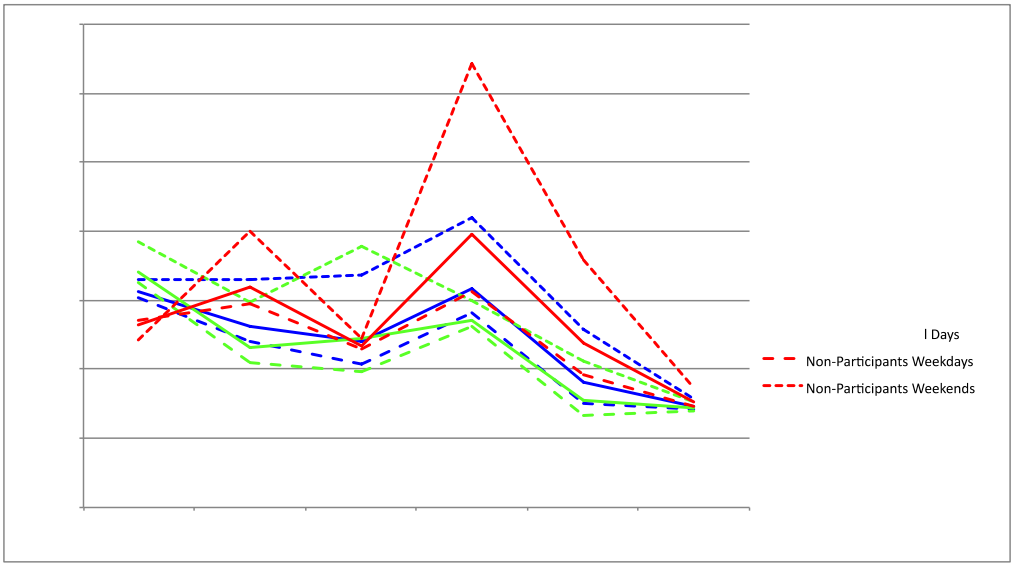

Figure 5: Mean car distance (kms) per household per day for Queensland

Both at a person and a household level, the overall figures (Figures 6 and 7) indicate that non-participants continued to increase weekend PKT through the first three to four waves, but then showed a marked decrease in the last two waves. In contrast, weekday travel stayed nearly level for the first four waves, but also declined in the last two waves. For participants, there is relatively little movement in either weekday or weekend figures for the first three waves, but there is a decline in the last two waves. Similar to the results from South Australia, the comparison between wave 1 and wave 6 shows that both participants and non-participants have declined in their use of car travel. However, non-participants show almost no net change in weekend travel, while their weekday travel declined quite markedly. Participants, on the other hand, show a decline of about 6 or 7 kilometres per day per household (about 4 to 5 kilometres per day per person) over the entire monitoring period. These results suggest that TravelSmart has had a sustained effect and that households that participated have not resumed to pre-TravelSmart levels of car use. On the other hand, whatever external factors influenced a decline in non-participant car travel had a lesser effect on participants, who had presumably already reduced travel prior to the monitoring period, and found relatively little scope for major further reductions.

