Questioning the need for speed: can "effective speed" guide change in travel behaviour and transport policy?

Paul J. Tranter and Murray May
UNSW@ADFA, Canberra, ACT, Australia

1 Introduction

Transport policy in cities throughout the world has been based on the premise that increasing trip speeds is a worthwhile goal. In any cost-benefit assessment of a new road, a significant component of the 'benefits' concerns the time savings for people using the new road. It is assumed that if many individuals can save a few seconds or minutes, then this time saved will collectively be valuable. However, such transport policy is based on a lack of understanding of the relatively minor contribution of trip times to the total time devoted to transport, at least for private motorists.

In this paper, we take a more holistic view of time savings by examining the concept of effective speed. Effective speed is calculated using the formula: speed equals distance divided by time. Here, however, time extends beyond the time involved in undertaking a trip to encompass the total time devoted to transport (including the time spent at work to earn the money to pay all the costs created by the particular mode of transport.) The calculations in this paper are based on the direct costs of transport (costs paid by individuals). These direct costs are the most important considerations in individual transport decisions. If external costs (e.g. health costs) of transport are also considered, then effective speeds become significantly lower for motorised modes of transport.

This paper describes the concept of effective speed, and uses available data to provide some estimates of effective speeds in the context of Australian cities. Effective speeds are calculated for specific cars available in Australia, as well as for cyclists, bus passengers and train passengers. The paper then explains the potential for "effective speed" to stimulate travel behaviour change in individuals and new ways of thinking among transport policy makers. To explore this potential we sought the views of key stakeholders in Australian transport policy and practice, using qualitative interviews. The stakeholders included local government, motoring organisations, bicycle groups, travel behaviour change practitioners and public transport operators.

To help introduce the concept of effective speed it is useful to think of a simple example of how someone might use a machine to "save time". Imagine that you are living in a small village that existed 100 years ago. It is your job to walk to the river each day and bring back a bucket of drinking water for your family. This takes you one hour each day. So you decide to build a machine to collect the water for you. Your machine uses a combination of cogs, pulleys, springs, cables and levers. All you need to do to collect the bucket of water is to pull a lever. Your machine then takes the bucket to the river and returns it to you, full of water. The only catch is that you need to spend an hour each day winding up the spring that provides the energy to make the machine work.

Using the example of the machine described above, we can ask a simple question: if we are assessing whether the machine is worth having, should we take into account the time we spend winding up the spring? The answer, obviously, is yes. In our society, the equivalent of spending time winding up the spring is the time we spend at work, going nowhere, earning the money to pay all the costs associated with a particular mode of transport. Any machines we use to "save time" in transport will require some time spent on "winding up the spring". If we spend more time winding up the spring than the time the machine saves us, then the value of the machine is questionable.

It is likely that there will be considerable cognitive dissonance involved for many people when they are exposed to the concept of effective speed. In the same way that smokers continue to support the habit of smoking in the face of evidence of its negative effects, motorists may wish to ignore the reality of the total time devoted to the car. Motorists may be unwilling to consider the possibility that their cars may be consuming more time than they save. However, if we accept that the time spent "winding up the spring" should be considered, then we should also accept that the total time devoted to cars (or any form of transport) is an important component of the decision making about the most effective form of transport.

2 Effective speed: the concept

In the calculation of car speed, the time required for car travel is rarely adequately considered. Most drivers consider only the time spent in the car while it is moving (and perhaps while it is idling) when estimating their average speed. They ignore the considerably larger amounts of time that must be devoted to their cars. As well as the time a driver must spend sitting in a car, he or she must spend time earning the money to make the car travel possible. During this time, the driver is effectively going nowhere; hence their speed for this time is zero. When this time is taken into account, along with other time devoted to the car, it is apparent that the car does not save us as much time as we think it saves us.

The concept can be traced back to the 1850s, and various writers since this time have shown an awareness of the ideas behind 'effective speed'. Some have made some estimates of effective speeds in specific contexts. The first person to bring attention to the idea behind the 'effective speed' argument was probably Henry David Thoreau in his book *Walden,* published in 1854. In *Walden*, Thoreau argues that "the swiftest traveller is he that goes afoot". He compares his own speed as a pedestrian with the speed of another traveller who takes the train to a nearby town:

> "I start now on foot, and get there before the night. You will in the meanwhile have earned your fare, and arrive there some time tomorrow, or possibly this evening, if you are lucky enough to get a job in season. Instead of going to Fitchburg, you will be working here the greater part of the day. And so, if the railroad reached around the world, I think that I should keep ahead of you" (Thoreau, 1960, 47).

In 1974, Ivan Illich wrote his thought-provoking book *Energy and Equity*, in which he brought Thoreau's arguments into the 20th century. Illich explained:

> "the typical American male devotes more than 1,600 hours a year to his car. He sits in it while it goes and while it stands idling. He parks it and searches for it. He earns the money to put down on it and to meet the monthly installments. He works to pay for petrol, tolls, insurance, taxes and tickets. He spends four of his sixteen waking hours on the road or gathering his resources for it. And this time does not take into account the time consumed by other activities dictated by transport: time spent in hospitals, traffic courts and garages, time spent watching automobile commercials or attending consumer education meetings to improve the quality of the next buy. The model American puts in 1,600 hours to get 7,500 miles: less than five miles per hour" (Illich, 1974, 18-19).

