Household-Based Voluntary Travel Behaviour Change: Aspirations, Achievements and Assessment

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As always, any errors or omissions in this present paper are the responsibility of the author.

Summary

Voluntary travel behaviour change has been the subject of a large amount of scrutiny as it increasingly a component of urban transport strategies to achieve reduction in the degree of reliance on private car use. Pilot projects and large-scale applications in Australia, the United Kingdom, Europe and the USA have demonstrated widely differing levels of impact on car use and on the use of alternative modes (public transport, walking and cycling), but in all cases the measured impact has been a reduction in car use.

It can be difficult, in any individual study of travel behaviour, to meet the strict statistical requirements to demonstrate that the level of impact has been measured with a very high level of confidence. For pilot projects, in particular, the cost of such measurement would be very large in relation to the cost of the intervention itself. However, repeated results from pilot projects and large-scale applications in a range of places add support to the effectiveness of such initiatives even allowing for such uncertainties of measurement.

This paper outlines the experience to-date with voluntary travel behaviour change initiatives, including the measured impacts of pilot projects and large-scale applications. It concludes that, whilst there are outstanding issues of how reliably to measure the impacts of specific initiatives, the documented body of evidence is now sufficient to conclude that:

- Reductions achieved in car use are substantial;
- The reductions in car use vary in scale by a factor of about 3.5;
- A substantial part of the travel behaviour change occurs at times and places where there is existing spare capacity in non-car transport systems; and
- The socio-economic return is very high and more than sufficient to meet public sector investment criteria.

These conclusions are sufficient to support the continuing roll-out of voluntary travel behaviour change programs based on dialogue marketing principles, without the need for specific validation of every proposal.

Introduction

There have been some very significant shifts in the strategic direction of transport in recent years, which have broadened the range of questions to which transport professionals are expected to provide answers, initially articulated in *Transport: The New Realism* (Goodwin, et al, 1991).

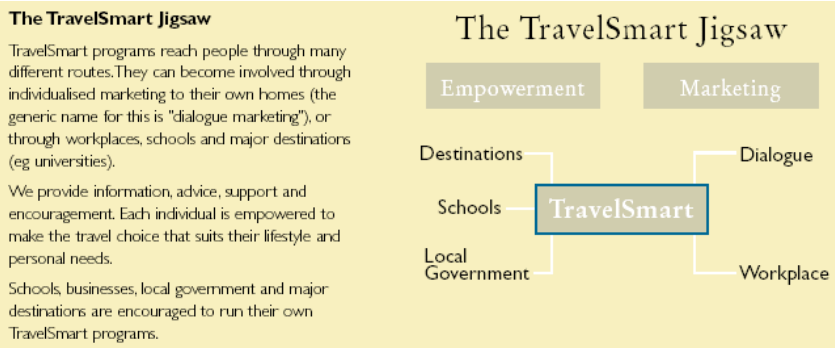
These changes have been accompanied by a growing willingness to set multi-modal aspirational targets for transport, usually in terms of reducing car use and increasing use of all alternative modes (mainly walking, cycling and public transport), and broadening the range of strategies and programs considered to include management of travel demand as well as means of responding to autonomous expressed demand for travel.

In particular, this has led to the development of strategies to achieve voluntary behaviour change, based on the observation that there are significant misperceptions and imperfect knowledge of the availability, cost and level of service provided by existing transport opportunities.

The phrase 'reorganising the mental garage' was coined in Perth, Western Australia, in response to the statement 'I'd use my bike more but I have to move the car to get at it … and once I'm in the car it is so easy just to keep driving' (Ker, 2003b). This was a direct precursor of the development of the multi-modal travel behaviour change program that has become known as *TravelSmart* (Transport WA, 1999; Ashton-Graham, 2003a and 2003b). TravelSmart programs typically include (Figure 1):

- household/community-based initiatives;
- workplace travel planning;
- major destinations; and
- schools programs.

Figure 1 ***The TravelSmart Jigsaw*** (Source: http://www.dpi.wa.gov.au/travelsmart/pdfs/6of6.pdf)



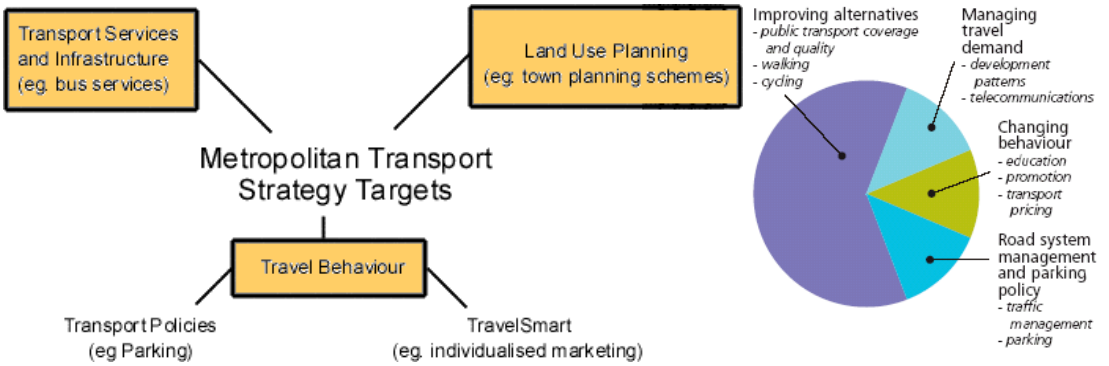
This paper documents experience with and issues arising from household-based voluntary travel behaviour change (sometimes called 'dialogue marketing') initiatives.

Part of the Solution

It is important to acknowledge that travel behaviour change is one part of a package of approaches necessary to achieve the objectives and targets set for many towns, cities and metropolitan areas (Figure 2). It should not be portrayed as a 'silver bullet', although there is some evidence that it does enhance the effectiveness of other measures as well as having a strong impact in its own right.

Figure 2 Travel Behaviour Change in Context

(Source: http://www.dpi.wa.gov.au/travelsmart/marketing.html (left) and Victoria, 2002, p41 http://www.dse.vic.gov.au/melbourne2030online/content/strategic_framework/03h_transport.html)



It is also important to recognise that other interventions to reduce car use, such as workplace travel plans, are in part targeting the same market of car journeys for which a viable alternative exists. However, there may also be synergistic effects if several measures are applied in the same place at the same time, for example a workplace travel plan and safe routes to schools might be required for a parent to be able to give up driving children to school and then driving on to work (Sloman, 2003).

What is Household-Based Travel Behaviour Change?

Voluntary behaviour change may be defined as *change that occurs when individuals make choices for personal reward without a top-down mechanism, regulation of any sort or a feeling of external compulsion … an individual decides to make a change so that he or she will improve their personal life in some way* (Ampt, 2003, p4).

