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World Transport Policy & Practice is a quarterly journal which provides a high quality medium for original and creative work in world transport.

WTPP has a philosophy based on the equal importance of academic rigour and a strong commitment to ideas, policies and practical initiatives that will bring about a reduction in global dependency on cars, lorries and aircraft.

WTPP has a commitment to sustainable transport which embraces the urgent need to cut global emissions of carbon dioxide, to reduce the amount of new infrastructure of all kinds and to highlight the importance of future generations, the poor, those who live in degraded environments and those deprived of human rights by planning systems that put a higher importance on economic objectives than on the environment and social justice.

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Cycling in African Cities: Status & Prospects*Theo Rwebangira*

A low level of personal mobility characterises urban transport in most cities of Sub-Saharan Africa. One of the major reason for this is that the majority of the residents of these cities cannot afford the cost of public transport where it is available. Cycling, which would have provided a solution to the mobility problem, has not been acknowledged by the planning authorities in these cities. As a consequence there are no facilities for cycling and as a result it plays an insignificant role in the provision of mobility. Poor traffic safety discourages individuals who can afford a bicycle from cycling and this explains the difference in cycling between the large and medium-sized cities in Africa.

Keywords

Africa, cycling, mobility, non-motorised transport, urban environment.

National symbolism undermining healthy transport policies? A case study of Canberra's V8 Supercar race*Paul J. Tranter & Timothy J. Keffe*

The paper examines the public health implications of the GMC 400 V8 Supercar Race held in Canberra, in June 2000 and 2001. The race was held in and around the Parliamentary Zone, a place of powerful national symbolism. The race had a number of potential impacts on public health and on the development of healthy transport policy. Of particular importance were the impacts on – and the messages about – road safety. The impacts of the race can be examined at a number of spatial scales. At the local scale, disruptions to healthier and safer transport modes such as walking, cycling and public transport, are considered. At the national scale, the issues of the glorification of the car (and a particularly 'unhealthy' type of car), as well as the glorification of speed and the combination of alcohol advertising and high-speed racing emerge. These issues may also have an impact at the international scale, considering the television coverage of the race. The location of the race in Australia's Parliamentary Zone, considered by many as the political and symbolic heart of the nation, adds legitimacy and official sanction to the potentially health-damaging impacts of the race.

Keywords

Car racing, cultural symbolism, motor sport, road safety.

Twisted Logic in the upside-down world of 'road safety' ideology: A case study of 'The Safety & Security issues of Women drivers & passengers'*Robert Davis*

A response to 'The Safety & Security issues of Women drivers & passengers' by Woodcock *et al.* in *World Transport Policy & Practice* 7.1. This article is

questioned for its use of an apparently feminist approach to safety which conflates women's rights with motoring privileges; it is specifically criticised for identifying car occupant safety with vehicle crashworthiness. This critique then moves on to show how the article should not simply be contested, but that its main importance is as a text to be seen as a case study in 'road safety' ideology. This leads to a demonstration of certain assumptions which function in a destructive fashion, characterised by an inversion of the road safety policy required for a more civilised transport system.

Keywords

Cars, civility, danger, design, safety, vulnerable road users.

Determinants of air travel growth*Stefan K. Nielsen*

This article identifies the main determinants of air travel growth focusing on drivers and impeters. Major drivers of air travel growth are increased personal incomes combined with reduced real airfares, the latter furthered by airline marketing strategies and government subsidies to the aviation industry. Other drivers are increasing market liberalisation and globalisation of manufacture, trade, personal relations and economic and political systems, as well as changing geography, population growth and migration. Working structures and changing age- and wealth distribution in the population also play a role, as well as changes in social norms and values and individual needs, wants and desires. Future policies for impeding air travel growth may aim at reducing growth in personal incomes while increasing real airfares, limiting the expansion of aviation's socio-technical system and setting up per capita quotas for air travel. Promotion of alternative lifestyles, as well as restrictions to globalisation and market forces may also prove useful in the longer term.

Keywords

Aviation, air travel, environment, growth.

Liveable Neighbourhoods*Evan Jones*

Liveable Neighbourhoods is a new policy of the Western Australian Government to combat the high car dependency, lack of public transport and poor walking conditions in suburban sprawl. This paper gives an overview of the urban design and structuring principles behind the policy.

Liveable Neighbourhoods is based on an urban structure built with walkable, mixed-use neighbourhoods. These neighbourhoods cluster around a town centre to give sufficient population catchment to support main street retail, office and community facilities, and support public transit.

A traditional movement network in *Liveable Neighbourhoods* overcomes the disconnected street system, lack of footpaths, unsafe routes and long walking distances to most destinations that characterise conventional suburban developments. *Liveable Neighbourhoods* encourages people to walk by providing an environment of high pedestrian amenity and efficiency, and one that is stimulating, legible and safe for pedestrians.

Liveable Neighbourhoods recognises the complexity of daily movement patterns and the need to make pedestrian trips as short and pleasant as possible. The primary pedestrian network is the street system, which is detailed to support pedestrian movement.

Keywords

Liveable Neighbourhoods, pedestrians, Perth, urban design, walking, Western Australia.

Walking as a local transport modal choice in Adelaide

Andrew Allan

A glance at transport statistics for Australia indicates that 'walking' as a transport option is a relatively insignificant form of urban travel. For medium to long, intra-urban trips, this is probably indeed the case. This will continue so long as the morphology of Australian cities is predominantly shaped by the needs of motorised transport.

This paper provides an overview of the extent of walking as a transport option, at least in the journey to work. The characteristics of walking as a transport mode are discussed, which is important in setting the context of the walking permeability indices that are developed in the subsequent section. The walking permeability indices are the principal form of analysis used in assessing how well the City of Adelaide and the inner city residential development of Garden East and the new middle distant northern suburb of Mawson Lakes are in catering to walking as a local transport modal choice. The final section examines strategies to facilitate walking in Adelaide.

Keywords

Adelaide, urban design, walking, walking permeability distance index, walking permeability distance time index.

Recent large scale protests at extravagant gatherings of world leaders (Seattle, Gothenburg, Genoa) have marked a rising tide of discontent with a global economic system that is increasingly incapable of dealing with poverty, equity, social justice and the satisfaction of basic human needs and wants. The lubricating oil for this global economic system is long distance transport of goods and people. The discussion about globalisation is gradually recognising the importance of celebrating what is locally distinctive (and can be supplied locally) and rejecting those things transported across the world simply to meet corporate profitability targets. Put at its simplest there has to be something very wrong with a global system that can supply New Zealand onions to a Sainsbury's supermarket in Lancaster – and supply them more cheaply than European sources.

This journal has sustained a debate around this subject for all of its 7 years of life. We published the now famous Steffi Böge yogurt paper in Volume 1 and have returned to this theme at regular intervals since then. For most of this time the problem has been seen as a transport problem. The discussion has focussed on the environmental impact of long distance transport including the cancer-inducing effect of air transport and respiratory damage of lorry transport. It has been seen as a pricing problem: transport does not cover its full external costs or transport is too cheap. What we are now seeing in the global protest against large corporations, chemical polluted food, foot and mouth disease and air transport is very different. The penny has finally dropped in that we are now confronted with two very different lifestyle choices, each of which has dramatic implications for sustainable development and global equity. Model 1 is the globalisation model and Model 2 is the localisation model.

Model 1 advocated by most leaders of the developed world and enthusiastically supported by the UK Prime Minister, Tony Blair, is of a world where most of the important decisions are made by large corporations, where long distance movement of people and freight is a sign of modernisation and efficiency and where old fashioned public services (like the UK National Health Service or the Vienna public transport system) should be broken into 'bite-sized chunks' and run by the private sector in a way that satisfies shareholder needs for a return on investment and does not serve wider community interests.

Model 1 is a greater transformation of society and economy than the industrial revolution or the introduction of settled farming at the end of the Neolithic period. Model 1 does not only generate substantial amounts of long distance traffic that need more and more airports, roads and ports – it requires the fundamental breakdown of local production and

consumption links to feed a large appetite for profit, turnover and spatially-fragmented intensive production. Long distance transport is the life blood of this new order. There can be no limit on air travel (new terminals and runways will be built) no limits on new motorways (Eastern Europe must be connected) and no limits on private sector involvement (London underground must be run with the substantial involvement of private firms).

Model 2 is the one not on offer. It is the one that the democratic process cannot deliver. There is no choice. Model 2 requires a substantial effort to satisfy basic needs and wants as a priority. Rather than spending billions on GM technology in India we could re-engineer water supplies to ensure water-efficient local agriculture prospered. We could provide peasant farmers with secure access to land and protect their rights. Rather than build high speed trains, airports and monorails we could ensure that our cities were havens of peace and security for children, the elderly, pedestrians and cyclists. We could have highly efficient local public transport (like Vienna, Graz and Zurich) rather than the disastrous UK versions in fragmented, insecure, dangerous and dirty private sector organisations. We could encourage small farmers in the UK to grow organic food for local consumption and bring an end to the export of the same number of animals as are imported through the same ports. All this is possible but it is not on offer. European governments with one or two notable exceptions are bent on large scale production, globalisation of supply, exploiting children in factories in Morocco and Thailand and global pollution.