In 1990 the German sociologist D. Seifried (Whitelegg, 1993a, 1993b) used the phrase "social speed" to describe the average speed of a vehicle after hidden time costs are considered. Seifried considered the time spent at work to earn the money to pay for the car and its running costs, as well as the external costs of the car. Such external costs include environmental and social costs (e.g. accident costs). Seifried's calculations indicated that when all costs are considered, the "social speed" of a bicycle can be faster than a car.

Kifer (2002) conducted an assessment of the multitude of costs associated with running a car in the United States, including the direct costs used in the calculation of "vehicle operating costs" by motoring organisations, as well as various hidden or indirect costs of cars. When only the direct costs to the motorist are considered, the "net effective speed" of US motorists was estimated to be a mere 9.7 mph (assuming a trip speed of 25 mph as the probable US average for cars) (Kifer, 2002). (These 'direct costs' did not include parking costs, tolls, fines or vehicle accessories.)

Todd Litman (Victoria Transport Policy Institute) estimates that the average Canadian motorist devotes nearly 20% of their household budget to their cars, equating to approximately 1.5 hours per day. "Combining this with the amount of time spent driving represents an overall speed of about 15 miles per hour (24 km/h) per working day" (Victoria Transport Policy Institute, 2003). Research on the effective speed of Canberra residents indicates that cycling and public transport is competitive with many cars (Tranter, 2004).

3 Effective Speeds in Australia

This section of the paper outlines the calculation of effective speeds for single occupant car driving, bus travel, cycling and walking in one Australian city – Canberra. Canberra was chosen because, of all Australian cities, it is likely to have the highest trip speeds by car, as well as having few disincentives to use the car. There are no tolls on Canberra roads, little traffic congestion and minimal car parking costs (compared with larger Australian cities). None of the speed advantages of rail and light rail are present in Canberra. To provide a comparison for urban train travel, an example of a Perth train is used.

To estimate the 'effective speed' of any mode of transport, we need to do three things. First, we need to estimate the average in-vehicle (or per trip) speed. For a car driver, this can be calculated by dividing the total distance travelled by the total time spent in the car (from the time you open the car door to the time you get out of the car). Second, we need to estimate the time devoted to that mode in terms of activities that are undertaken as a consequence of making trips by that mode or of owning and operating a particular vehicle. These include putting fuel in the car, checking oil and tyre pressures and walking to and from the car when it is parked. Third, we need to calculate the time that a person must spend at work to earn the money to pay for a particular mode of transport. For car drivers, the cost of operating a car has been partly calculated by the NRMA as average vehicle operating costs (NRMA, 2004). The NRMA calculations do not cover the full range of costs associated with cars.

3.1 Estimating trip speeds

While there is information available on average speeds on particular roads (Richardson, 2003) such studies do not provide all the data needed to calculate average trip speeds. For car drivers, to calculate average trip speed requires consideration of the time spent getting into and out of the car, putting on seat belts, opening and closing garage doors, driving around car parks, and reversing out of private garages or driveways.

Data on peak hour speeds on major routes in Australia's capital cities shows some major roads with peak hour speeds down to 18 km/h (Brisbane's Moggill Road) (Hinchliffe, 2004). Minor roads have average recorded speeds of as low as 3 km/h (inner-city Sydney) (Kerr, 2004) and 6.3 and 6.4 km/h (St Paul's Terrace and Hale St Brisbane) (Hinchliffe, 2004). "On the seven major routes to and from the Sydney CBD, average speeds in 2002-2003 were 34 km/h for the AM peak and 41km/h for the PM peak" (RTA, 2003, 6). Given the range of speeds listed above, it is unlikely that any major Australian city would have an average in-car speed of more than 40 km/h. None of the speeds quoted above include speeds in car parks, petrol stations, driveways, laneways and culs-de-sac, most of which feature in the normal driving patterns of city drivers.

In this paper, the calculations of effective speeds are based on the following estimates of trip speeds:
Car – 45 km/h
Bus – 25 km/h
Cycle – 20 km/h
Train – 60 km/h
A more detailed account of the calculations of effective speed is provided in Tranter (2004).

3.2 Other time devoted to transport

Car ownership and use necessitate a range of activities. Some of these activities have been included in Table 1, which depicts some of the calculations for "effective speeds". Not only must the car driver spend time 'in' the car, but anyone who drives a car must also devote time to getting to and from the car when it is parked. Most car owners devote time to cleaning their car, and time is needed to put fuel in cars. Getting a car serviced also involves a time cost: even if the owner employs specialists to do the servicing, the car has to be delivered to the service agent and picked up again. There are several other time costs that have not been included in the calculations (e.g. time spent paying insurance and registration bills and time spent purchasing cars).

3.3 Transport Monetary Costs

The effective speed calculations were based on NRMA car operating cost survey results, in which NRMA's motoring experts examined nearly 500 models of motor vehicle (NRMA, 2004). Operating cost calculations were based on an average mileage of 15,000 km for vehicles owned for a 5 year period. (Average costs for the entire vehicle fleet are likely to be lower than the averages for these cars.)

Table 1: Effective speed calculations for Canberra drivers, bus users, cyclists and pedestrians, and Perth train travellers.