Household-based initiatives attempt to influence travel behaviour for all purposes by working with individuals and households

People may change their travel behaviour for negative (eg spending too much time in traffic) or positive (eg wanting to do something more rewarding with their time) reasons, but there is often a trigger for change (eg moving house or taking up a new job). Voluntary household travel behaviour change (VHTBC) is based on providing or reinforcing triggers, without the need to wait for a major life changing event, through:

- Information – about local activities and about transport;
- Opportunity – to try alternatives; and
- Incentive – increasing awareness of the personal benefits of change.

Because such behaviour change is voluntary (and based upon new information or experiences of a positive nature), it is likely to be maintained unless there is a countervailing incentive for the change to be reversed. As long as the quality of experience in the changed behaviour is maintained, there is no reason for the individual to revert to previous behaviour.

Types of Intervention

The most frequently applied voluntary travel behaviour change intervention technique is *Individualised Marketing* (also known as *IndiMark*®). *Travel Blending*® is an alternative approach that has been applied in a number of places, usually in the context of a *Living Neighbourhoods*® program.

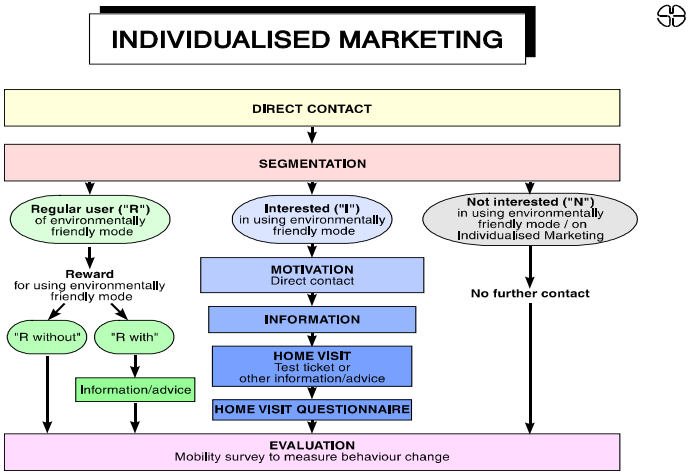
Individualised Marketing (IndiMark®)

The IndiMark® application segments households into several broad categories in order to determine the type of treatment they receive. The process establishes a dialogue with

participants, resulting in each household receiving a customised treatment that is determined by their specific needs, in particular whether they are:

- Already regular users of non-car modes of transport (the 'R' Group in Figure 3);
- Interested in using alternatives to the car and able to do so (the 'I' Group in Figure 3); or
- 'Not Interested' or not able to use alternatives because of their particular (mis)perceptions or travel needs (The 'N' Group in Figure 3).

Figure 3 Individualised Marketing Process



The range of assistance varies in level of intensity and type, including:

- "no further contact",
- delivering generic brochures that are requested,
- delivering location specific information as requested,
- providing personalised documents or verbal advice,
- passing on comments,
- providing a token reward, and
- for a small proportion, arranging personal home visits or test tickets for the public transport system.

The most comprehensive documentation of a large-scale IndiMark® application is available for South Perth, Western Australia (Socialdata, 2001).

The IndiMark® process has been documented, made accessible and open to scrutiny, including an intensive independent audit of data collection and analysis procedures for the South Perth large scale project in 2001 by Konstadinos Goulias (Immediate Past Chair of the US Transportation Research Board Committee on Travel Behaviour and Values). This audit concluded that the 'behavioural differences between the persons receiving information in IndiMark and all other segments support the claim that significant behavioural changes were motivated by participation in the program' (Goulias, 2001).

Travel Blending and Living Neighbourhoods (based on Perkins, 2001)

Travel Blending was conceived as an innovative campaign to reduce air pollution in Sydney prior to the 2000 Olympic Games by the New South Wales motoring organisation the NRMA, and was developed by Steer Davies Gleave in association with Monash University and the NRMA. It is based on the view that awareness of the adverse environmental impacts of motor vehicle use is generally not sufficient to produce a significant change in travel behaviour, and a link is required to move people from awareness of a problem towards a change in behaviour.

Philosophically, Travel Blending has been cited as an example of a new approach in the application of transport policy based on concepts of information sharing, more explicit citizen

participation and recognition of the importance of identity. Travel Blending is designed to encourage participants to:

- Think about activities and travel in advance (in what order should activities be done, who should do them, where should they be done).
- Blend their travel by *blending modes*, *blending activities* (doing as many things as possible in the same place or on the same journey), or *blending over time* (making small sustainable changes on a weekly basis).

The aim of the approach is to "*provide people with an achievable goal rather than a set of general possibilities*", meaning:

- *Some* change is possible for everyone in the short-term
- The *changes can be incorporated into people's lifestyles* without negative effects
- All people can identify the *possibilities for change over the long-term*
- Changes are *sustainable* over the long-term.

With application to geographical areas, the concept was expanded to maximise participation and build on the synergies of involving everyone in a neighbourhood. This approach has been named "Living Neighbourhood®" and parallels the TravelSmart coverage of schools and work places as well as households, but does so in a spatially integrated manner for each suburb.

Other approaches

A number of places (eg Adelaide, South Australia; Christchurch, New Zealand) are currently developing their own approaches for household-based travel behaviour change, although inevitably these draw heavily on documented experience with Individualised Marketing® and Travel Blending®. In terms of their potential effectiveness in achieving population-wide travel behaviour change, the keys lie as much in the ability to identify, contact and involve households and to retain them in the process as upon the intrinsic effectiveness of the technique itself (see ‘Outcomes’, below).

Outcomes

Richardson, et al (2003) have identified a range of statistical issues affecting the ability to measure the travel behaviour change outcomes of household-based interventions. These are discussed later in this paper. This section takes the measured travel behaviour changes as ‘best estimates’ for the purpose of illustrating and understanding the outcomes.

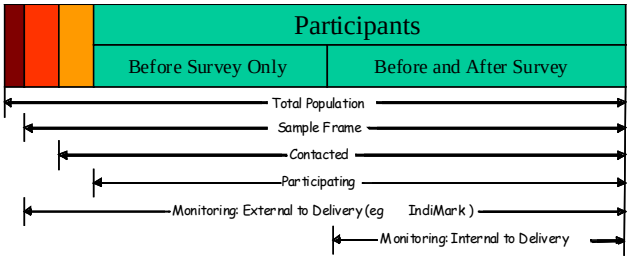
Estimating Population Outcomes

In strategic terms, the impact of travel behaviour interventions will depend upon the effectiveness in contacting the target population. The higher the proportion of ‘participants’, the less the dilution of the direct impacts when measured across the population as a whole (Figure 4).

IndiMark® assesses car-reduction impacts across the whole sample frame population, whether or not they are active participants in the intervention.

Some techniques, such as Travel Blending®, measure travel behaviour change only for those who participate throughout the process and complete both a ‘before’ and ‘after’ travel survey as an integral part of the intervention. The group completing both travel surveys is often a very small proportion of the target population.