Solving transport problems depends absolutely on political will and a strong sense of what is in the public interest. If we continue to privatise both space (shopping malls) and services (bus and rail) then we will not produce a high quality public realm. If we want to create liveable neighbourhoods in Perth (Jones), then a strong local democracy intent on rewarding local businesses and reducing the damage caused by lorries and cars will be more successful than a weak democracy intent on following the lead set by a large corporation. Air transport is the key to many of the plans of the global corporation and in this issue Nielsen shows just how resilient are the determinants of air travel growth. At the other end of the spectrum walking is a key indicator of what is healthy, vibrant and attractive in our cities (Allen). Walking does not fit in with a globalisation agenda which is why national governments find it difficult to embrace it as a policy issue. Also in this issue we show how the prospects for cycling in African cities (Rwebangira) are developing in circumstances where traffic levels make cycling very difficult indeed.

International grand prix racing is an unlikely subject for a transport journal. Tranter and Keeffe discuss the

transformation of public space in Australia's capital, Canberra, to illustrate some very uncomfortable facts about the ways governments perceive cars, fast cars and the problems they cause to ordinary local residents. The message sent out to the world by the conversion of prime parts of Canberra to a racing circuit is very clear indeed: the excitement of fast cars, the worship of speed and danger and the strutting of testosterone-laden young males is a good thing for a government to encourage.

Finally, in this issue we devote space to a serious disagreement. In our last issue (7,1) Woodcock *et al.* discussed their findings and views around car design and the safety of female car occupants. In this issue we publish a paper by Bob Davis who takes the authors to task for their uncritical acceptance of road safety ideology and for their inability (as he sees it) to

encompass a wider view of what a safe, secure transport system could actually look like. Bob Davis sees Woodcock *et al.* as part of the problem. It is right and long overdue that road safety discussions should move beyond the straight reporting of academic findings and chip away at uncomfortable areas occupied by ideology. We were very happy to publish Woodcock's paper and we are equally happy to publish Davis's rebuttal. Readers will now be better informed on some of the very hard ideological and scientific issues at the heart of road safety debates. If this contributes to fewer deaths and injuries on the roads and footpaths amongst pedestrians and cyclists then something really useful will have been achieved.

John Whitelegg

Editor

World Transport Policy & Practice

Cycling in African Cities: Status & Prospects

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Abstract

A low level of personal mobility characterises urban transport in most cities of Sub-Saharan Africa. One of the major reason for this is that the majority of the residents of these cities cannot afford the cost of public transport where it is available. Cycling, which would have provided a solution to the mobility problem, has not been acknowledged by the planning authorities in these cities. As a consequence there are no facilities for cycling and as a result it plays an insignificant role in the provision of mobility. Poor traffic safety discourages individuals who can afford a bicycle from cycling and this explains the difference in cycling between the large and medium-sized cities in Africa.

Keywords

Africa, cycling, mobility, non-motorised transport, urban environment.

Mobility and Poverty

Cycling as a mode of urban transport enables people to travel at relatively low costs. With a bicycle longer distances can be covered at much higher travel speeds than on foot, thus increasing individual mobility. In practice this means that one is able to earn or save more through better access to job opportunities and distant cheaper markets. There exists a vicious cycle linking low mobility and low income (Figure 1).

Situations of low mobility for entire households start becoming bottlenecks for household income when it becomes difficult to afford public transport and few services or economic opportunities are available within walking distances. The solution at a system level is to reduce the cost of transport, while at the policy level this would lower significantly the percentage of the city product that is spent on transport.

At this point, much better pedestrian and bicycle mobility are the transport options that can create a win-win situation between improved economic productivity, social coherence and improved physical environment. Cycling in particular can play a very positive role and have an impact on economic growth. For the great majority of people in Sub-Saharan African cities, the alternatives to public transport are either walking or not making the trip at all. Public

transport tends to take a large proportion of the earnings of the urban poor. Moreover, the immobility imposed by walking deprives many of economic opportunities to improve their lives or effective social networks.

The comparative costs found in recent studies show the following unit cost of travel per passenger-km:

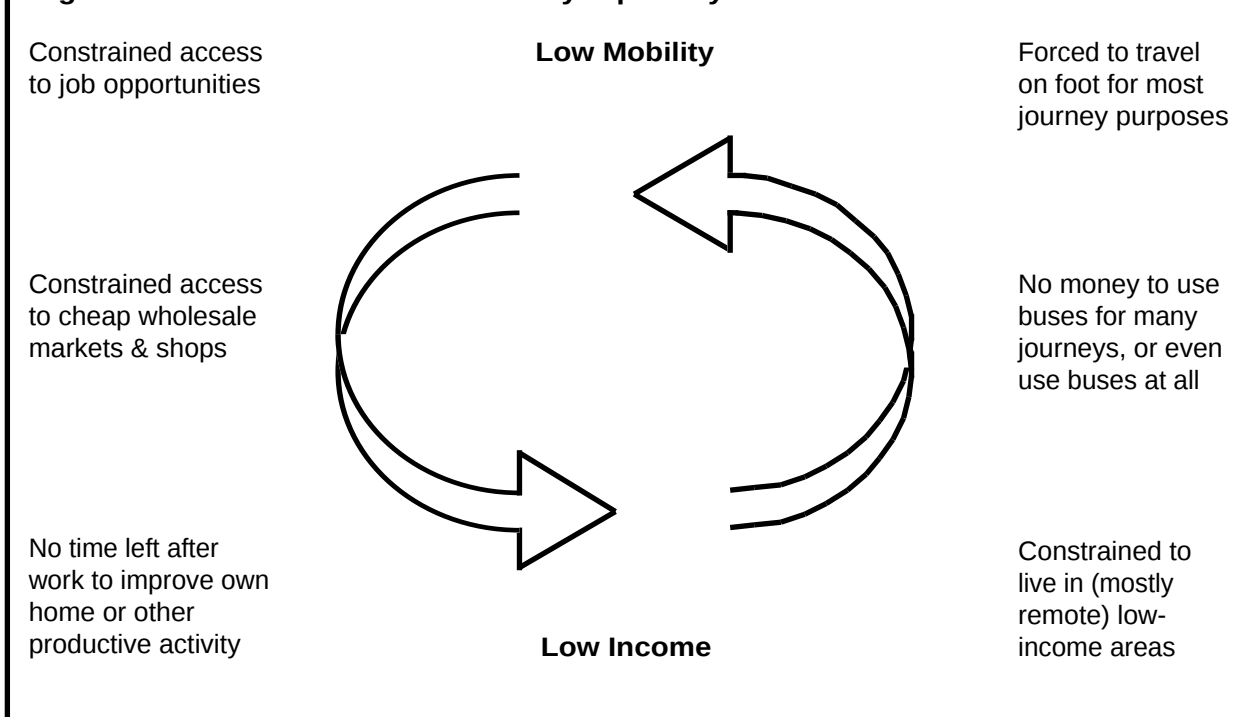
- Bicycle 2 US cents / km;
- Walking 3 US cents / km;
- Bus 4 US cents / km; and
- Car 30 US cents / km.

Urban transportation planning

Traditional transportation planning models do not work well in Sub-Saharan African cities where widespread poverty is prevalent. The emphasis on personal choice that forms the basis of trip distribution and modal split models breaks down when a significant proportion of the population has extremely limited economic options, or, as is often the case, no options at all. As a result, in most African cities one finds a diversity of transport modes including walking, bicycles, handcarts, tricycles, animal drawn carts, cars and buses. All the current urban transport planning models have a problem dealing with modal diversity of the kind mentioned above.

The recommended concept for planning for urban transportation in African cities is the one that recognises and takes into account the developmental needs of these cities. This, as mentioned earlier, develops measures aimed at improving the productive potentials of the cities, the distribution of urban opportunities, and the improvement of social life and the physical environment. This can be done through the following:

- maintain or increase growth of real resources per capita;
- decrease poverty and deprivation;
- promote increased accessibility to, and responsiveness of, public sector administration in urban affairs; and
- promote adaptable physical and spatial arrangements to accommodate the social and cultural needs of the majority.

Figure 1: The vicious circle of mobility & poverty

In practice, this means a highly decentralised strategy focusing on the corridor or neighbourhood level. Within a corridor, the competing demands of motorists, cyclists, adjacent shopkeepers, street vendors and residents are considered. In planning exercises for the pilot projects in Tanzania and Kenya this concept was implemented. For example, sidewalk obstructions were removed and the space gained allocated to non-motorised traffic and to economic opportunities for the urban poor.

Apart from the direct relationship between the above mentioned and real resources, there are also very important aspects of personal dignity, self respect and self confidence. The real public investment policies and the priorities that they show have a significant impact on these feelings for the common city inhabitant. Urban transport policies are very visible, and nobody fails to understand their real priorities. Urban road building priorities that do not take into account the needs of the average low income inhabitant of the city increase the feeling of poverty and deprivation.

The promotion of increased accessibility to centres of economic activity can be achieved by either improving the ease of travel towards these centres or by locating them near to the main residential areas. The example of the Temeke Pilot Project shows that enhancing centres of economic activity close to residential concentrations greatly improves

their accessibility. Central Temeke was made much more attractive and easier to reach on foot by such enhancements.

Urban cycling in East Africa

Travel behaviour and, in particular, modal split was studied by means of household surveys in four cities, namely Dar Es Salaam, Nairobi, Eldoret and Morogoro.

Table 1 shows the typical modal split that was found out during the study. From these figures it can be seen clearly that there is a significant difference in cycling behaviour between the large and the medium-sized cities. The modal share of cycling is 23% and 12% in Morogoro and Eldoret respectively, while the corresponding share for Dar Es Salaam and Nairobi is 3% and 1%.