	MONARO	LANDCRUISER SAHARA	FACLON XT	HYUNDAI GETZ	ACTION BUS	BICYCLE	PERTH TRAIN	WALK
Operating cost/fares	13807.56	17013.88	9666.8	5503.68	966	400	2080	200
Infringement fines	104	104	104	104	0	0	0	0
Car parking	49	49	49	49	0	0	0	0
Accessories	200	200	200	200	0	100	0	10
Tolls	0	0	0	0	0	0	0	0
Total transport costs	14161	17367	10020	5857	966	500	2080	210
Income	40100	40100	40100	40100	40100	40100	40100	40100
Work proportion for transport	0.353	0.433	0.250	0.146	0.024	0.012	0.052	0.005
Work hours per week	38	38	38	38	38	38	38	38
Work hours per year	1824	1824	1824	1824	1824	1824	1824	1824
Hours on vehicle expenses	644	790	456	266	44	23	95	10
Other time for transport (hours)								
Walking to & from vehicle **	30	30	30	30	60	30	60	0
Cleaning car	12	12	12	12	0	0	0	0
Repairs and servicing time	4	4	4	4	0	25	0	0
Buying fuel, checking tyres etc	4.5	4.5	4.5	4.5	0	0	0	0
TRIP SPEED	45	45	45	45	25	20	60	6
Hours in vehicle	333	333	333	333	600	750	250	2500
Total hours devote to transport	1028	1174	840	650	704	828	405	2510
Effective speed in km/h	14.6	12.8	17.9	23.1	21.3	18.1	37.1	6.0

Note that these NRMA operating costs do not include a range of other costs that add to the cost of driving and are paid by individual drivers. Parking costs and fines for driving infringement (e.g. speeding) were not considered. Costs of any car accessories (e.g. car polish, seat covers, tow bars, baby capsules, child seats, windscreen covers) were not included. Some of these extra costs have been estimated in this paper, and added to the calculation of total costs of the car. (The external costs of motoring are not considered in the NRMA calculations.)

The figures used in this paper for car parking costs and for infringement fines are based on ACT Treasury data on revenue from car parking and infringement fines (Sinclair Knight Merz, 2004), averaged for Canberra drivers. The estimates for the cost of bicycles rely on information from several Canberra cyclists and are based on ‘high-end’ road bicycles. The monetary costs for bus and train passengers are simple to calculate: their only cost is bus fares. The bus fare was calculated using the annual cost of Monthly Adult Pre-purchased tickets ($966 per year at June 2005). Train figures were based on Three Zone fares in Perth, using Multi-rider 40 tickets ($2080 per year). Other direct costs associated with car use have not been included in the calculations in this paper. These costs included those associated with the private garaging of cars and private driveways.

3.4 Time at work needed to pay for each mode of transport

The calculations of effective speed require the consideration of the time spent at work to earn the money needed to pay for all the costs of various modes of transport. The calculations here are based on "Average Full-time Adult Total Earnings" as at February 2004 - $40,100.60 after tax (ABS, 2004). To calculate the time at work needed to pay for the costs, the total car costs are divided by the total net income. It is assumed that full time work equates to 38 hours per week for 48 weeks per year.

Table 1 provides data for a sample of cars currently available in Australia. The four cars selected for this paper are:

1. an Australian made high-performance car (Holden Monaro) (the most expensive "Sports Car" listed in the NRMA survey, with a weekly operating cost of $265.53).
2. an expensive and fuel-hungry large 4WD (Toyota Landcruiser Sahara). (This was the vehicle with the highest operating costs as calculated by the NRMA - $327.19 per week. There may be other cars that have higher operating costs, but these were not listed in the NRMA tables).
3. an Australian made 6 cylinder sedan (Falcon XT). The NRMA operating costs for this car, at $180.76 per week, were below average for the "large car" category. (Large car operating costs ranged from $160 per week for the Camry Altise to $255 per week for the Holden Calais.)
4. a small four cylinder hatchback (Hyundai Getz). This car had the cheapest operating costs listed by the NRMA, at $105.84 per week.

Effective speed calculations for these four cars, as well as bus passengers, train passeners and cyclists and pedestrians are shown in Table 1. The calculations are based on an annual distance of 15,000 km. The only car that has a higher effective speed than the bus passenger and the cyclist is the Hyundai Getz. If the Hyundai Getz driver had to pay a moderate cost for parking (say $5 per day during working days), this would reduce the Getz driver's effective speed to 21.3 km/h (the same as the bus passenger at 21.3 km/h). The train has by far the highest effective speed, at least when only the direct costs to the transport users are taken into account. If subsidies and external costs are taken into account, it is likely that the bicycle would be the fastest mode of travel.

The Holden Monaro CV8-R V2 is a high performance two-door sports coupe, with a 5.7 litre V8 engine. In outright performance on a race track, this car would clearly be superior to the smaller Hyundai Getz XL 1.3 litre manual hatchback. The Monaro is capable of accelerating to 100 km/h in a time that is about 5 seconds less than the Getz. However, the Monaro Driver must spend an extra few hundred hours to 'buy' this 5 second advantage. The Monaro driver must devote 35% of his or her work time to paying for the car travel (compared to only 15% for the Getz driver). The driver of a Toyota Landcruiser may be faster over rough terrain than the driver of the Getz. But, for the time the average driver needs a 4WD drive, the Getz driver could leave the car behind and walk, and still have a speed advantage over the Landcruiser. (Compared to the Getz driver, the Landcruiser driver must spend an extra 524 hours at work to pay for costs associated with the car, not including any external costs.)