Figure 4 Structure of Participation and Monitoring



In those cases where measurement is internal to the intervention, it is necessary to make further assumptions about the extent to which those who complete both surveys are representative of the total participating group. Perkins (2001, p30) assumed that 'the change measured from the 2 diary sample is representative of the change amongst all of the households which completed diary 1', but it might be more realistic to assume that those who benefited most (ie had the greatest change in travel behaviour) would be more willing to complete a second travel diary. In the latter case, some lower level (but still positive) of travel behaviour change should be attributed to the 'diary 1 only' group.

In the case of pilot projects, where outcome measurement can only be among the participating group, the population correction will need to be based on the extent of non-contact and non-participation as well as the difference between the population and the sample frame.

Monitoring IndiMark®

The evaluation of IndiMark® has been developed and applied separately from the actual IndiMark® intervention. The two independent evaluation tools used for the large-scale applications in Perth are:

- Before and after mail-out/mail-back travel surveys supported by control group surveys of another population.
- Analysis of public transport electronic ticketing information on services operating in the area subject to the intervention.

The emphasis in travel surveys is to generate the highest response rates, to isolate external effects and to be representative of the target population. The travel surveys undertaken for the first large-scale application in South Perth were also subject to independent audits.

Nevertheless, it is important to recognise that not all the target population could be contacted, although contact rates were very high (see Table 1). In a practical sense, therefore, the achievable impact will be lower than that measured across the contacted population or the participating population.

For large-scale projects, impact is measured by random sample of the total sample frame population and the population correction will be smaller, since:

- some households would have been initially non-contactable for temporary reasons (eg away on holiday); and
- contacted households who did not participate in IndiMark® might, nevertheless, respond to the monitoring survey.

There is, therefore, a legitimate range of uncertainty in estimating the population-wide impact of large-scale IndiMark® applications:

- the lower bound will be the measured change factored by the proportion of the population that participated (ie assuming all non-participants in IndiMark® also did not participate in the monitoring survey); and
- the upper bound will be the measured change factored only by the difference between the total population and the sample frame (ie assuming all non-participants in IndiMark® did participate in the monitoring survey).

In practice, the outcome will lie somewhere between these two bounds.

It should be noted that for the purposes of the discussion above 'participants' have been defined as households successfully contacted (generally around 90% of the population in a large-scale project area). The surveys have been weighted to be representative of 'active participants' (being households who agree to look at the information available) and 'passive participants' (who are contacted but decline to take any further part in the program). Hence the survey methodology for IndiMark is much closer to a target area population response than for the 'active participant' measure used for most TravelBlending applications to date.

Reducing Car Use

The primary objective of multi-modal IndiMark® interventions is to reduce the extent (mode-share) of car use. Table 1 sets out the measured outcomes of the principal multi-modal interventions and, where appropriate, makes adjustments for potential non-representativeness of the sample populations.

Table 1 Summary Outcomes of IndiMark® Voluntary Household-Based Travel Behaviour Change Applications (Source: Socialdata)

IndiMark® Project	Location	Scale	Relative reduction in car driver trips	Total Population [(d)]	Target or Sample Frame Population	Non-contact	Non-participation	Range: Target Population Impact [(c)]
South Perth (2000)	Australia	Large-scale	14%	16,153[(a)] households	15,267 households	6.3% (967 households	6.0% (918 households	12.3% - 14%
Goteburg	Sweden	Large-scale	13%	n/a	10,042 households; 17,071 persons	Non-response of 9.7% (976 households)		11.7% - 13%
Viernheim	Germany	Large-scale	12%	n/a	3,800 households 9,120 persons	5.8% (222 households)	7.8% (297 households)	10.4% - 12%
Subiaco (2002)	Australia	Large-scale	12%	n/a	7105 households	10.9% (772 households)	4.7% (332 households)	10.1% - 12%
Brisbane	Australia	Pilot	10%	n/a	400 households; 1,109 persons	6.5% (26 households)	4.2% (17 households)	8.9% – 10%
South Perth (1997)	Australia	Pilot	10%	n/a	383 households; 865 persons	6% (23 households	Included in 'non-contact'	9.4% - 10%
Gloucester	UK	Pilot	9%	n/a	515 persons	3.6% (19 persons)	9.9% (51 persons)	7.8% - 9%
Viernheim	Germany	Pilot	8%	n/a	200 households; 480 persons	Non-response of 10.5%		7.2% - 8%
Portland	USA	Pilot	8%	n/a	600 households; 1200 persons	Information not available	Information not available	n/a
Cambridge (2002)	Australia	Large-scale	7%	8,571[(b)] households	9,402 households	9% (850 households)	9.1% (857 households)	5.7% - 7%
Frome	UK	Pilot	6%	n/a	553 persons	2.3% (13 persons)	6.7% (37 persons)	5.5% - 6%
Marangaroo (2002)	Australia	Large-scale	4%	n/a	3975 households	12.9% (514 households)	3.9% (155 households)	3.3% - 4%

[(a)] Based on Australian Census, 2001. In practice, this will slightly overstate the number of households at the time of the intervention early 2000.

[(b)] Based on Australian Census, 2001. In practice, this will slightly understate the number of households at the time of the intervention in late 2001. The apparently higher number of households in the sample frame than in the 2001 Census is, however, not explainable solely by this.

[(c)] Excluding sample frame/population correction and any community/ market transformation effects flowing from participants passing on information to non-participants.

(d) The total population cannot always be estimated because of the way in which initiatives are defined, especially in terms of a 'fixed budget' of households over a defined geographical area rather than application to the total population.

Where estimated, the percentage reduction in car-kilometres of travel has been greater than that in car trips, indicating that the behaviour change occurs for longer as well as short trips.

It is important that such results are used appropriately, especially with respect to transferability and the impact on congestion, which should be measured across the whole population or, alternatively, in specific vehicle-km terms by time of day. For many of the projects reported in Table 1 the vehicle kilometre changes have been measured by geocode of trips (to reported origin-destinations). In general a combination of mode shift and destination shift (of car trips) result in larger (proportionate) reductions in car km than in car trips.

Transferability

It is clearly the case that voluntary travel behaviour change is only feasible where there is sufficient existing capacity in alternatives to the car to accommodate the change without substantial worsening of conditions for existing users or where additional capacity can be provided. In the latter case, the capital and operating costs of providing that additional capacity should be an integral part of the evaluation of actual or potential interventions. At the same time, capacity increases may also provide a benefit to existing users that should also be included.

This is potentially problematic for cities such as Sydney and London where public transport systems are operating close to capacity for a substantial part of the day, although we note that the same problem will exist for any initiative to reduce car use and increase public transport use.