In Morogoro, 6% of cycling trips are made using hired bicycles showing that the market for cycling is commercially attractive. The level of vehicle ownership in all study towns was very low with bicycle ownership ranging from 0.2 – 0.7 bicycles/household and car ownership ranging from

Table 1: Typical modal split for large and medium-sized cities

	Dar Es Salaam	Morogoro	Nairobi	Eldoret
Walk	46	67	45	4
Cycle	3	17	1	12
Hired	-	6	-	-
Bus	44	12	45	24
Car	6	4	7	10
Other	1	-	3	6

0.06 - 0.16 cars / household. The determinant for bicycle ownership was mainly the cost, meaning the majority of the households could not afford the purchase price of a bicycle. The other reason for low bicycle ownership concerned safety: households, especially in Nairobi and Dar Es Salaam, considered conditions for cycling to be very unsafe.

Table 2 shows the average number of trips made by different population segments indicating that a person with a bicycle is as mobile as a car owner and one trip per day more mobile than a person without a vehicle. Overall people without access to a vehicle and women in general have very low mobility.

Table 3 shows the modal split for all adult trips in Morogoro. From this it can be seen that 33% of all trips made by males are by bicycle and only 2% of all trips made by women are by bicycle. This clearly shows the gender imbalance in cycling.

Constraints to cycling

The most important constraints to cycling were found to be:

- lack of traffic safety for cyclists; and
- lack of affordability of a bicycle.

The lack of traffic safety for cyclists is the main reason why in large cities cycling is almost absent as a mode of transport. In the pilot project towns measures designed to improve traffic safety resulted in a significant increase in cycling on particular routes.

All other constraints are by comparison unimportant and only apply to small market segments. For example a negative attitude towards bicycle use is only a constraint among adults with a middle or high income, who form less than 20% of the population in the study cities. A cultural barrier to cycling by women seems to exist more among men than among women themselves, and to relate significantly to the spending priorities in the household. Discomfort of cycling, which includes exposure to heat, rain, and fatigue appears to be of minor significance and is only mentioned by non-cyclists. Lack of bicycle tracks is not a constraint as such, but only in as much as it is part of the larger problem of finding a convenient, safe cycling route.

Current status of urban cycling

In medium sized cities, cycling provides greatly improved mobility to its users. On average this was found out to be 2.5 trips per day, which is 50% more than pedestrians and, of course, allows longer trips. Most cycling is on mixed traffic roads with the average motor vehicle speed of 20 – 30 km / h and a maximum speed of 50 km / h. With relatively simple and low cost measures, cycling can be made attractive for – and available to – a much wider proportion of the population. The main challenge at the moment is to maintain cycling safety after road rehabilitation in these cities.

In large cities (Nairobi and Dar Es Salaam), the traffic conditions are generally so unsafe for cyclists that cycling has declined significantly over the last 20 years. In Dar Es Salaam cycling is still possible without too much risk of accidents in some parts of the city, outside the centre. The number of cyclists has slowly increased since 1995. At this moment an estimated 3% of all trips are by bicycle. The recently improved traffic safety on a number of collector roads, through the provision of road humps and raised pedestrian crossings, seems to play a positive role in encouraging people to cycle.

Partly as a result of the bicycle use hierarchy in the household and partly because no tradition of cycling by women exists, cycling in the pilot cities is almost entirely limited to men. This is of course not true everywhere: for example in the Mwanza region in Tanzania, cycling by women is common. The first bicycle promotion activities aimed at increasing female bicycle ridership met with a positive response. Encouraging women to cycle appears to have a significant long-term mobility improvement potential, but must be combined with efforts to assure sufficiently safe traffic conditions for cyclists.

In cities with a significant amount of cycling, the highest potential for an increase in cycling is among adult women and among secondary school students, as many adult males already cycle. In non-cycling cities, young adult males should be the first target group.

Table 2. Mobility of different population segments (average number of trips/day)

entire adult population	1.7
men	2.1
women	1.4
person without access to vehicle	1.5
same, regular bus user	1.6
same, seldom uses a bus	1.4
person with a bicycle available	2.5
person with a car available	2.4

Table 3. Modal split of adult trips in Morogoro

	Men	Women
Walking	52	83
Bicycle, Private	33	2
Bus	11	12
Car	4	3

Cycling policy and policy instruments

The policy to promote cycling in African cities is:

- for medium sized cities: encourage a shift from bus to cycling and an increase in bicycle use by women; and
- for large cities: improve traffic safety for cycling on all roads.

The instruments for implementing these policies are:

- *Bicycle Safety*: Restoring bicycle safety to make urban cycling possible again in large cities and safeguard bicycle safety in medium sized cities. This can best be achieved by traffic calming measures.
- *Bicycle affordability*: Reducing the cost of a bicycle by eliminating all taxes and duties on bicycles and bicycle parts.
- *Improved bicycle route networks and sufficient road capacity for cycling*: Providing a coherent bicycle route network in all cities, by improving existing roads for bicycle use, by constructing missing links, and by including good bicycle facilities in new urban roads under construction.
- *Bicycle Promotion*: Focus on implementing a targeted program to enable cycling by women and secondary school students.

Bicycle promotion options tested in Morogoro

A number of interventions were tested in the Morogoro Pilot Project to determine their effectiveness in increasing the modal share of cycling. They are discussed below.

- *Incentives to employers to establish bicycle credit or saving schemes*. It was found that market conditions and attitudes were unfavourable for credits pre-financed by employers for their employees. The opposite model, that of employee savings was more successful. In Eldoret, where many successful saving societies exist, the saving society of a large factory started a bicycle credit scheme for its members. There was a maximum of 300 participants and all the bicycles were taken within

two weeks.

- *Incentives for bicycle sale-on-credit schemes by dealers*. This was found to be against the current business tide. The market is moving away from small credits to poor clients who are regarded as too risky.
- *Incentives for bicycle lease contracts*. This idea found a positive reception by bicycle hirers in Morogoro, but their financial position was too weak at the time to allow them to pre-finance enough bicycles.
- *Promotional bicycle sales to women and secondary school students*. The scheme, which gave a 15-20% discount on the bicycle cost, was very popular. The response by women shows that there is a significant potential for more cycling by women, currently at less than 5% of all cyclists in Morogoro. The overall response shows that the price elasticity of the bicycle is high as a small price discount triggered a significant increase in the number of buyers. Consequently, an import tax or VAT exemption to stimulate bicycle use will have a significant effect.
- *A support program to bicycle hire operators*. This had a positive response especially when combined with the operator's initiative to hire out Ladies bicycles. Ladies bicycles were found to attract more women as clients and even more men liked them for their greater riding convenience.
- *Cycling lessons in secondary schools*. This was found to be very popular among girls as well as boys and a very useful long-term promotional activity.
- *Bicycle parking*. Bicycle parks were not as well used as expected. Successful bicycle parking schemes depend on the location and the risk of theft. In Morogoro even a small token fee had an inhibiting effect on the use of the park.
- *General promotion publicity*. Bicycle races, a bicycle day with a parade, and other promotional activities were undertaken to strengthen the image of the bicycle as a modern and attractive mode of transport.

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National symbolism undermining healthy transport policies? A case study of Canberra's V8 Supercar race

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Abstract

The paper examines the public health implications of the GMC 400 V8 Supercar Race held in Canberra, in June 2000 and 2001. The race was held in and around the Parliamentary Zone, a place of powerful national symbolism. The race had a number of potential impacts on public health and on the development of healthy transport policy. Of particular importance were the impacts on – and the messages about – road safety. The impacts of the race can be examined at a number of spatial scales. At the local scale, disruptions to healthier and safer transport modes such as walking, cycling and public transport, are considered. At the national scale, the issues of the glorification of the car (and a particularly 'unhealthy' type of car), as well as the glorification of speed and the combination of alcohol advertising and high-speed racing emerge. These issues may also have an impact at the international scale, considering the television coverage of the race. The location of the race in Australia's Parliamentary Zone, considered by many as the political and symbolic heart of the nation, adds legitimacy and official sanction to the potentially health-damaging impacts of the race.

Keywords

Car racing, cultural symbolism, motor sport, road safety.

Introduction

A healthy transport policy is concordant with a policy to develop more sustainable transport. Transport policies have considerable effects on the health of individuals (Dora, 1999; Mason, 2000). Transport can have both health damaging and health supporting impacts. Motor vehicles provide the basis for unhealthy transport policy. This is because of their negative effects on humans through pollution (particularly for respiratory diseases) and through road accidents (more Australian lives have been lost in road accidents than have been killed in combat in all wars fought by Australians). Unrestrained use of cars also discourages the use of transport modes likely to keep people fit through 'transport exercise' or 'active transport' (exercise that is incorporated into the daily

transport habits of people). The British Medical Association estimates that 20 times as many 'life years' are gained through improved health from cycling as are lost because of cycling-related accidents. Physical activity has been described as 'today's best buy in public health' (Mason, 2000), but deliberate policies are needed to encourage transport exercise.

A healthy transport policy would:

- Discourage motor car use as much as possible, for example by highlighting the negative impacts of cars rather than glorifying them;
- Encourage the use of smaller, slower, quieter, more fuel efficient and less polluting types of car;
- Support the lowering of speeds for motor vehicles, particularly in urban areas where such vehicles share road space with vulnerable, non-motorised users;
- Promote walking, cycling and public transport as the most healthy modes of transport in urban areas; and
- Aim for a zero road death toll (such as Sweden's 'Vision Zero' policy).

Many of the impacts of Canberra's GMC 400 V8 Supercar Race may be antithetical to each of these key components of a healthy transport policy.