In city driving, an enormously powerful car is unlikely to provide any significant speed advantage. It may arrive at the next red light a couple of seconds earlier than less powerful cars. Its average in-vehicle speed (trip speed) will only be significantly faster if its driver is willing to break speed limits and ignore red lights. (There may be a time cost for this in terms of the time spent at work earning the money to pay for traffic fines.) An apparent paradox exists wherein the higher performance cars (those with the highest potential speed on a race track) are the cars with the lowest effective speed.

The above calculations have assumed that a Hyundai Getz buyer has an income of $40,100 (after tax). But what if the Getz buyer is an 18 year old earning a respectable income (for that age) of $20,000? This person would pay more for insurance (about $1100 more) than the figure used in the NRMA calculations, and would also have a larger excess to pay in the event of an accident. The effective speed for such a driver, even in the frugal and inexpensive Hyundai Getz would be less than 15 km/h, slower than the cyclist, and much slower than the bus passenger. Such a driver would clearly be doing better on the bus, even before allowing for the external costs. If this person was to catch the bus instead of using the Hyundai, he (or she) would have a spare $6000 to spend on taxi fares home from their favourite nightclub.

3.5 What is the effect of a dramatic increase in trip speeds?

One way to increase in-car travel speeds, at least hypothetically, is to build dozens of new freeways to new dormitory suburbs, strung out close to these freeways. Commuters could drive for long distances at high speeds each day (at least till they reached a congested city centre or sub-centre). However, even if it is possible to double the average in-car speed without increasing the cost of the transport, this will have minimal impact on the effective speed. In contrast, if we can significantly increase in-vehicle bus transport speed, the majority of this increase is reflected in an increase in effective speed.

The most important insight from calculations of the impact of increases in trip speed on ‘effective speeds’ is that even if it is possible to dramatically increase the average in-vehicle speed for car drivers, this will have negligible impact on the effective speed of a car driver. However, the majority of any increase in the in-vehicle speed for a bus passenger (or for a cyclist) will be reflected in an increase in ‘effective speed’. For example, if a Monaro driver could increase his or her average in-car speed from 45 to 55 km/h, this would generate an ‘effective speed’ increase of a mere 0.9 km/h. Alternatively, if the speed for a bus passenger increased from 25 to 35 km/h, this would increase the effective speed of the bus traveller by 6.9 km/h. Even if the Monaro driver could achieve an average trip speed of 90 km/h, the effective speed would be increased only by another 1.9 km/h to 17.4 km/h. This is still slower than the bicycle with a trip speed of just 20 km/h.

The implications of this are profound. If our transport goal is to increase speeds (and we are not arguing that it should be), it is far more ‘effective’ to invest money on increasing the trip speeds of the cheaper and slower modes than it is on increasing car speeds. For public transport, a greater proportion of any increase in trip speed is reflected in increased ‘effective speed’. This is reinforced by the fact that as public transport improves and more people switch to it, it becomes even more effective as it becomes cheaper. The reverse is true for the car. The more cars that use the roads, the more congestion will slow cars and the higher will be the per-kilometre running costs.

The above calculations are based on real costs using 2004 data. But what would happen to “effective speeds” if the costs of motoring were to increase, as they are expected to over coming years as a result of the looming oil vulnerability crisis (Robinson & Powrie, 2004)? If fuel costs were to increase by $2 per litre, and if bus and train fares were to double, the effective speed of car drivers will fall significantly, while the speed of the bus user will fall only slightly. Using the trip speeds listed in Table 1, the Monaro driver’s ‘effective speed’ (not considering external costs) would fall to 12.4 km/h, while the bus passenger would be travelling at an effective speed of 20.1 km/h (almost the same as the Getz driver at 20.2 km/h) and the train passenger would still be the fastest, at an effective speed of 30 km/h.

3.6 Incorporating External Costs

The calculations outlined so far in this paper are based only on the individualised costs to motorists and public transport users. Mass car use also involves considerable external costs. One of the major external costs of mass car use involves the generation of greenhouse gas emissions. As well as greenhouse gas emissions, external costs include “costs for congestion, crash risk, roads and parking facilities, traffic services and environmental impacts” (Victoria Transport Policy Institute, 2003). These costs are difficult to measure, but are significant. They are not paid by individual drivers, but are shared by all taxpayers or users. Many of these external costs are not borne by today’s generation: “their full effects felt only by subsequent generations” (Harris, Lewis, & Adam, 2004). The magnitude of these costs indicates that “reductions in motor vehicle travel can provide substantial benefits to society” (Victoria Transport Policy Institute, 2003).

The health cost of transport related pollution, including in-car pollution is significant. Researchers are only just beginning to understand the full impact of pollution, and recent research indicates that “in-car air pollution may pose one of the greatest modern threats to human health” (International Center for Technology Assessment, 2000, 5). The number of deaths caused by transport related pollution is higher than the number of deaths from vehicle accidents (World Health Organization, 2002). The health cost of the lack of exercise associated with car use should also be considered (Vandegrift & Yoked, 2004). A detailed estimate of such costs is outside the ambit of this paper. We should, however, bear in mind that society pays a cost for the dubious speed advantages of mass car usage.

The calculations so far in this paper overestimate effective speeds, as they only look at internal costs (the costs borne directly by the user). It should also be noted that not all internal costs were included (e.g. costs of garaging the car were not included.) Non-users subsidise all users of motorised transport in Australia. If car drivers were required to pay the full cost of using their cars, including parking costs and the environmental and health costs associated with these cars, then their effective speeds would be even lower. About 1/3 of total (car) transport costs are external in North America: " … user costs would need to increase 50% to internalise all costs" (Litman, 1999). If we apply the same multiplier to the Australian case, effective speeds would be as low as 9.6 km/h (for the Toyota Landcruiser), and even the Hyundai Getz driver (at 19.1 km/h) would be going slower than a bus passenger.