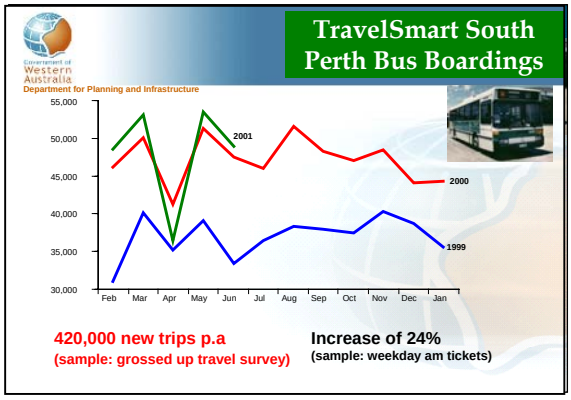
Congestion

The impacts of voluntary household-based travel behaviour change appear to be largely outside the peak period and/or are for non-work trips (Figures 7 and 8). It should not be assumed, therefore, that peak-period traffic volumes will be reduced by the same proportion that car use reduces overall. Nevertheless, because congestion is a rapidly increasing function of traffic volume in peak periods, the effective impact on *congestion* will be disproportionately larger than the impact on *traffic*.

Corroborative Data

Impacts on levels of car use have only been measured through sample surveys and are, therefore, subject to statistical error. Independent corroborative information, for Western Australian IndiMark® applications has been derived from the public transport ticketing system and this confirms the level of change in public transport use through the proportionate change in bus-boardings in the areas of application (Figure 5)

Figure 5 Bus Boardings' in IndiMark® Areas



Impacts on Activities and Travel

IndiMark® applications have consistently reported little or no change in either the average number of activities per person per day or the average number of trips per person per day. There has, however, been an apparent tendency to shorter trips (ie destination substitution), as total distance travelled is reduced, but any reduction in average trip length is unlikely to be statistically significant.

Sloman (2003) notes that other interventions such as workplace travel planning target some of the same market and, hence, the effectiveness of a dual workplace and community intervention would be less than the sum of the individual impacts. However, the major impact of household interventions, at least for public transport trips, appears to be for non-work purposes (Figure 6). Similarly, the increase in public transport usage appears to be spread throughout the day (Figure 7), which is important where the public transport system may be operating at or close to capacity in peak periods. In the South Perth case (Figure 7), it is estimated that 80% of the additional public transport trips took place outside the 'peak of the peak' and thus placed no additional demands on capacity. Indeed, the seven large-scale applications, to date, in Perth have achieved around 10% increase in patronage without exceeding the current spare capacity on peak public transport services.

Figure 6 Public Transport Trips per person per year by Purpose: South Perth (left) and Kassel (right)

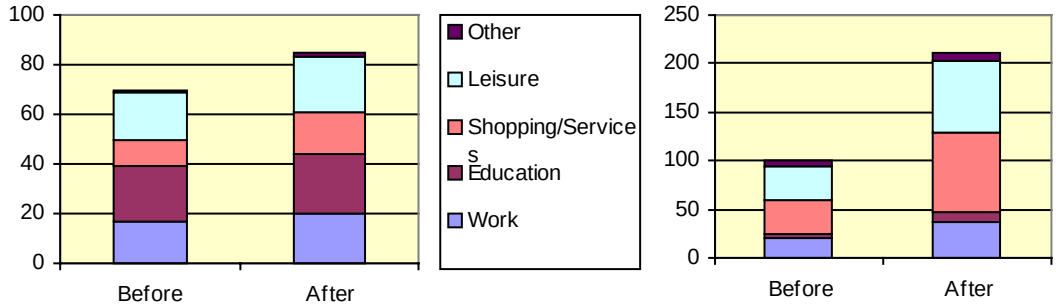
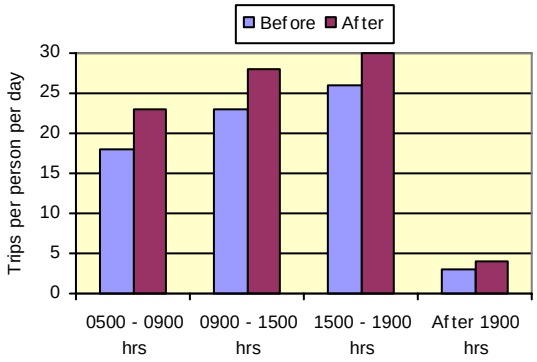


Figure 7 Public Transport Trips by Time of Day: South Perth



Multi-modal or Uni-Modal (public transport)

Individualised Marketing was initially developed as a marketing tool for public transport (Socialdata, 1998). The innovation in South Perth, which has subsequently been adopted in other places, was to develop a multi-modal application, shifting the focus from increasing public transport use to reducing car use. This was an important development, given the lower existing mode share of public transport in Australia compared to Europe, indicating the need for a wider range of choices to be competitive with the private car.

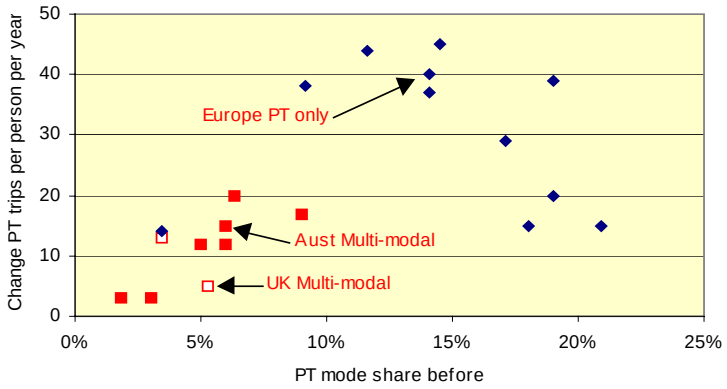
It follows, however, that the multi-modal applications have been in places with lower public transport mode shares than the single-mode (public transport) ones, so comparison is difficult.

There is no useful overlap between the ranges of existing public transport mode shares from which quantitative comparisons can be made.

Moreover, the public-transport-only applications did not report the impacts on car usage, either in terms of trips or travel, so the only basis for comparison with the multi-modal applications is through the number of public transport trips. This is, at best, a partial measure of impact and, in particular, it cannot be assumed that an apparent lower impact on public transport use is a reflection of diminished impact on travel behaviour with multi-modal application.

Figure 8 shows the public transport impacts (in terms of additional public transport trips per person per year) for uni-modal (public transport) applications that also reported a control group and for which the estimates of change are, hence, most robust. The data are consistent with a lower public transport impact from multi-modal applications, but could equally be an artefact of the lower public transport mode share, as indicated by the single-mode 'Europe' outlier. Comparison is further complicated by the fact that the uni-modal (public transport) interventions were in Europe. It cannot be taken as meaning that a uni-modal focus outside Europe would achieve the higher level of public transport impact achieved in European cities.