This paper examines possible implications for healthy transport policy of the GMC 400 V8 Supercar Race, held in Canberra in June 2000 and 2001. Some of these impacts are local in scale, while others may have national or international impacts. Some of the impacts are common to most motor racing events. However, the GMC 400 V8 race is unique in the world in the way in which its spatial location gives particular sanction to some potentially damaging influences and messages of the race for public health, particularly road safety. The paper takes a geographic approach to understanding the impacts of the race. An important component of the paper involves the explanation of the meaning of place that has been deliberately developed for the Parliamentary Zone, the location of the race.

The paper adopts the 'danger reduction' approach to road safety, which is concerned with reducing

danger in the whole environment, and promoting equity and accessibility for non-motorised road users (Tight *et al.*, 1998). This approach recognises that to improve road safety it is necessary to provide physical environments and cultural circumstances that are conducive to lowering traffic accidents. It contrasts with the 'casualty reduction' approach, which requires vulnerable users to bear much of the burden of responsibility for their own safety, or relies on secondary safety measures such as increasing safety within vehicles. In the danger reduction approach, the importance of an environment that is 'safe' for pedestrians and cyclists is recognised. The approach acknowledges that a lack of accidents does not always mean that an area is safe, and that if non-motorised road users must modify their behaviour to avoid accidents, then this is a legitimate public health issue. This approach also recognises the importance of developing cultural attitudes in which behaviours such as heavy drinking, speeding or risk taking on roads are seen as socially unacceptable rather than as something that is glorified as 'macho' behaviour (Hartig & Dunn 1998).

Background to the GMC 400 V8 Supercar Race

'Nowhere in the world do you see anything like this. They run here between the old and new Parliament House. It doesn't happen with NASCARs around the White House. It doesn't happen with Formula One cars around the House of Lords. But here the V8s are storming around the National Capital' (Race commentator for GMC 400 V8. The last section of this commentary was given just as cars raced past signs advertising a popular Australian beer.)

The Global Machinery Company (GMC) 400 V8 Supercar Race was held on a track which passed through the Parliamentary Zone in Australia's national capital (see Figure 1). The weekend-long festival (June 9-11, 2000 and June 8-10, 2001) consisted of races for a variety of categories. Three feature races were conducted for the V8 Supercar category, which is designed solely for Ford Falcon and Holden Commodore V8-engined cars. Ford Falcon and Holden Commodore are two of the most popular Australian-made large cars. They are sold with either large six- or eight-cylinder engines.

The organising group behind the race was the product of an alliance between the 'official guardians' of the Parliamentary Zone as a national place, and a number of groups with a commercial interest in the race. The 'official guardians' were the National Capital Authority (NCA) and Federal Parliament. The groups with a commercial interest consisted of the Canberra Tourism and Events Corporation (CTEC) an Australian Capital Territory (ACT) Government-run

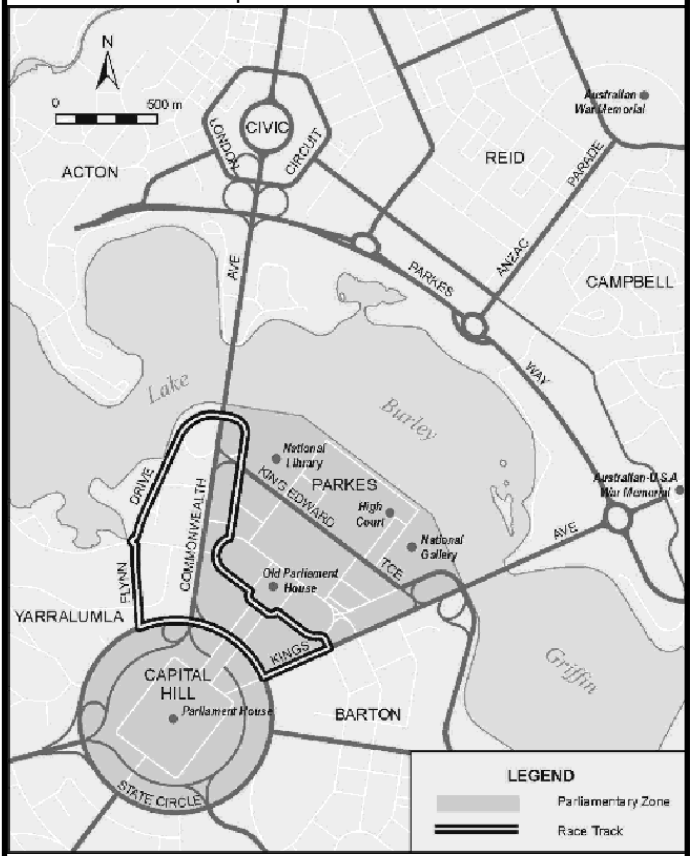
corporation responsible for tourism in Canberra, and a private company called the Australian Vee Eight Supercar Company (AVESCO), the national promoters of V8 Supercar racing. These two organisations received permission to stage an overtly commercial activity, a car race complete with advertising and sponsorship, in what was until that time a carefully developed national symbolic place, for cultural, legal and governmental uses.

Although the event itself lasted just three days, the organisation and physical preparation and dismantling of the track lasted approximately 12 weeks in 2000. In accordance with motor sport safety regulations, safety barriers had to be constructed around the entire length of the circuit. As well as these safety barriers, many grandstands, corporate facilities and other temporary buildings were constructed in association with the event. One of the most controversial changes to the landscape associated with the race involved the advertising signs that were erected, including those advertising alcohol.

The Parliamentary Zone has been designed as a place in which *all* Australians can feel welcome and at home (NCA, 2000a). Despite this, the GMC 400 V8 severely restricted public access in and around the

Figure 1: The Parliamentary Zone.

The Zone, as defined by the *Parliament Act* (1974) is the darker shaded area. The double line denotes the racetrack for the GMC 400 V8 Supercar Race.



Parliamentary Zone during the event. Vehicular traffic was affected noticeably by road closures. The traffic congestion caused by the works associated with the race received much media attention, and attracted a great deal of public criticism. The degree to which traffic was disrupted stemmed from the fact that the track precincts occupied part of the main arteries between North and South Canberra.

The GMC 400 V8 proved to be highly controversial, prompting considerable criticism of its appropriateness for the Parliamentary Zone (Keffe, 2000; Rees & Davey, 2000). Some of this criticism related to the road safety implications of the race, and to the messages it sent about sanctioning or venerating a form of transport that is the antithesis of green transport – V8 motor cars. Such cars consume more energy (in their manufacture, in their operation and in their eventual disposal), create more pollution, and are likely to be more effective in killing and intimidating other road users, than smaller, more fuel-efficient and less powerful cars.

Impacts on healthy transport policy at the local scale

If the ACT government had public health and a healthy transport policy as a high priority, it would invest heavily in the promotion of walking, cycling and public transport (all of which themselves generate little traffic danger) (Tranter & Whitelegg, 1994). The government would discourage car traffic as much

as possible, through lower speed limits, traffic calming, reduction in car parking spaces and increased car parking costs. Instead, the ACT government chose to make a number of Canberra roads 'safe' for cars to travel at speeds well over 200 km/h.

The GMC 400 V8 was an event that severely compromised both the freedom and the safety of cyclists and pedestrians. Pedestrian access to the areas surrounding the track remained relatively open until roads and footpaths around the Parliamentary Zone were blocked off. However, even before that time, as shown in Figures 2 and 3, construction works restricted use of cycle paths and footpaths. In the case of Figure 2 the footpath was particularly dangerous considering that the only lane of traffic on the road (because of road works) was near the footpath. This left almost no space for pedestrians within the area. During the race itself, cyclists were diverted on a contorted route that involved cycling under parts of the race track, adding considerably to the length of their journey. Public transport routes were also diverted around the race route, inconveniencing passengers.

Speed has been clearly established as a major contributing factor to accidents. Anything that encourages drivers to speed is likely to lead to a reduction in road safety. There is considerable anecdotal evidence of car drivers (mainly young males) 'doing the track' and testing their own driving skills in

Figure 2: Restricted pedestrian traffic access to Langton Crescent.

Use of the footpath (on the right) was practically impossible, while traffic was restricted to one lane, further endangering pedestrians.



the period leading up to the race before the road closures were put in place but while many of the concrete barriers were in place. The concrete and steel mesh barriers changed the psychological feel of the streets used in the race route (see Figure 4). One anecdote from a Canberra driver suggested that simply driving along the roads of the track gave him a definite sense that he was on a race track: 'the concrete barriers close in on you, and make you feel as though you are in a race ... you can feel your hands tightening on the steering wheel'. Thus, at the local scale it is possible that the race may have helped to raise the risk thermostat, or the target level of risk (Wilde, 1982; Assum *et al.*, 1999). This effect may also have operated at larger spatial scales, for any spectators whose propensity for risk taking may have been heightened by watching cars travelling at high speed.

Apart from the local impacts of the GMC 400 V8, some of the impacts may have been experienced at national or even international scales.

Impacts at national and international scales

In terms of the casualty reduction approach, car racing has been claimed to have some positive impacts on road safety. For example, research on improved braking and vehicle occupant protection is an important aspect of vehicle design for car racing. However, a more holistic approach to road safety would include 'reducing the emphasis on in-car safety and more crashworthy vehicles', instead concentrating on measures to ensure the safety of all road users (Tight *et al.*, 1998, 190). This argument follows logically from the concept of risk compensation and the redistribution of risk (Wilde, 1982; Adams, 1995). Drivers in 'safe' cars compensate to some extent for the safety benefits by driving more quickly or with less vigilance. The safety benefits are consumed as performance benefits. Consequently, the burden of risk is shifted to pedestrians and cyclists. A far better approach to public health than protecting drivers and passengers would be to make car travel less attractive to motorists and to reduce the speed of motorised traffic (Hass-Klau, 1990; Hass-Klau *et al.*, 1992; Whitelegg, 1997).