4 Effective speed: reactions to the concept

We explored the potential for “effective speed” to stimulate travel behaviour change in individuals, and to facilitate new ways of thinking among transport policy makers. To do this, we sought the views of key stakeholders in Australian transport policy and practice, using qualitative interviews with individuals. The stakeholders included transport academics, transport bureaucrats, local government, motoring organisations, bicycle groups, travel behaviour change practitioners, and public transport organisations and operators.

Those interviewed generally supported the value of “effective speed” as a valuable adjunct in promoting sustainable transport policies and practices. It also became clear that there is a dearth of work on the application of the concept in communities and policy work. The interviews generally supported the notion that effective speed is a holistic concept that could have useful application in encouraging people to reconsider the perceived advantages and disadvantages for differing modes of travel.

4.1 The complexity of influencing travel behaviour

Individual travel behaviour is set within the wider socio-cultural web of institutions such as the media and advertising, industry and government (Organisation for Economic Cooperation and Development, 1997). The ongoing advertising budgets supporting car-based lifestyles are large, and the advertised images of cars are typically glamorous and capitalise on the psychological effects of speed and power. For example, a recent advertisement for a new hybrid car goes as follows:

> "0-100km/h in 4.03 seconds never felt so responsible.
> When the pedal drops, a thrust of V10 power blurs the world. You feel a bristling in your spine, your legs, your stomach.
> And you haven't even reached 250km/h yet.
> Toyota's 'Alessandro Volta' by Italdesign, is the world's first hybrid supercar. Its V6 All Alloy Quad Cam engine and an electric motor on each wheel combine to produce 300kW, startling fuel economy and low emissions. Sustainable exhilaration. That's why we can't wait for tomorrow" (Toyota, 2005).

The process of behavioural change is complex, with many myths associated with what will bring about desired behavioural outcomes (Gardner & Stern, 2002). Brand's (1997) work on green lifestyles shows that the classical assumption that a high level of environmental knowledge leads to high environmental consciousness, and consequently to matching environmental behaviour, is not supported by the empirical findings. Rather, because of a variety of situational and infrastructural factors, environmental consciousness has been shown to account for not more than 10-20% of variance of (mostly) self-reported behaviour. In contrast, other factors including financial considerations, time efforts, inconvenience and other everyday life barriers, cultural habits and value preferences, play a vital role. Typically, utilitarian considerations of time, convenience, the available alternatives, and cost dominate most people's choices about travel.

Measures to restrict or limit the freedom of the car driver can often run up against fierce lobby groups defending these alleged freedoms (Diekstra & Kroon, 2003). In addition, at an individual level, attempts to reduce private car use can often evoke psychological resistance, as the car is perceived as a symbol of independence. For example, one study in The Netherlands supplied information and individual feedback to participants on the effects of their car use on the environment and/or their finances. However, this turned our to have virtually no effect on travel behaviour. When cognitive dissonance creates psychological tensions because of a conflict between attitudes and behaviours, in some circumstances people are more likely to alter their attitude than their behaviour, and tend to excuse themselves from the behaviour (Tertoolen, Van Kreveld, & Verstraten, 1998).

The interviews we undertook on effective speed are in accord with the findings of research work that suggests that it is typical for most people, except the most environmentally committed, for utilitarian and instrumental values to often prevail over environmental values, in determining their behaviour. Thus a number of interviewees pointed to people's travel decision-making being based on short-term considerations, in particular factors applying "today", and how one might most easily and conveniently get from A to B. Time constraints and practical considerations were considered to be the most influential in the decision-making, rather than say costs or time issues averaged over a longer time period, as might be obtained as a result of effective speed calculations.

The effect of positive environmental values is constrained by the influence of prevailing incentives or disincentives to adopt sustainable practices (Guagnano, Stern, & Dietz, 1995). The more difficult, time-consuming or costly the behaviour, or if the behaviour is not required or tangibly rewarded, the less the influence of pro-environmental attitudes is on that behaviour being adopted. For example, forgoing the convenience of a private car, especially in cities constructed around this form of transport, is a disincentive in conflict with pro-environmental desires to use more sustainable public transport forms.

4.2 Applying "effective speed" in social marketing

To meet the challenge of having people undertake a more holistic evaluation of their travel behaviour, as implied in the effective speed concept, it is important to apply findings from social science about what motivates people's behaviour. Behaviour change programs often assume that people will change if they receive information about why and how to reduce car use. This assumption is incorrect (Ampt, 2003; McKenzie-Mohr & Smith, 1999), and is based on an "impoverished view of the complexity of human-social engagement" (Hobson, 2001, 193).

Travel patterns are most likely to result from a combination of habits and circumstances, with routine and habitual behaviour likely to involve "practical consciousness" that is rarely questioned. What is critical is a shift from "practical consciousness" to "discursive consciousness", where a change in behaviour is facilitated by debate about behaviours taken for granted.