Figure 8 Single-Mode and Multi-Mode Applications: Impact on Public Transport Use



Multi-modal application is more consistent with overall strategies for reducing car use and increasing use of all non-car modes of transport. Public transport accounts for significantly less than half the mode shift (eg 12% of total trips changed from car in South Perth; 33% in Brisbane), so even if the public transport impact could be doubled by a uni-modal focus there would be a lower overall impact on car trips.[1]

Durability of Voluntary Household Travel Behaviour Change (VHTBC)

There is limited evidence on the durability of car-use reduction resulting from voluntary travel behaviour change. Indeed, it is intrinsically difficult to demonstrate the long-term effectiveness of voluntary travel behaviour change, for reasons that include:

- 'survey fatigue' (and hence reduced response rates), particularly in the case of pilot projects with small numbers of participants; and
- the increasing influence of exogenous factors in the longer term, which tends to reduce the validity of control group approaches.

Where monitoring has continued after the intervention, little loss of impact in the 2-4 years following the intervention has been identified (Figure 9), even though no additional IndiMark® or reinforcement of the behaviour change was undertaken in the intervening period. Monitoring of the sustainability of the impact to date suggests that little or no maintenance is required for five years and potentially much longer.

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[1] Since public transport trips are longer, on average, than walk or cycle trips, this conclusion does not necessarily hold to the same extent with regard to kilometres of travel and related measures (eg motor vehicle exhaust emissions).

Figure 9a Durability of VHTBC Impact: South Perth Pilot Project (Source: Socialdata, 2000)

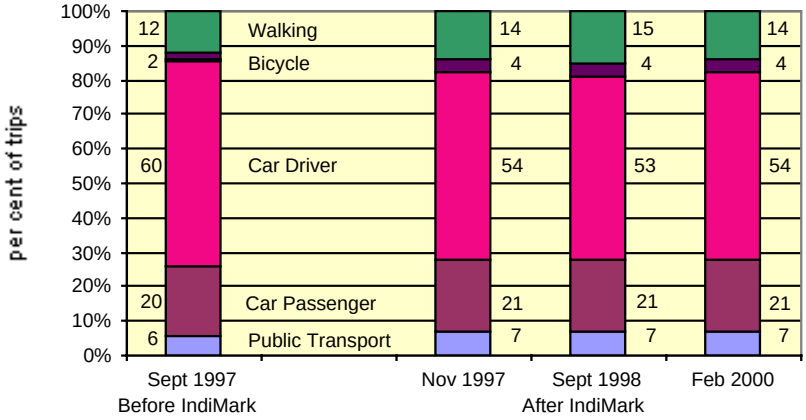
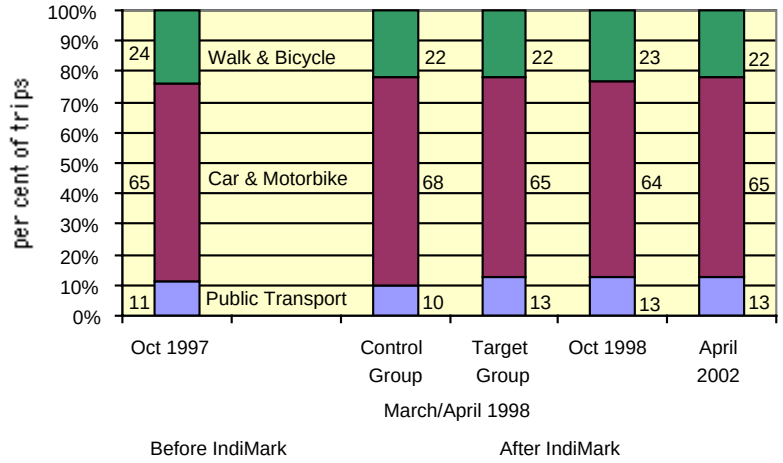


Figure 9b Durability of VHTBC Impact: Dalvik, Sweden (Source: Socialdata)



Similar stability has been demonstrated over periods of up to four years for public transport increases in Kassel and Nuremberg (Germany) (Socialdata, 1998). Public transport ticketing increases have now been maintained for the Town of Cambridge project in Australia for a duration of more than two years and are ongoing. Eight projects in Perth, Western Australia, now show increases in patronage concurrent with the start of the IndiMark program in each area, while there is no system wide patronage growth in excess of the rate of provision of new services in fringe development associated with an expanding population and urban area.

Unlike a change in attitude or awareness that often erodes over time, IndiMark® achieves significant levels of behaviour change. The newly-acquired behaviours are consistently reinforced by the personal benefits realised (health, time, stress, money, etc.) and the regular need for mobility. There is no reason to expect the new behaviours to change signficantly as long as the quality of the resulting experience does not change.

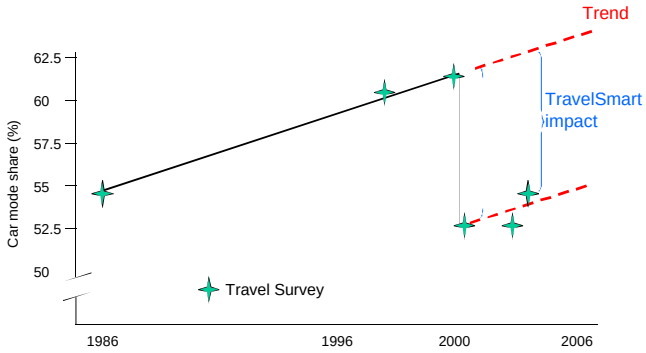
The behaviour changes may be threatened when households change location or progress to further life stages. The behaviours may, however, also expand to other people as they see the personal benefits demonstrated and may even impact on home location choice. Impacts will also be affected by other changes - for example, in the South Perth large-scale intervention, changes to public transport services in the area adversely affected the ability to measure public transport impacts beyond two years after.

These long-term possibilities pose a significant problem for long-term evaluation, but a fertile source for research into culture change processes. Conceptually, the long-term impacts need to be measured against the underlying trend of car usage, rather than against the level of usage at the time of the intervention (Figure 10).

Impact on Future Growth in Car Use

Travel behaviour change does not stop continued growth in car traffic. It does, however, wind back past growth. In South Perth, for example, it has been estimated that the impact of IndiMark® was equivalent to reverting back to 1986 levels of private (target area resident) car usage. Subject to the durability issues discussed above, car use by the people of South Perth would continue to be 14% below the level that would have come about in the absence of the intervention (Figure 10).

Figure 10 ***Framework for Measuring Long-Term Impacts*** (Data from South Perth Largescale application)



It does not follow, however, that car use will be back to 2000 levels after another 14 years, as the underlying trends that led to increased car use in the past are unlikely to continue as strongly into the future. There are some obvious limits, for example, to growth of car ownership and reduction in household sizes.

Future growth in car use, unless specifically related to lack of durability of the initial behaviour change, does not in any way lessen the impacts of IndiMark® or similar initiatives.

Scale of Application

Other things being equal, large-scale applications provide greater opportunities for generating positive feedback either through publicity or through word-of-mouth.