Some of the messages relating to public health (even if subtle or subliminal) that may come from the GMC 400 V8 can be identified through a careful analysis of the television coverage of the race, including the advertisements associated with this coverage. Apart from messages about the importance of having functional equipment (e.g. shock absorbers) in your car, most of the identifiable health messages would be likely to undermine public health through encouraging dangerous behaviours (speeding on urban roads, driving aggressively, tailgating, and alcohol consumption).

The car race demonstrates the glorification of

speed, or as Hartig and Dunn (1999) might argue, a glorification of problematic hyper-masculinity. The race glorifies a certain image for young males: 'risk taking', 'beer drinking', 'aggressive', 'egocentric', and 'macho'.

The GMC 400 V8 was held on public urban roads, all of which had posted speed limits of 60 km/h (in 2000). Many of the cars in the event were involved in accidents (with other cars or with the concrete barriers). Fortunately, no one was killed or seriously injured. Unfortunately, a possible message from the GMC 400 V8 is that it is safe to drive around urban streets at high speed crashing into things: driving at 160 km/h *above* the current speed limits is safe, as long as your car has good suspension and good brakes ... and you wear your seatbelt. The GMC 400 V8, like other production car races on public roads, disguises the extreme dangers involved in such activities, particularly for non-motorised road users. This may suggest to macho teenagers that urban speed limits are ridiculously low, while in fact they may be far too high (when pedestrian safety is considered) (Whitelegg, 1993).

Figure 3: Restricted access to cycle paths.

This photo demonstrates the impact of scaffolding erected for grandstands in Flynn Drive on access to the footpaths/cyclepaths. Although access was still possible, it was restricted and did present a possible risk to users.



Aggressive driving is another behaviour that is encouraged in racing car drivers. As one of the GMC 400 V8 commentators explained: 'You've got to be aggressive'. But aggressive behaviour is not conducive to road safety. One type of aggressive driving involves the practice of tailgating. Travelling extremely close to another car gives you advantages in racing. Another commentator for the race suggested that merely tailgating was not aggressive enough. During the race, when a faster car was trying to get past a slower one on the narrow racing circuit, a commentator offered this piece of advice: 'in a situation like that, a little tap up the bum is not wrong really'. Research has indicated that tailgating is increasing among motorists (at least in Germany). In the 1970s it was 'only at motor races that you saw such dangerously close distances between cars as are now seen on motorways ... since 1981 the percentage of 0.5 second gaps between overtaking cars in the fast lanes has risen by one-third (Holzapfel, 1995, 41).

Another possible impact at a larger spatial scale involves the possible effect of the race on drink driving (as well as alcohol consumption generally). The association of alcohol and speed is arguably the most significant road safety impact of the race, particularly

in terms of the symbolism of allowing the clear association of alcohol and speed in Australia's most significant national place.

Alcohol advertising and sponsorship at the GMC 400 V8: the alliance of alcohol and speed

Of all the factors associated with road accidents, two of the most significant are alcohol consumption and speed. These factors are particularly important for young men, but recent research shows the importance of habitual alcohol consumption among young women as well (Dobson *et al.*, 1999). One study has even suggested that drivers who simply believed that they had drunk alcohol drove more recklessly: 'believing that they had drunk alcohol gave them 'permission' to drive recklessly, since now they could not be considered responsible for their actions' (Holzapfel, 1995, 43). Drink driving is frequently associated with other aspects of unsafe driving, including speeding, unsafe overtaking and ill-judged decision making. All of these behaviours may have been encouraged by the thrill of watching the GMC 400 V8, complete with alcohol advertising and sponsorship.

Advertising and sponsorship are deliberate strategies to change attitudes and behaviours. They

Figure 4: Flynn Drive, showing part of the GMC 400 V8 circuit in 2000.

Normally the scenic Lake Burley Griffin would be visible on the left. With the concrete barriers, the road now takes on the appearance of a NASCAR racing circuit.



frequently rely on the technique of association of a particular product with popular activities. Alcohol advertising and sponsorship can influence the place of alcohol in our culture, and thus can reduce any attempts by communities and health authorities to control alcohol consumption. People (particularly young people) attending or watching car racing events where alcohol is promoted, advertised and consumed, may learn to associate alcohol consumption with the excitement of the event or the skill and popularity of the drivers. Alcohol advertising and sponsorship avoids any messages about the risks of alcohol use and abuse.

The GMC 400 V8 television coverage was sponsored by a range of companies, including an Australian brewing company. A number of racing cars sponsored by a brewing company clearly displayed the logo of a popular Australian beer. Drivers also had this logo on their clothing. Large signs advertising beer were placed beside and across the track. (Normally, billboard style advertising is not allowed in Canberra, particularly in the Parliamentary Zone. However, the race organisers had received an exemption for the erection of advertising signs.) There were also a number of television advertisements for various alcohol products during the coverage of the race. Not surprisingly, some of the car advertisements shown during the race emphasised high speed, power and acceleration (hardly the characteristics needed for increased road safety).

Television advertisements for alcohol are normally restricted to after 8.30 p.m. on Australian television through the Commercial Television Industry Code of Practice. However, the code makes an unfortunate exception to this, allowing such advertising as an 'accompaniment to the live broadcast of a sporting event on weekends and public holidays'. If the reason for the restrictions on advertising alcohol to adult viewing periods is to limit the exposure of young people to this advertising, then the exception for sporting events is a very questionable concession to the alcohol industry. Many young people (including those under the legal drinking age) watch sporting events (including car racing). Such people are thus exposed to this advertising, which is normally restricted because of this potential audience. Australia's Federal Health Minister, Michael Wooldridge agrees, suggesting that 'many younger people are getting messages about alcohol that they shouldn't be getting and that are contrary to what we are trying to do with our campaigns to discourage under-age drinking' (Gray, 2000).

The locations of the signs advertising beer around the track were well chosen in terms of their visibility to television audiences. At the corner of State Circle and Flynn Drive, where racing cars were slowing to

negotiate the corner, signs advertising an Australian beer were strategically placed on both sides of the road. Because of the slow speeds at this point (cars back to first gear), the signs were clearly evident as cameras followed the cars into and through the corner. After the cars negotiated this corner, they then accelerated down Flynn Drive, one of the fastest parts of the track. Located over the track, and stretching right across the entire race track, was a huge advertising sign for the same beer.

In terms of the power of association, the location of this large sign across the track was unfortunate for road safety, and fortuitous for advertisers who obtained a subliminal association of beer with excitement, speed and power.

Many studies have demonstrated a link between alcohol advertising, drinking and public health, particularly in younger age groups, and there have been many calls for a ban in Australia (and elsewhere) on alcohol advertising (Sivyer, 1990; Grube & Wallack, 1994; Casswell, 1995; McDaniel & Mason, 1999). In particular, the marketing of alcohol in association with sport has been criticised for its informal sanctioning of drinking, and for promoting the false notion that alcohol consumption is virile and healthy and will lead to success. Breweries seek links with sport as this offers them a macho vehicle (literally in the case of car racing) to appeal to young males. Ironically, alcohol consumption in males lowers levels of testosterone, the male hormone that maintains the sex drive (Burke, 1999). Sporting events have been described as incongruous with the use of alcohol. Indeed, Australia's Federal Health Minister indicated his support for limiting alcohol advertising at sporting events, even suggesting that 'restricting alcohol sponsorship of sport is the next major public health challenge' (Gray, 2000). Some studies have also suggested that the Australian public would not oppose restrictions on the advertising of alcohol (Sivyer, 1990).

Australia has few restrictions on alcohol advertising or sponsorship compared with countries such as Sweden. Australia has also been described as a nation of high-risk boozers in which 51% of all alcohol consumed exceeded safe drinking guidelines. Recent research by Australia's National Drug Research Institute found that Australia had become 'economically dependent on high risk drinking' where 50% of the \$2 billion tax collected on alcohol purchases is 'based on drinking that represents a risk to health and safety' (Canberra Times, 2000).

Saffer (1997) provides evidence from regression modelling indicating that alcohol advertising not only increases consumption of alcohol, but is also related to increased highway fatalities. His analysis indicated

that a ban on broadcast alcohol marketing could reduce highway fatalities in the U.S.A. by between 2000 and 3000 lives per year.

Alcohol advertising has many parallels with tobacco advertising. Both involve public health issues, both involve powerful and well-funded lobby groups, and both see benefits in associating themselves with sporting events. The restriction of alcohol advertising is often opposed on the grounds that unlike tobacco, moderate alcohol consumption may have health benefits. However, the argument that moderate consumption of alcohol is beneficial loses its validity in terms of the impact of alcohol on road safety. An awareness of the harmful impact of even moderate alcohol consumption, especially on young drivers, is reflected in regulations limiting Blood Alcohol Concentrations (BACs) to zero or to very low levels for Learner Drivers and Provisional Licence holders in many parts of Australia and throughout the world. In some Australian states (e.g. Tasmania and Queensland) certain categories of inexperienced drivers are restricted to BACs of zero. Other states (e.g. ACT, NSW) restrict such drivers to BACs of 0.02 grams of alcohol per 100 millilitres of blood. In Sweden this limit (0.02) is the maximum level for any driver.

The power of alcohol advertising at the GMC 400 V8 may have been enhanced by its location in the Parliamentary Zone. Not only could the advertisers associate alcohol with speed and excitement, but also with national symbolism.

The significance of place: car racing in the Parliamentary Zone

‘Our point is that the race is in the wrong place. We feel that the best location for a car race is on a designated track ... the Parliamentary Triangle for [reasons of] safety ... symbolism, and the totally inappropriate exploitation of national assets, is not a suitable location’ (Rees & Davey, 2000, 8).