Given that the effective speed concept was considered by interviewees to be a way of thinking not generally applied in the community, community-based social marketing approaches that enable more discursive debate appear to be better suited to the application of this concept (McKenzie-Mohr & Smith, 1999). This allows perceived barriers and benefits to be addressed in a more considered way. Further, it enables benefits in terms of the values of the participant (whether it be to save time, money, the environment or gain independence or fitness) to be considered in relation to behaviour change that is likely to be sustained (Ampt, 2003).

Community-based social marketing to influence travel behaviour in Australia has been applied via travel behaviour programs such the various *TravelSmart* programs. Such programs have the explicit aim at the household level of switching individual travel behaviour from the use of cars to public transport, walking and cycling. At the organisational level, these programs seek to have employers accept responsibility for how their staff travel (Transport WA, 1999, 11). Travel behaviour change programs of this kind have yielded abatement of the order of 5-18% of personal transport emissions, and a re-survey in South Perth shows that the reduction is more sustained than expected (Energy Strategies, 2003, 56). We therefore consider that there is merit in pursuing *pilot projects* at the household, workplace and school levels to explore in more detail how the effective speed concept can be applied in these settings. Depending on the context, a variety of information and media aids (e.g. a game, DL size brochure, DVD, and an "effective speed calculator") could be used to support the implementation of such projects.

Gardner and Stern (2002) contend that, at least in the USA, the reason most people prefer car driving to mass transit systems is that the perceived benefits outweigh the disadvantages. That is, the list of perceived advantages is long and the list of perceived disadvantages is short. In the case of car driving, the list of perceived advantages includes speed, comfort, independence, arrival/departure flexibility, route selection, prestige, delayed costs, privacy and enjoyment of driving. The perceived disadvantages include traffic congestion, and petrol and maintenance costs. The reverse generally applies for alternative modes of land transport and public transport, with the perceived list of advantages being short, and the perceived list of disadvantages being long. The perceived advantages include making friends, keeping fit and the ability to work and read. The perceived disadvantages include exposure to weather, discomfort and crowding at peak hours, noise, long walks to stops, waiting times, unreliable arrival times, small cargo capacity, limited route selection, limited time flexibility, low prestige and long travel times.

"Effective speed" is a concept that has potential for people to re-evaluate the perceived benefits and barriers linked to using various modes of transport. People in general are inclined to overestimate the advantages of car use (such as short travelling time, comfort, flexibility, easy reach of destinations) and to underestimate the disadvantages (such as the costs, travelling time, health and safety factors, and environmental pollution) (Nijkamp, Rienstra, & Vleugal, 1998, 81). The effective speed concept brings the perceived advantages and disadvantages into even greater question by using a more holistic approach, such as including the time spent at work to earn the money to use each transport mode. A reduction in the concessions that are made to the private car clearly requires significant attitudinal changes in the community, together with the provision of attractive alternative modes of travel and redesign to reduce the need to travel. The interviews broadly supported effective speed as one more tool in an array of approaches to help achieve such an outcome.

However, even if use of the concept resulted in small changes, such as families not choosing to buy a second car, or people choosing to buy small, less expensive cars in place of bigger, more expensive ones, it would be of value. If the concept became much more established in the community's consciousness, effective speed labelling could then also appear on cars and other modes of transport, along with petrol consumption figures and greenhouse gas emissions where relevant (Tranter, 2004).

4.3 Using "effective speed" to influence and work with sustainable transport policy

65% of people interviewed considered that effective speed could be used to influence policymakers and politicians, including by presentations at relevant conferences such as ATRF. A particular problem arising from the heavy dependence on the car is the mind-set it has produced in planners and decision-makers. The discussion earlier in this paper about the disproportionate effect on the effective speed for an equal increase in trip speed for various modes of transport underlines why such arguments can be useful. Likewise the discussion on external costs demonstrates how inclusion of these reduces the effective speed still further. In keeping with the effective speed concept, new ways of providing price signals to motorists should also be considered, such as replacing the annual fixed costs of registration and compulsory third party insurance with higher running costs (Lowe, 2005, 212).

Just as ecological economics offers a broad based approach to economic issues, effective speed can provide additional validation for other arguments relevant to sustainable transport policy. For example, urban Australians are driving further each year, on average. They are also likely to be using heavy four-wheel-drive vehicles rather than small sedans, resulting in more fuel use (and greenhouse gas emissions) per kilometre travelled (Lowe, 2005, 134). Professor Lowe argues that reducing motor traffic is an obvious priority in terms of scaling down the rate of production of gases contributing to climate change. He says the obvious needs are to create a more diverse (and more fuel-efficient) public transport system, to improve land use planning, and to improve the provisions for cyclists and pedestrians. The conclusions based on effective speed considerations are in accord with such recommendations.

A number of interviewees raised the issue of the way in which incentives are provided by governments and institutions to embed car-based lifestyles (e.g. fringe benefits tax, purchasing and benefits programs within companies and universities).

A co-ordinated approach to applying the "effective speed" concept needs to tie in with a range of sustainable transport policies, including land use planning, traffic free precincts, traffic calming, road pricing, congestion charges, increased car parking charges, and promoting car sharing schemes. Such measures reduce the speed and convenience of urban car travel, and are increasingly being applied in Europe (Low, Gleeson, Green, & Radovic, 2005). Such measures decrease the effective speed of cars, and increase the list of perceived disadvantages of using them.

The re-building and improvement of sustainable transport infrastructure is a further necessary component. A number of interviewees commented on the fact that available alternatives do not always exist, and sometimes where they do, they do not meet the list of perceived benefits people are attracted to (e.g. concerns about the safety and punctuality of Sydney's trains). Newman (2005) has called for a new "Sustainable Cities" program to provide funds for infrastructure innovations in a way that the "Better Cities" program previously did.