There are few instances where the impact of scale can be measured, but in the City of South Perth, Western Australia, an initial pilot project (360 households) to prove the technique itself as a multi-modal intervention was followed by a large-scale application to the whole of the City (15267 households). The pilot project was a random sample of the population used for the large-scale project, with the only differences between them being:

- The pilot project was undertaken with minimum publicity, to minimise any external or feedback influences on the outcomes; and
- The large-scale application included improvements to information and signage at all bus stops in the target area.

The large-scale application produced a 14% reduction in car trips across the target population compared to 10% in the pilot project (see Table 1, above). However, the increase in public transport trips was slightly lower (17% compared to 21%), indicating that the larger car-trip reduction in the large-scale was due to positive feedback.

In Melbourne, Victoria, delivery of household-based travel behaviour change has progressed through a series of projects that have progressively increased in scale and complexity:

- A small-scale pilot of 500 households in the suburb of Elwood (in 2002);
- Medium-scale pilots of 2000 households in Elwood, Anstey and Dandenong (in 2003); and
- A large-scale pilot of 6000 households along the Alamein train line (in 2003).

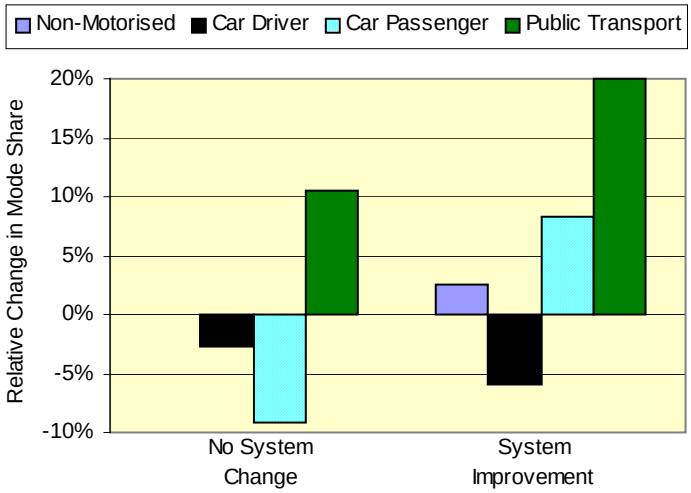
The Department of Infrastructure is about to undertake a large-scale application to 30000 households (DoI, 2003a).

This structured approach, with associated monitoring and evaluation, potentially allows some conclusions to be drawn about the effect of scale of application on effectiveness and outcomes.

System Improvements Multiplier

In many, but not all, cases, Individualised Marketing has been applied without any substantial improvements to the infrastructure or service levels for alternatives to the car. In others, there have been some large or small system changes that would independently have generated some change in public transport use. Where control group measurement allows impacts to be clearly interpreted, it appears that public transport system improvement roughly doubles the impact of VHTBC in terms of car driver and public transport mode share in single-mode (public transport) interventions (Figure 11). There are also different impacts on non-motorised and car passenger mode share, which were not directly targeted by these interventions but suggest a more fundamental review of personal travel behaviour when systems change.

Figure 11 Travel Behaviour Impacts, with and without public transport improvements (net of control group changes): Uni-modal (public transport) projects only
(Source: Ker, 2003, based on data from Socialdata, 1998)



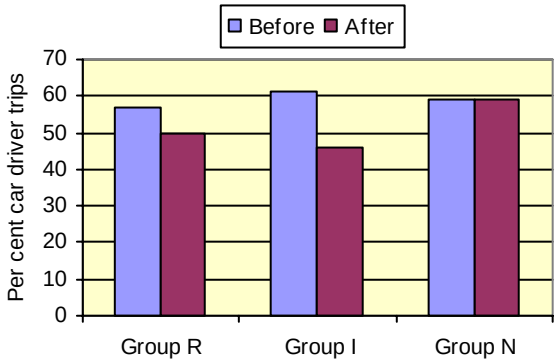
Induced demand

Any significant change to level of service for a mode, in the absence of other changes, would be expected to impact the level of demand for that mode. The potential does therefore exist for a portion of the benefit of travel behaviour change to be eroded through time, just as the congestion relief of a road expansion is gradually eroded through induced demand.

However, it appears that any such induced demand effect is likely to be small:

- Most reduction in car use is either off-peak and/or for non-work purposes and so at times and places where congestion is unlikely to be at its most severe; and
- The 'N' group, which is not subject to any active intervention, does not show any increase in car usage (Figure 12), despite being most conveniently located relative to the roads with reduced traffic.

Figure 12 Car Trip Reduction by Intervention Group: South Perth



The potential for induced demand will be greater where the road system is operating at or close to capacity for larger parts of the day. In these circumstances, some complementary measures may be necessary to minimise erosion of the benefits of the travel behaviour change. It should be noted, however, that all initiatives to achieve mode shift would encounter similar problems, unless they were based on reducing capacity (and hence increasing congestion) or increasing cost (eg congestion pricing) for car use.

Travel behaviour change is not a final solution, it is a step in a process of behaviour change, contingent on long term policy and program objectives and actions. Depending on the objectives, the reduction in car trips resulting from TBC could be used to:

- cater for more population growth;
- delay or prevent the need for new infrastructure;
- support the provision of new walking, cycling or public transport services or facilities;
- reduce public transport operating subsidies;
- improve road freight travel times;
- reduce public perceptions of congestion; and
- improve social and environmental outcomes of transport.

Evaluation of Outcomes

Socio-economic benefit-cost

There have been few comprehensive benefit-cost evaluations of travel behaviour change. In part, this is due to the uncertainty concerning key aspects of the level and durability of the travel behaviour change impacts themselves.

A conventional benefit-cost evaluation of the South Perth pilot project was able to demonstrate that, even under highly conservative assumptions about the range and durability of impacts, the socio-economic return on investment was several times higher than that usually generated by urban transport investments, at 13-15:1 compared to 3-5:1 (Ker and James, 2000). A key factor in the conservative nature of this evaluation was the assumption that the travel behaviour change impacts would progressively reduce to 15% after 10 years.

On the other hand, the rate of return in South Perth was enhanced by the fact that there was spare capacity, even at peak periods, in the public transport system, so no additional public transport capacity was required.

Further refinement of the evaluation, including removing the assumption of progressive impact reduction, indicates that socio-economic returns could be as high as 78:1 over 25 years or, more conservatively, 45:1 over 10 years (Ker, 2002, Table 4.3.1(b)).

Neither of these evaluations took account of the sample frame, non-contact and non-participation factors set out in Table 1. On the South Perth Figures, socio-economic rates of

return should be factored down by up to 14% as the evaluation is based on the measured changes per person multiplied by the target population to produce an absolute value

Whilst the range of estimated benefit-cost outcomes is large, especially when the impacts of the full range of applications (Table 1) is considered, even the lowest value is still more than competitive with most conventional urban transport investments.[2]

Financial impacts

Some benefits of travel behaviour change are also reflected in financial outcomes for government. These include:

- net fare revenue (allowing for revenue-sharing arrangements with private operators);
- health service costs, due to improved health and fitness and to reduced exposure to air pollution; and
- road system costs, due to reduced need for additional road capacity and traffic management, such as traffic signals.