The Parliamentary Zone in Canberra is a very significant national place that has been created in a conscious and deliberate process (NCPA, 1996; Keffe, 2000). The importance of national symbolism in the Parliamentary Zone cannot be overstated. The *Parliamentary Zone Review* declared that ‘the symbolic appeal of the Parliamentary Zone, mainly attributable to its political roles and the clarity of its geometry and setting must not be compromised’ (NCA, 2000a, 6). The *National Capital Plan* which is used to control the Parliamentary Zone, describes it as ‘the

Figure 5: Australia's new Parliament House providing a symbolic backdrop for the promotion of the GMC 400 V8 Supercar race.



home of the nation's most important cultural and judicial institutions and symbols' (NCA 2000b, 28). The elements of the landscape that contribute to the sense of nationalism include many national icons and monuments, such as Parliament House, the National Library and the National Gallery. Many of these elements of the Parliamentary Zone landscape are instantly recognisable as symbols of Australian nationalism.

Alcohol advertisers try to associate their product with the glamour and excitement of car racing. Similarly, the organisers and promoters of the GMC 400 V8 make a particular point of capitalising on the national functions of the Parliamentary Zone as a way of raising interest in the race. The race was marketed using the slogan "The Nation's Heart is Racing". As one commentator for the television coverage of the race explained: '... let's recap the location of this unique circuit ... old and new Parliament Houses, Treasury, National Gallery, National Library, High Court building ... so many landmarks, so much excitement'. The association of the national icons of the Parliamentary Zone with the GMC 400 V8 (and its various sponsors) represents the exploitation of publicly owned and nationally symbolic property for commercial gain (see Figure 5).

Ford Falcon and Holden Commodore V8 cars are regarded as the quintessential 'Australian' supercars. Allowing the marketing of alcohol through sponsorship of these V8 cars not only informally sanctions the idea that alcohol consumption is healthy and virile, but also that alcohol consumption is typically Australian. The great Aussie V8 driver is associated with the great Aussie drinker. Also, because of the national importance of sport in Australia '...the advertising of alcohol in conjunction with sport is reinforcing the concept that alcohol is also part of the fabric of Australian society' (Sivyer, 1990). For the GMC 400 V8, this association is strengthened by being located in Australia's most significant national place.

The GMC 400 V8, like many other car races in Australia, sanctions the combination of the pursuit of speed on public roads with the promotion of alcohol. Unlike other car racing events anywhere in Australia, and perhaps anywhere in the world, the location of the GMC 400 V8 is problematic in terms of a public health message. It is one thing to allow the combination of alcohol advertising and speed in a car race. It is considerably different if this event is held in a significant national place. The location of the GMC 400 V8 in the Parliamentary Zone in Australia's national capital sends a message to people throughout the world that our federal government supports, more than simply condones or allows, the combination of alcohol advertising and high speed car travel on

public roads. This could be interpreted as implying that the Federal government is willing to place road safety issues at a lower priority than the promotion of local brewing industries. Allowing the GMC 400 V8 to be held in Australia's most significant national place also implies that Australia's federal government is happy to glorify events that may undermine the development of healthy transport policies.

Conclusion

Other local interests often conflict with issues of well-being. The GMC 400 V8 was staged in Canberra for economic reasons. However, in determining the overall benefit of the race, it is unlikely that any consideration was given to the possible public health implications of the race: increased alcohol promotion; the glorification of powerful cars; the reduction of security for pedestrians and cyclists; and the sanctioning of high speed and aggressive driving behaviour in a nationally significant place. Though such costs are difficult to measure, they should at least be part of any comprehensive approach to improving well being in society.

Many decisions made by governments and policy makers have impacts on people's well-being. However, it is likely that the public health consequences of many decisions are not recognised. Politicians and government departments need to recognise the wider implications of all of their policies and actions. They need to put public health issues, particularly the reduction in road fatalities, above any other motives, including economic development. They should be encouraged to follow an ethical rule proposed to guide road system designers in the 'Vision Zero' philosophy of road safety. This ethical rule states: 'Life and health can never be exchanged for other benefits within the society' (Tingvall & Haworth, 1999).

The authorisation of the GMC 400 V8, along with exemptions for alcohol advertising signs, in the Parliamentary Zone provides an example of how politicians, both ACT and Federal, may have (albeit unwittingly) helped to promote values that undermine public health.

Banning all alcohol advertising and sponsorship for the GMC 400 V8 in Australia's Parliamentary Zone would be a very symbolic first step that could provide a catalyst for any further moves to tighten regulations on alcohol advertisements in Australia. This would send a powerful message to young people that Australian society does not condone the association of car racing and alcohol, and is willing to place the health of Australians above increasing the profits of alcohol companies.

Notes

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Twisted Logic in the upside-down world of 'road safety' ideology: A case study of 'The Safety & Security issues of Women drivers & passengers'

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Abstract

A response to 'The Safety & Security issues of Women drivers & passengers' by Woodcock *et al.* in *World Transport Policy & Practice* 7.1. This article is questioned for its use of an apparently feminist approach to safety which conflates women's rights with motoring privileges; it is specifically criticised for identifying car occupant safety with vehicle crashworthiness. This critique then moves on to show how the article should not simply be contested, but that its main importance is as a text to be seen as a case study in 'road safety' ideology. This leads to a demonstration of certain assumptions which function in a destructive fashion, characterised by an inversion of the road safety policy required for a more civilised transport system.

Keywords

Cars, civility, danger, design, safety, vulnerable road users.

Introduction

Woodcock *et al.* appear to have a feminist perspective, that is to say one that holds that women – in this specific case, and probably elsewhere – are being disadvantaged with respect to men. My view is that there is always a difficulty in a male commentator discussing questions of actual or alleged discrimination against, disadvantaging of, or oppression of women by male practices or male-based ideologies or cultures. Nevertheless, there is a strong case for academic discussion being open to male writers such as myself: one might also point out that a number of the authors and those acknowledged in the production of the article are male.

A central issue, then, is that of women's alleged 'rights' as motorists and car passengers. (For brevity's sake I often restrict myself to them as drivers). But women's rights can surely only be meaningful if they are genuine rights. These rights would have to be universally available to women, and probably men as well. They would have to be accompanied by the

fulfilment of associated responsibilities (or at least genuine accountability).

But neither of these two conditions obtains, or is even considered seriously in the text. Indeed, the thrust of any policy based on the assumptions underlying the text would be to create societies where there are significant problems created for humanity, about half of which is female. These two issues are considered below, followed by a more general discussion of what safety on the road should be about.

Do you really want women to drive?

What would happen if women actually had the 'right' to drive cars as they do at present in countries such as Britain or the United States, and used it? After all, rights have little meaning unless they can be used.

At present the vast majority of people in the world do not own cars. Over the last 50 years, while the number of cars has increased approximately 10-fold, the global population has doubled. In fact the number of people in the world who do not own cars has increased from 2.5 billion to 5 billion. While Woodcock *et al.* refer to the 'growing number of female users', the number of women in the world **without** access to cars has grown in this period. Even with increased car production and a tailing off of population growth the vast majority of women in the world will not be using cars in the foreseeable future.

Even in Britain the number of adult women with driving licences has only become a majority in the last few years. As there are about half as many licence holders again as cars being driven, we can assume that a majority (just) of women will not be driving on a typical given day.

In a report for an OECD Working Party on Pollution Prevention and Control, Adams (2000) considers the prospects. The UN medium projection for the world population in 2025 – the kind of timescale I suggest we should be considering – is 8.5 billion. The US in 1993 had a motor vehicle ownership level of approximately 0.75 per person, which has increased

since then. If we take just that 1993 level as indicative of what a human being had a 'right' to, we are considering a level of car ownership in 25 years time of some 6.4 billion motor vehicles, compared to about 0.5 billion now.

There are ways in which those with some time on their hands may like to amuse themselves while speculating on this scenario. Allowing for London parking standards of 3 metres length per car, 6.4 billion cars – and many of the motor vehicles would be larger and longer than cars that could park in such spaces – would take up some 40 million kilometres when parked. If stationary they could be accommodated on a motorway stretched around the equator (sea included) if it were 1000 lanes wide (Adams, *op.cit.* pp.109-110).

There are rather more serious considerations. It is likely that changes in fuel technology will lead to less damaging effects in terms of noxious and greenhouse gas emissions from typical cars in the future. However, even if they were significantly reduced, with the kind of growth considered above the adverse effects on humanity would be disastrous for millions of people. Even with such new fuels, increases in motor vehicle usage would create more problems than stabilisation or reduction in amounts of car usage, as at least some problems are likely to continue while oil and other fossil fuels continue to be employed.

In fact Adams does not consider these two most widely cited problems. Just some of the others he does are:

- Social polarisation: The significant minority of those without access to cars (about one in five households in Britain in present, although the vast majority in the world are likely to remain carless for the near future even under present trends) are disadvantaged with respect to those with access to cars. Increased car dependence brings with it lifestyles where non-car use becomes increasingly unattractive.
- Land use: Increased sprawl of cities and increased difficulty for non-car users as journeys become too difficult to make by the alternatives.
- Community relationships: the conviviality of local communities is undermined.
- Promotion of geographical uniformity and loss of cultural diversity.
- Loss of safety for non-car modes such as walking and cycling and loss of health for the car dependent. Shifting from the healthy and environmentally more benign modes of cycling and walking produces health problems – obesity, heart disease, stroke, depression, and stress. In the normal public health accounting terms these account for far more life-years lost than 'Road Traffic Accidents' (see, for

example, BMA / Davis, 1997).