The interviewee comments tended to support Newman's (2005, 126) contention that "to overcome car dependence, travel options are required where public transport is faster than other traffic down all main corridors". Increased funding would also address the other requirements of effective public transport such as service quality (frequency of service, ease of interchange, comfort, safety), integrated timetabling and route planning, as well as responsiveness to customer needs. Such measures increase the perceived advantages of public transport, and decrease the list of perceived disadvantages.

4.4 Wider public communication using "effective speed"

A number of those interviewed supported the idea of a co-ordinated and integrated communications campaign based on the "effective speed" idea. This would involve in part, an extended media program over a period of several years in order to achieve changes in people's perceptions. Such media activity would need to be both clever and sustained, in order to have any hope of competing with the high advertising budgets of the car industry.

Media outlets could be targeted simultaneously to have an expert or "opinion leader" interviewed on the issue. Attention could be achieved by building on the counterintuitive ideas inherent in the "effective speed" concept, as with the notion that a small car is "faster" than a Monaro or four-wheel-drive vehicle. Alternatively, the idea could be linked to media attention already being given to controversial issues (e.g. the price of oil, freeway construction). Other low cost approaches could include articles in magazines distributed to members of motoring organisations, thus reaching a large audience of people relatively easily.

Given the use of both media and social marketing methods, co-ordination between government departments by linking interests and budgets could be potentially useful. Relevant departments would include: Department of Health and Ageing (obesity), Department of Transport and Regional Services (travel demand management), Department of the Environment and Heritage (greenhouse issues, air quality).

Some interviewees suggested that, particularly when using the media, issues such as saving time and money would likely be better motivational issues than speed *per se*, in view of the problems associated with easily communicating the "effective speed" concept. One idea involves a split screen concept, with the same person in both, but depicting differing realities side by side. For example, one half of the screen image could show the person working. The other half might contrast with an image of a mortgage paid off or a holiday setting, achieved as a result of cost savings by applying the effective speed concept to the person's transport decisions.

Doug McKenzie-Mohr (1999), a well-known Canadian environmental psychologist, cautions that many public media programs underestimate the difficulties of changing behaviour by erroneously equating such changes with the approaches used to sell products. Prudent advice and input on marketing strategies would be required in order to avoid what he considers to have been financially wasteful media strategies in Canada. This is supported by Gardner and Stern's work on the myths surrounding behavioural change.

5 Conclusions

The concept of "effective speed" has been raised in earlier times, for example by Henry David Thoreau in the 19th century and Ivan Illich in the 20th century. As a way of holistically evaluating various travel modes, we argue here that it can and should be used now in the early 21st century as a valuable adjunct in promoting sustainable transport policies and practices.

The high costs associated with deaths and injuries from road accidents are well known, as are the high costs of congestion and transport related pollution. Now, however, broader global trends are bringing into further question the current dependence on the car, and highlighting the need to facilitate alternatives. These trends include transport's increasing contribution to climate change, as well as its vulnerability to impending oil price rises. Interviews we conducted with a variety of stakeholders in the transport field suggest that the concept of effective speed is potentially useful as a tool for helping to bring about the changes in community attitudes and behaviour that are necessary to move towards sustainable outcomes.

In particular, we consider that "effective speed" is likely to be useful in travel behaviour change programs such as *TravelSmart*, which facilitate the development of "discursive consciousness" in relation to travel choices. Such programs could facilitate understanding of the concept in a variety of settings including households, organisations, and educational institutions such as schools and universities. We also found support amongst those interviewed for its use with policymakers and politicians. Further, we found encouragement for using the concept as the basis for an integrated communications campaign. However, given that the concept needs to be communicated simply, at this level it could be more valuable to focus on motivational elements inherent in the concept, such as saving time or money.

6 Recommendations

As an initial step, we consider that it would be worthwhile for federal and state governments to fund pilot projects using "effective speed" in travel behaviour change programs such as *TravelSmart*. This would involve testing the ideas in household, workplace, and school settings to explore in more detail how the effective speed concept can be applied in each case.

We also consider that it would be useful for federal and/or state governments to explore the possibility of an integrated communications campaign based on “effective speed” ideas. This could potentially bring together departments with linked interests and budgets, including Department of Health and Ageing (obesity concerns), Department of Transport and Regional Services (travel demand management), and Department of the Environment and Heritage (greenhouse issues, air quality). Such planning would need to recognise the difficulties inherent in changing behaviour. It should also be part of a broader policy approach that considers, for example, the need for much improved public transport infrastructure.

7 Acknowledgment

The research for this paper was sponsored by the Australian Greenhouse Office, Department of the Environment and Heritage.

8 References

ABS. (2004). *Average Weekly Earnings, Australia*. Canberra: Australian Bureau of Statistics.

Ampt, E. S. (2003, August). *Voluntary household travel behaviour change - Theory and practice.* Paper presented at the 10th International Conference on Travel Behaviour Research, Lucerne.

Brand, K.-W. (1997). Environmental consciousness and behaviour: The greening of lifestyles. In M. Redclift & G. Woodgate (Eds.), *The international handbook of environmental sociology* (pp. 204-217). Cheltenham, UK: Edward Elgar.