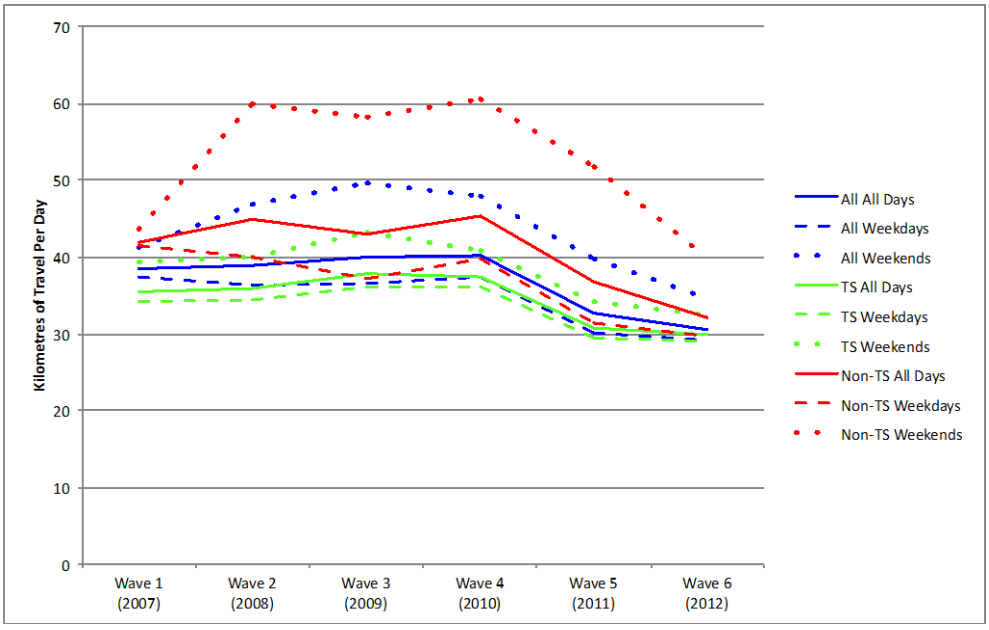

Figure 6: Average daily passenger kilometres of car travel per person all jurisdictions

However, all of the results presented here are aggregate in nature. One of the major advantages of the measurement approach taken, is that we have longitudinal measurement of multiple days of travel for a number of individuals and households that can be analysed. However, this analysis has not been completed at this time and will be the subject of a future paper.

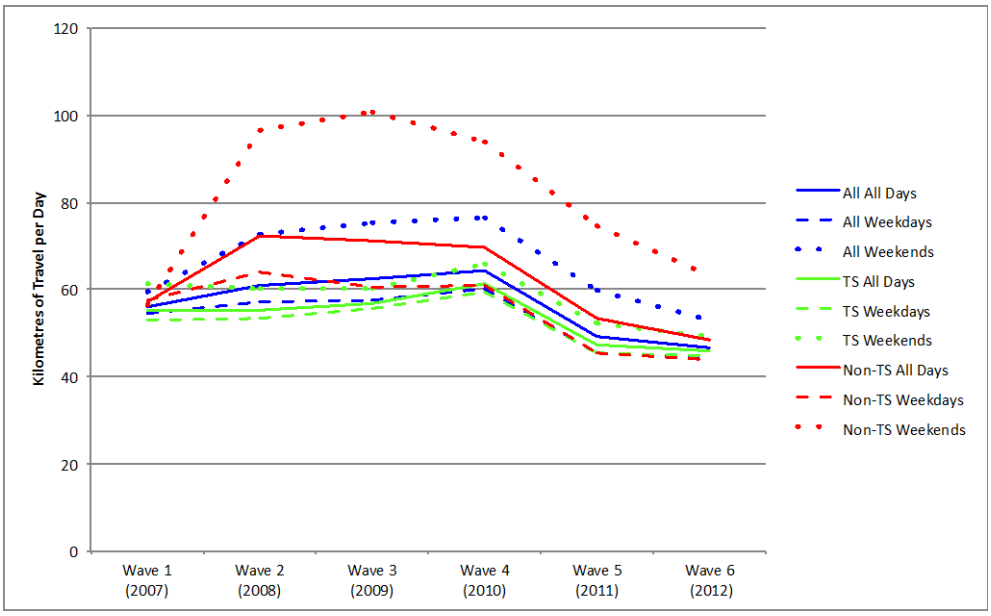

Figure 7: Average daily passenger kilometres of car travel per household all jurisdictions

5. Conclusions

The aggregate analysis of the six waves of long-term data indicate that there has been a continuing decrease in PKT over the five-year monitoring period for both TravelSmart and Non-TravelSmart households. Non-TravelSmart households performed consistently more PKT per day than their TravelSmart counterparts, and the difference between the two remained more or less the same throughout the monitoring period. This suggests that TravelSmart households succeeded in reducing PKT during the implementation of this intervention, and then maintained their lower level of driving through the long-term monitoring. There is no evidence of a return by the overall sample to levels of driving that match those prior to the TravelSmart intervention. Presumably other factors have led to a continuing decrease in PKT by car for all households in the areas surveyed in subsequent years.

In conclusion, based on work reported elsewhere about the immediate effects of TravelSmart – that it is effective in reducing personal kilometres of travel by car – this analysis also shows that the reductions in car travel appear to be maintained for more than five years after the implementation of TravelSmart. There is no evidence from this analysis to suggest that people return to pre-intervention levels of driving.

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