For Perth, Western Australia, these have been estimated to have a present value of $3.1-$4.7 million for every $1 million invested in IndiMark, with a further $1.2-2.1 million in health system costs to the Commonwealth Government (Ker, 2002).

Allowing for sample frame, non-contact and non-participation factors in full, the total financial benefit is around $3.6-$5.6 million (at South Perth impact levels) for each $1 million invested or $1.8-$2.8 million (at Cambridge impact levels).

The project cost provides cost recovery to Government in around 3 years with (unlike infrastructure or service only solutions) no apparent need for ongoing servicing or maintenance cost implications.

Issues in Measuring Outcomes

Different Types of Intervention

It is difficult to compare the measured outcomes of IndiMark® and Travel Blending® because, whereas those of IndiMark® are measured across the whole target population, those of Travel Blending® are measured only in respect of those who participate throughout the process. For IndiMark®, the monitoring instrument is applied independently of the intervention, but for Travel Blending® the monitoring instrument also provides feedback to the participants and hence is limited to those still participating at that stage.

Perkins (2001, p30) states that "… Travel Blending and IndiMark results cannot be directly compared. The Travel Blending results are not proportions of the persons/households approached, but of the sample of the participants who completed both diaries". He goes on to state that "the changes … may be proportional to around 60% of the households approached *(ie. Multiply the percentages … by 0.6 for a guesstimate of the affect* [sic] *as a proportion of all households approached)*"

In practice, this is an optimistic assessment for the Travel Blending® pilot projects as reported, as:

- only 28% and 43% of households approached participated to the extent of completing the first travel diary; and
- only 14% and 15% of households approached both participated and completed both before and after travel diaries (Perkins, 2003, p27).

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[2] If we take Frome (at 6% gross car trip reduction, compared to 14% for South Perth) and apply South Perth sample frame, non-contact and non-participation factors in full, the socio-economic return for Frome is around 4.6:1 up to 16:1 (10 years).

DfT (2002) states that ‘data collection (where data collection has been carried out) have [sic] generally been surveys about frequency of use of different modes … such surveys are not as rigorous as travel diaries … In the main cases where travel diaries have been used, they have only been for those who have taken an active part in the experiment, and thus, only include those for which a positive change is likely.’ Whilst this is the case for Travel Blending®, IndiMark® travel diary monitoring is across the whole target population (see Figure 4).

Experimental Design and Outcome Measurement

Travel behaviour is subject to a wide range of influences and measurement is, with the exception of journey to work in the Census, of necessity through sample surveys. This makes it very important to establish clear objectives for the intervention and to set up an experimental design that minimises or clearly identifies exogenous impacts on travel behaviour, in order to isolate the real impacts of the intervention.

In the case of TravelSmart and IndiMark®, as developed in Western Australia, the key objective is to reduce the car-driver mode share.

The impacts of travel behaviour change initiatives are measured either by sample survey of the target population (for large-scale IndiMark® applications) or, where the measurement is part of the intervention (Travel Blending®) or for small-scale pilot projects, through surveys of the participants. Each of these approaches has a number of statistical issues associated with measurement, including:

- Type of survey - typically, repeated cross-sectional surveys have been used, but panel surveys can remove issues associated with sampling variability between surveys.
- Sample sizes necessary for statistical significance - the smaller the quantum of change and the smaller the existing value (eg percent mode share), the larger the sample size required.
- Extrapolation from the survey sample to the total population - understanding the 'non-contact' (including differences between the sample frame and the actual population), 'non-participation' and 'drop-out' impacts. However, where change is measured through population-wide sample surveys, as with large-scale IndiMark® applications, only 'non-contact' rates need to be taken account of.
- Understanding the implications of survey response rates, especially if these vary between before and after surveys.
- Inherent variability of travel behaviour even for a single individual on a daily basis.

These issues and their implications for measurement of travel behaviour change have been discussed by Richardson et al (2003). Their main conclusions are that larger sample sizes are generally required to detect changes, with a high degree of confidence:

- in distance travelled or travel time than in trips undertaken;
- from repeated cross-sectional surveys than from a panel survey;
- when using a daily travel diary compared to a weekly diary (although this difference can be reduced in a panel survey by maintaining the same day of the week for each household);
- personal travel compared to household travel; and
- a 10% change in public transport usage (and, by implication, any other 'minor mode') than a 10% change in car usage.

However, some of the parameters enabling smaller sample sizes also give rise to survey designs that are more difficult to undertake. Panel surveys are more difficult than repeated cross-sectional surveys; weekly travel diaries are more burdensome than daily diaries (with consequent impact on response rates and, possibly, accuracy of responses); and getting

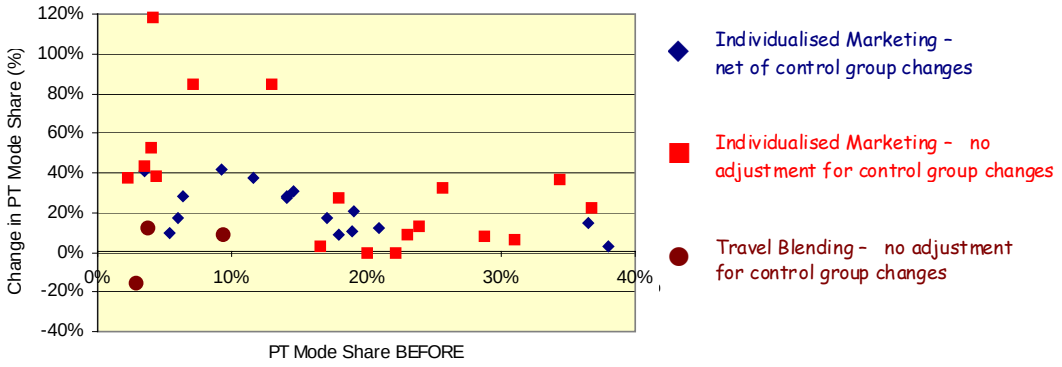
responses from all household members is more difficult than from one member of a household (Richardson et al, 2003, pp22/3).

In addition to the statistical measurement issues, which are internal to the application, it is desirable to be able to account for any exogenous factors that might affect travel behaviour, especially in the case of long-tem monitoring. This is most appropriately achieved by the use of a control group with similar characteristics to the intervention population, including:

- location (eg proximity to the CBD or other activity centre)
- demographic characteristics;
- transport system characteristics (including public transport, walking and cycling); and
- existing travel behaviour.