Diekstra, R., & Kroon, M. (2003). Cars and behaviour: psychological barriers to car restraint and sustainable urban transport. In R. Tolley (Ed.), *Sustainable transport: Planning for walking and cycling in urban environments* (pp. 252-264). Boca Raton, FL: CRC Press.

Energy Strategies. (2003). *ACT greenhouse strategy: 2002 review of performance and options for the future*. Canberra, ACT: Energy Strategies Pty Ltd.

Gardner, G. T., & Stern, P. C. (2002). *Environmental problems and human behaviour* (2nd ed.). Boston, MA: Pearson Custom Publishing.

Guagnano, G. A., Stern, P. C., & Dietz, T. (1995). Influences on attitude-behaviour relationships: A natural experiment with curbside recycling. *Environment and Behavior, 27*, 669-718.

Harris, P., Lewis, J., & Adam, B. (2004). Time, sustainable transport and the politics of speed. *World Transport Policy and Practice, 10*(2), 5-11.

Hinchliffe, M. (2004, 12 June). Road problems slow traffic*. The Courier Mail*.

Hobson, K. (2001). Sustainable lifestyles: Rethinking barriers and behaviour change. In M. J. Cohen & J. Murphy (Eds.), *Exploring sustainable consumption: Environmental policy and the social sciences* (pp. 191-209). Oxford, UK: Pergamon.

Illich, I. (1974). *Energy and Equity*. London: Harper and Row.

International Center for Technology Assessment. (2000). *In-car Air Pollution*. Retrieved 15 September, 2004, from http://www.icta.org/projects/trans/incar.pdf

Kerr, J. (2004, 22 May). Peak buses full by 2010, study warns*. Sydney Morning Herald*.

Kifer, K. (2002). *Auto Costs Versus Bike Costs*. Retrieved 28 August 2004, from http://www.kenkifer.com/bikepages/advocacy/autocost.htm

Litman, T. (1999). *Transportation Cost Analysis for Sustainability*. Retrieved 2 September 2004, from http://www.vtpi.org/sustain.pdf

Low, N., Gleeson, B., Green, R., & Radovic, D. (2005). *The green city: Sustainable homes, sustainable suburbs*. Sydney: UNSW Press.

Lowe, I. (2005). *Living in the hothouse: How global warming affects Australia*. Melbourne: Scribe Publications.

McKenzie-Mohr, D., & Smith, W. (1999). *Fostering sustainable behaviour: An introduction to community-based social marketing*. Gabriola Island, British Columbia: New Society Publishers.

Newman, P. (2005). Urban design and transport. In J. Goldie, B. Douglas & B. Furnass (Eds.), *In search of sustainability* (pp. 123-136). Collingwood, VIC: CSIRO Publishing.

Nijkamp, P., Rienstra, S. A., & Vleugal, J. M. (1998). *Transportation planning and the future*. Chichester, UK: John Wiley & Sons.

NRMA. (2004). *Vehicle Operating Costs*. Retrieved 16 August 2004, from http://www.mynrma.com.au/operating_costs.asp

Organisation for Economic Cooperation and Development. (1997). *Report of the OECD meeting on sustainable consumption and individual travel behaviour*. Paris: Author.

Richardson, A. J. (2003). *Travel time variability on an urban freeway.* Paper presented at the 25th Conference of Australian Institutes of Transport Research (CAITR), 3-5 December 2003, Adelaide, SA.

Robinson, B., & Powrie, S. (2004). Oil depletion: the crucial factor in transport planning. *Proceedings of the 27th Australasian Transport Research Forum, Adelaide, 1 October.*

RTA. (2003). *Annual Report*. Sydney: Roads and Traffic Authority, NSW.

Sinclair Knight Merz. (2004). *The ACT Transport Costing Study*. Retrieved 2 September 2004, from http://www.actpla.act.gov.au/plandev/tp-intro/tp-archive/transportstudy.pdf

Tertoolen, G., Van Kreveld, D., & Verstraten, B. (1998). Psychological resistance against attempts to reduce private car use. *Tranportation Research Part A, 32*, 171-181.

Thoreau, H. D. (1960). *Walden*. New York: New American Library.

Toyota. (2005, 18 June). Can't wait for tomorrow [Advertisement]*. Good Weekend (The Sydney Morning Herald Magazine,* pp. 4-5.

Transport WA. (1999). *TravelSmart 2010: A 10 year plan*. Perth, WA: Transport WA..

Tranter, P. J. (2004). *Effective Speeds: Car Costs are Slowing us Down*. Retrieved 3 March 2005, from http://www.greenhouse.gov.au/tdm/publications/pubs/effectivespeeds.pdf

Vandegrift, D., & Yoked, T. (2004). Obesity rates, income and suburban sprawl: an analysis of US states. *Health and Place, 10*(3), 221-229.

Victoria Transport Policy Institute. (2003). *The Cost of Driving and the Savings from Reduced Vehicle Use*. Retrieved 9 July 2004, from http://www.vtpi.org/tdm/tdm82.htm

Whitelegg, J. (1993a). Time Pollution. *The Ecologist, 23*(4), 131-134.

Whitelegg, J. (1993b). *Transport for a Sustainable Future: the Case for Europe*. London: Belhaven Press.

World Health Organization. (2002). *Evaluation of the implementation of the Charter on Transport Environment and Health*. Retrieved 15 September 2004, from http://www.unece.org/doc/eur/eur.02.5040828.3.annex4.e.pdf