All of these disbenefits are entwined in the web of car dependency, and not just car dependency, but **increasing** car dependency. Ameliorative efforts, such as the initiative to 'get people out of cars and on to public transport' are at best of minimal, and often expensive, assistance. To illustrate this example further, the increased use of rail over the last few years in Britain has not reduced car usage, but very often slotted neatly into car dependent lifestyles as increased urban sprawl lengthens commuting and other journeys, only part of which are travelled by train. Bus travel is often inappropriate as an alternative precisely because car dependency fits with land use patterns where bus use is inappropriate. Alternatives of public transport, in short, only function as a sustainable solution if measures are taken to discipline car usage in the first place.

An example: School escort journeys by car

This picture of what happens if the 'right' of car usage is to be achieved demands a holistic analysis. However, this can proceed with consideration of individual types of travel by car. School escort journeys by mothers have become a matter for attention. The freedom of mothers to drive children distances outside local areas and to a wider selection of schools brings certain costs. This freedom means that it becomes more difficult to rely on the suitability of local schooling as those with greater freedoms to travel – generally the wealthier – use their freedom to move away, thus impoverishing local provision. Escorted children lose out on the benefits of independent mobility, with attendant psychological and physical health benefits. Those enjoying this 'right' may well secure superior schooling, and cope with the health disbenefits to their children by other means – perhaps driving them to a gym after school where they can use stationary bicycles, for example. They may feel they have fulfilled maternal duties by spending a few hours a day engaged in this activity. They may feel they have protected their loved ones from the threat of danger from traffic which they have assisted in contributing to. They may feel they have protected girls from sexual assault on roads increasingly empty of traditional communities walking about, because of the increased use of cars of which they are examples.

Nevertheless, policy makers and all of us concerned about transport and the environment should consider the disbenefits for others – impoverished local schools, increased danger on the road, increased noxious greenhouse gas emissions, etc. On top of this, the subtle changes that involve increased car dependency for other kinds of journey continue apace.

In the first reference to their article, Woodcock *et al.* refer to an Automobile Association publication entitled: '*Women and Cars: Emancipation, Enrichment and Efficiency*'. For some women that may be an accurate description. However, the 'right' to cars is assumed with no real sense of awareness of the need for control over the manifold adverse consequences of attempts to secure this 'right'. Until it is, in the name of the majority of humanity (and the majority of women) who will suffer from this attempt, no civilised analysis of women's car travel can proceed.

Indeed, until awareness of the problems is translated into real programmes based on proper control of the disbenefits of car dependency, it can be argued that further promotion of car dependency, including women's 'right' to car travel, should not be supported by those committed to sustainable transport.

Women have often played oppressive, destructive and discriminatory roles in history. Arguing that women should be equal to men in such roles is neither feminist nor civilised. As such the thrust of Woodcock *et al.* is flawed from the start. This becomes even more evident with their twisted logic on 'safety'.

Controlling violent men (and women) ...

Over the last twenty years of research and writing on road safety, as well as the routine work of a local authority transport professional, I have met numerous worried motorists concerned about safety on the road. In common with other professionals working in the field which has come to be known as 'road safety', I note that very few of them see that *their* driving could be the problem. The natural human tendency to see others as more of a problem than oneself is particularly important when it comes to being charged with the uniquely high potential for damage to others that car usage brings. It is exacerbated by a car culture which emphasises the individual power and freedom of the motorist.

But it is aggravated even further by a 'road safety' ideology which presents motorists as innocent victims – mainly of other motorists, although this is not dwelt on – requiring protection rather than proper regulation. Massive resources have been expended on engineering motor vehicles to allow drivers to crash into other cars, roadside objects and human beings without fear of injury. The plea by Woodcock *et al.* for female dummies in crash testing is just the latest intervention in a line from anti-burst door locks through seat belts and crumple zones to air bags and side impact protection systems. Many billions of pounds are spent on creating highways to make it easier to avoid crashes (long sight lines, anti-skid treatments, rumble strips, etc.) and to avoid the consequences when they do (crash barriers, removal of

trees and roadside objects, etc.).

Although there are pockets of road treated to protect pedestrians, it is to some extent true that, as Woodcock *et al.* state: '*... cars and road environments have been designed to accommodate male drivers*'. To be more precise, they have been designed to pander to what may be called the violence of motorists. It is an accommodation of rule-breaking, law breaking and what may be seen as criminal negligence on a massive scale. And it is that of female, as well as male, drivers.

'Violence' may seem a rather strong word to use. But consider the meanings of the word '*violence*' in the Collins English Dictionary, which include:

1. The exercise or an instance of physical force, usually effecting or intended to effect injuries, destruction, etc.
2. Powerful, untamed or devastating force.
3. An unjust, unwarranted or unlawful display of force, such as tends to overawe or intimidate.

Most of the danger posed by motorists is not of a kind which involves a significant degree of evil intent. Nevertheless, if we consider that human beings have responsibilities, and if we believe that there is a human-made problem which we should address – especially if we are professionals dedicated to safety on the road – then it can be seen that the above definitions are appropriate.

There should, of course, be some way of describing this violence. The normal way to do this is to quote the total figures of 'Road Traffic Accidents', and to present them irrespectively of what I see as the important characteristics of road danger. Generally these figures are presented in order to demonstrate that the ones selected are declining, or are lower in Britain than in lots of other countries: in other words to show that 'we' are doing well. I prefer not to do this.

What the aggregated RTA figures miss out, apart from the well-known non-reporting and misallocation of casualties, is the different road user groups. More importantly, it gives no idea of casualty rates in terms of exposure. Indeed, the relevant Government Department (part of which financed the research by Woodcock *et al.*) is notorious for hesitating to support cycling and walking because large increases in these modes might lead to additional casualties. The fact that casualty rates among these groups might decline is irrelevant to them – but not to ordinary human beings.

Even more important, there is no difference allowed between those killed or hurt by others – even committing infringements of important rules and laws – and those who hurt themselves. This kind of throwing together of statistics has serious problems.

Firstly, if we are to look at numbers of life years lost associated with transport irrespective of moral or legal considerations, we would see 'Road Traffic Accidents' as being lower down the scale than road safety professionals might like. We would allocate a far higher importance to life years lost from the health disbenefits of travelling by car rather than walking or cycling (obesity, heart disease, stroke, etc.). We would allocate more importance to noxious emissions, let alone greenhouse gas emissions. We would also have the not inconsiderable health disbenefits of disrupted communities. Then of course there is the matter of the costs of road building and other subsidies to motoring which could be diverted to health care.

In other words, if we are supposed to obey the statistics, we would be pressing ahead with traffic reduction programmes and keeping road safety – however it is defined – pretty well down the agenda.

Secondly, it erodes responsibility from those, essentially those in charge of motor vehicles, who have significant potential to hurt or kill others. It removes the politics and morality of road danger. Since the road safety movement in many countries (although Britain is in many respects different from several European countries here) was developed as an adjunct to the motor industry and the motorists' lobby, this was to be expected. It is not, however, something which should be tolerated by those committed to a civilised society, let alone a sustainable transport system.

The effects of road danger are not anyway easily assessed in quantitative terms. The loved ones of those killed or hurt in road crashes are generally affected by what they see as moral or political questions: some things are seen to be unjust and in need of proper control or regulation. All of us accept that some things are acceptable risks or 'genuine accidents': the issue is one of whether our culture allocates these incidents in a civilised way (Davis, 1993). One example will illustrate this.

How society considers everyday violence: the example of rail and road crashes

Road safety professionals frequently bemoan the fact that more importance is given by the media to train crashes, in which far fewer people are killed than in road crashes, and in which travellers have a far lower chance of being killed per journey or mile travelled, than in road crashes. Road safety professionals attribute this to the media-friendly spectacle of train crashes, or the fact that motorists believe that they are in control of their fate when driving. The implication is that the general public is foolish and should re-assess its chances in line with

what the professionals tell them.

But this is nonsense. Most of us consider that a rail system (perhaps operated in ways we disapprove of) which puts us in any more danger than we would like is at fault, whatever the chances of injury may be. It is a moral and political issue which no amount of statistic brandishing can – or, in my view, should – alter¹. Of course, I personally believe that monies which may be diverted to rail safety could be better spent on more important things: improved quality of rail services, control of road danger, the health service or education. Which brings us to 'road safety'.

Simply arguing that 'motorists believe that they are in control' – and that they are therefore misguided – is bizarre. The driving experience is marketed on the premise that individuals are in control of their fate, unsullied by the presence of other travellers on public transport or any unpleasantness the environment may present to them. The article by Woodcock *et al.* is all about how motorists see themselves as unfairly subjected to problems that impede their independence and control of their destinies. The fact that they as part of the motoring community are the source of this danger is a fact which is almost entirely absent: the arrogance of this denial is rooted in the psychology of motoring.

A justification sometimes given for what statisticians may say is a disproportionate amount of attention to rail danger is that road users have choices which they do not have as rail passengers – that they are indeed 'in control'. But that is precisely the point. The more dangerous have a great deal of choice in the extent to which they endanger others. While the more vulnerable may have some choice in how much evasive action they can take to avoid danger, the basic fact is this: danger comes from the motorised, and whatever the responsibilities of the vulnerable may be, their safety (and indeed the safety of all road users) comes down to the question of how that danger is accounted for.

How much violence: and how do we deal with it?