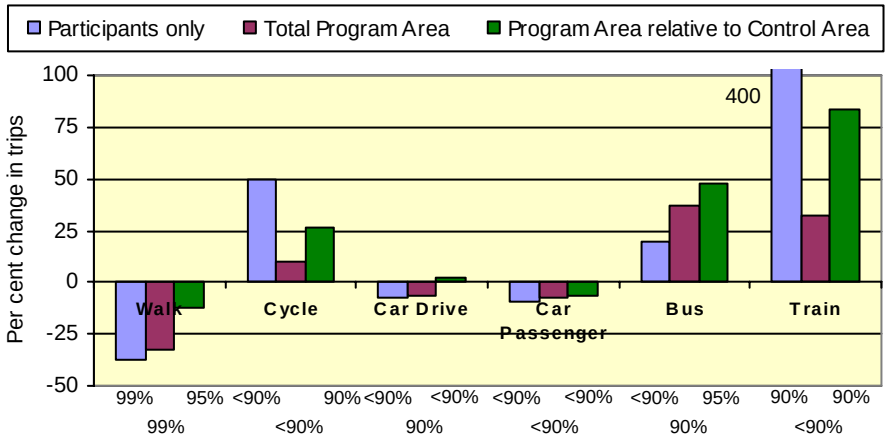
There is never a perfect match, but measurement against control groups has been shown to result in lower variability of measured outcomes of travel behaviour change initiatives, even in short-term measurement (Figure 13).

Figure 13 Control Groups and Variability of Travel Behaviour Change (Public Transport Only)



The importance of sample size, participation rates and control groups has been highlighted by a recent pilot project in South Australia to trial a modified and expanded Travel Blending® tool – see Figure 14 (Transport Planning Agency, 2004).

Figure 14 Mitcham, South Australia, Pilot Project Outcomes



In this case, the interpretation of results is made more difficult by the before and after surveys being undertaken at different times of the year (October, 2002, and May, 2003, respectively).

Statistical Rigour and Achieving Outcomes

As Richardson et al (2003) have demonstrated, the requirements for statistical validity in measuring travel behaviour outcomes are likely to be beyond the resources available for any individual application. Indeed, issues relating to sample loss, survey fatigue and the progressive impacts of other exogenous influences may mean that, in practice, the strict requirements of statistical rigour *cannot* be satisfied. This is especially the case in respect of demonstrating the extent to which durability of outcomes can be achieved.

However, a substantial body of experience, from pilot projects and large-scale applications in diverse situations and countries, is emerging that provides a high level of reassurance that substantial behaviour change is actually achieved (see Table 1, above). It is statistically highly improbable that all, or even most, of these results would be drawn from the 'over-estimating' part of what one would conventionally assume to be an unbiased distribution relating to sampling errors.

Moreover, as Richardson et al (2003) demonstrate, the requirements for statistical rigour in demonstrating a given level of travel behaviour change are more onerous for smaller components of the transport system. There is a lower level of potential statistical error in estimating change in car usage than in public transport, walking or cycling. It follows that there is greater certainty in respect of the key measure of car-trip reduction than for the consequences in terms of increased public transport, waking or cycling.

Similarly, the impact of Richardson et al's (2003) reporting of surprisingly high levels of daily variation in travel behaviour for any individual would also be muted by the increasing body of evidence based on repeated observations in a wide variety of contexts.

Perhaps most important, the Western Australian applications of IndiMark® have been supported by independent data on bus boardings that is consistent with the estimates of increased public transport use derived from sample monitoring surveys.

Estimating Potential

The extent to which actual travel behaviour change will be achieved through IndiMark®, Travel Blending® or related techniques will depend upon the extent of application, the extent of complementary initiatives and the effectiveness of application, including identification of those situations in which the potential for change is greatest.

There has been only limited research into the potential for change:

- In Perth, Western Australia, situational analysis has been applied to household surveys (Socialdata, 2000). This has demonstrated substantial variations in opportunities for change between areas, but there has been no formal analysis to relate this to actual outcomes from IndiMark® application where this has occurred in the same areas. Indeed it measures the theoretical maximum mode shift against the land use and transport system alone – no account is taken of socio-demographic or cultural context.
- A study for the Victorian Department of Infrastructure (DoI, 2003b) used a combination of analysis and professional judgement to conclude that potential would be highest where:
  - Existing mode share – this is a key indicator of the existing quality of the public transport system and therefore the potential to attract new users to the system as well as encourage existing users to use the system more often.
  - Coverage
  - Density
  - Connectivity
  - Access to major attractions
  - System capacity

  These criteria are measures of the capability of the existing system to move people within the area and particularly to trunk line public transport routes, interchanges and important activity centres

- Integration with projects – this criterion recognises the fact that implementation of TravelSMART projects is most effective when combined with the introduction of external changes that could impact on people's choice of travel mode, and will therefore provide a better "bang for the buck".

- In the United Kingdom, the Department for Transport has given grants for pilot household TravelSmart projects that include a range of demographic and travel/land use characteristics. Potentially, these pilot projects will provide a wealth of data that can be analysed to increase understanding of where voluntary travel behaviour change is most effective and why. In turn, this will support the development of more robust methods for formulating the most effective possible travel behaviour change programs.

Conclusion

Household-based voluntary travel behaviour change has been demonstrated to be an effective means of reducing the level of private car use in urban areas, in line with the strategic directions and targets espoused by governments. Whilst there are outstanding issues of how reliably to measure the impacts of specific initiatives, the documented body of evidence is now sufficient to draw some broad conclusions:

- Reductions achieved in car use are substantial, but will not on their own achieve the implicit or explicit targets set by most governments for sustainable urban transport. Voluntary travel behaviour change is not the 'silver bullet', but can make an important contribution.

- The impacts on travel behaviour vary in scale by a factor of about 3.5, in terms of percent reduction in car usage, and in structure (eg extent of shift to individual alternative modes).

- A substantial part of the travel behaviour change is likely to occur at times and places where there is existing spare capacity in non-car transport systems. This is a strength, in that additional investment in infrastructure or services is less likely to be required, but may also limit the extent of contribution to achieving objectives such as congestion-reduction.

- The socio-economic return from investment in voluntary travel behaviour change is very high and more than sufficient to meet public sector investment criteria. Even the poorest travel behaviour change results from documented applications of IndiMark® would produce benefit-cost returns better than most urban transport investments.

These conclusions are sufficient to support the continuing roll-out of voluntary travel behaviour change programs based on dialogue marketing principles, without the need for specific validation of every proposal.

Further research should build on, not be at the expense of, implementation. It should focus on identification of where the greatest returns from such initiatives would be obtained and establishing ways of maximising the effectiveness of voluntary travel behaviour change where alternatives to the car (for example, public transport) are operating at capacity for large parts of the day. The program of eleven demonstration projects across Perth, small demonstration projects across the UK and USA and single very large-scale application in Melbourne should go a long way to addressing the issue (of targeting the intervention to maximise outcomes) over the next few years.

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