So what is going on, and how is it accounted for? We might start by returning to a statistical assessment of road danger. Rather than tot up RTAs, we might consider the numbers of motor vehicle crashes as reflected in insurance claims, giving figures substantially larger than RTA casualties, but perhaps more indicative of road danger. We could look at those

¹ There is a debate about whether risk can be quantified at all. See Adams (1995) *Risk*. This involves issues around the assessment of risk by 'everyday' observers and those with a supposedly scientific agenda: my view is that there is a place for statistics providing their use is carried out with a circumspect attitude and awareness of the wider political and moral context.

people who feel too intimidated to travel by the more benign modes of transport, or to allow their children to. Such measures would lead us to a less complacent picture of road danger than the picture of improvement painted by the traditional road safety establishment might have us believe (Road Danger Reduction Forum, 2001, p. 9).

Of course, even here the figures can be spun to whichever political programme is advocated. We are regularly told that cycling is more 'dangerous' than other forms of transport. We return to the precise meaning of the term below. But even in terms of the chances of being hurt or killed – rather than those of hurting or killing others – cycling may be a lot less hazardous than is often imagined.

Considering typical urban cycling journeys in London we see that the chances of being killed or hurt on a given journey are very low. In fact, comparing these chances with the health benefits accruing from cycling we see that I am more likely to be killed by not cycling than from anything which might happen when cycling: traditional road safety culture can be very good at scaring people off unnecessarily from pursuing rational choices which are also in tune with sustainable transport policies (Royal Borough of Kingston on Thames, 1998, 7 – 9).

But what if I happen to want to cycle on rural roads? Here following the statistics becomes confusing. I learn that I have a much smaller chance of being injured on roads where there are, of course, far fewer cars to be in collision with. However, I also learn that because the speeds of vehicles are higher, the results of collisions are much more likely to be fatal. So the much more important measure indicates a worse situation, whereas the less serious indicator suggests a better one. On the other hand, the worse result (fatality) is less likely than the less bad one (injury only) (Davis, 1995). And what happens if I want to travel on longer journeys?

This, however, is only the beginning. For what we have been looking at are retrospectively analysed figures. What we are all concerned about with risk is what will happen. This is a different thing to which the retrospective analyses are less reliable than many professionals would have us believe. Indeed, it is common among students of cycling collisions to suggest that a greater presence of cyclists on the roads can make other road users more aware of their presence – the 'critical mass' argument. In other words, reducing my chances of becoming a casualty may involve getting a lot of other cyclists out there as well.

But even that fails to take us far enough forward. For basically I think I know what the issue is as I cycle on rural roads in Britain.

We know that factors in collisions are excessive speed of motor vehicles, and that motorists frequently assume that there is nobody on the other side of blind corners. We also know that large and relevant areas of the Highway Code are broken as a matter of course. Using the indicators of the Autoglass report (1996) we see that important rule infractions are committed by Britain's motorists at least dozens of billions of times annually.

It would seem to me that the response of professionals concerned with road safety should be to promote the appropriate steps to control this problem, rather than accept it. For a start, if motorists wish to have the choice and freedom to drive in an illegal or rule breaking way which may hurt or kill others, they should be held accountable with appropriate law enforcement and sentencing policy. Of course, even a half way serious attempt to do this would result in millions of licence disqualifications rather swiftly. Yet the response of the Government is opposed to it. In a consultation paper on sentencing policy issued in 2000, the relevant government Departments state:-

'It is important to note that against a background of over 30 million drivers holding full licences... there are 1.8 million endorsements in any one year. Some 95% of motorists therefore get through the year without committing an endorsable offence (*sic*). This goes a long way in showing how the average motorist does have a generally responsible attitude towards safety on the roads.' (DETR & Home Office, 2000).

In fact it indicates that the Police and the enforcement system deal with only a minuscule proportion of behaviours that could be offences.

Of course, law enforcement or transport policies designed to reduce traffic are not the only measures that can be taken. Traffic management and highway engineering can be implemented to control speed and reduce dangers to others. But this is limited, exceptional, or at least inadequate. Even if it was accomplished, while motorists are still legally charged with responsibility to others law enforcement and sentencing policy need to be transformed thoroughly and fundamentally.

Woodcock *et al.* are more than aware of this massive endangering of others. It is why they feel the need to protect female car occupants in the first place. Their approach avoids dealing with the issue of the responsibility of drivers, apart from some minor suggestions about activities to be taken on a voluntary basis. But it is even worse than that.

... or making them more violent

Why is it that the grand total of RTA fatalities declines in countries experiencing motorisation?

The normal response is that the plethora of interventions in highway and car engineering are responsible. It would, indeed, be remarkable if such fundamental transformations had not led to a reduction in deaths. But a closer look reveals a sinister aspect to these changes.

Less well mentioned in accounts of road safety history are the reductions due to increased congestion intensity where speed reduction or forced greater awareness by motorists of others reduces danger: danger still increases with increased motor traffic, but not by as much as would occur without this factor. Increased effectiveness of medical technologies plays a major role. Then of course the more vulnerable tend to move out of the road environment or moderate their behaviour.

Considering these factors as well suggests that the massive changes in engineering have not been as effective as they should have been. Why is this?

The answer is obvious. We all adapt our behaviour to perceptions of risk: indeed, it would be ludicrous to suggest that this could not be the case. Indeed, many fans of highway engineering will become proponents of the risk compensation hypothesis when it comes to the issue of controlling their speed: going slower would make them concentrate less.

Those of us concerned with promoting a less dangerous road environment for all are rather more concerned with the adaptive and compensatory behaviour of motorists put into more crashworthy cars with a highway environment designed to make them worry less about their responsibilities.

From studded tyres through seat belts on to anti-lock brakes; from accident migration at black spot treatments and motorway construction, the evidence is undeniable: engineering which panders to the danger of motorists exacerbates it (See Adams, 1985; Davis, 1993; Wilde, 1994). Put crudely, making environments idiot-proof produces idiots.

But if this is universal and inevitable, so what? Does it not back up those who argue against speed control and other danger reduction measures?

No. Insofar as motorists may relax more when driving less swiftly, the answer is to implement other means to deal with any decreased caution, not to refuse to implement the measure in the first place. Furthermore, measures designed to encourage safer conditions for walkers and cyclists may indeed reduce caution on the part of these road users: one must return to the fundamental distinction between hurting others

and doing harm to oneself.

But it gets worse. Part of the reason for inadequate controls over motor danger is the prevalence of forms of adaptive behaviour which do not get picked up so easily in studies of risk compensation. They are what I have called 'long term risk compensation' and refer to changes in the 'safety culture' which we suffer under. Here the violence moves on to another dimension.

Violence against language

A return to the Collins English Dictionary tells us that '*tending to distort the meaning or intent*' is defined as '*violent*'.

Consider an article in the main journal for traffic engineers in Britain devoted to countermeasures for car accidents in rural areas which typically involve cars being driven off roads by sleepy or drunk motorists into trees. The solution advocated is removal of roadside trees, and also stumps '*as these can still be aggressive*', as well as fences since these are '*a particularly aggressive form of man-made structure*'. (Rattenbury & Gloyns, 1992).

But their description of inanimate objects as aggressive is only part of an assault on the English language which is part of the 'road safety' tradition.

The very meaning of the word 'danger' is distorted. The transitive (doing to others) and intransitive (done to you) meanings of the word are confused. What this means is that a mode of transport like cycling (or walking) which poses relatively little threat to others is 'dangerous' because of the vulnerability of cyclists to the danger from cars, but because motorists are relatively invulnerable they are not 'dangerous' - despite the fact that their danger to all other road users is significantly greater than that of cyclists or pedestrians.

This culture contains an unpleasant element of victim-blaming. In a recent study of motorist prejudice against cyclists, one of the 'reasons' given for negative feelings towards cyclists is the fact that cyclists are not legally required to wear 'safety aids' such as crash helmets, as are motorcyclists (Scottish Executive, 2001).

We know that motorcycling is a form of transport far more dangerous to others than cycling, less environmentally sustainable and less healthy. We also know that the 'safety aids' employed by motorcyclists such as helmets have resulted in less careful behaviour by them. We also know that there is evidence on bicycle crash helmet wearing which suggests that it results in minimal, zero, or even increased casualty rates for cyclists (Davis, 1993, c. 11. A more recent review is Franklin, 2000).

All of this would suggest that the 'safety aid'

culture is not only misleading but is being employed to back up a dangerous prejudice against a form of necessary sustainable transport.

Conclusion: Homo Motorist: Victim or Problem?

We have a dangerous and twisted logic in modern 'road safety' culture. What should we do about it?

The most important thing is to recognise a degenerate culture for what it is: not least the ease with which those who have created the problem are allowed to present themselves as innocent victims of it.

It appears that the addictive cycle of motorisation has not been as beneficial as it might have promised even to that minority which has profited from car use. We learn from Woodcock *et al.* that a number of her survey respondents feel threatened and vulnerable. They are even being '*forced off the road*' by the behaviour of their fellow motorists. The promise of independent freedom has, of course, backed up the culture of fear: ever more sophisticated ways of separating car occupants from the environment and their responsibilities to it and other human beings has not even made them that happy.

We might use psychoanalytic and other psychological categories to describe this: the feature of being separated away from others is often referred to as schizoid. A medical condition about which there is much current debate is one where sufferers live lives remote from their fellow human beings. It is called autism.

But this unhappiness or neurosis is not as important as the effects on others. There is little mention of those road user groups who have – often literally – been forced off the road, or of the fact that the 'safety aid' culture has facilitated this process. We learn that some of the respondents feel that they should sometimes walk or cycle to be aware of the problems of these users. But a patronising attempt by the Queens of the Road to try not to hurt others – if they feel like it – is not the kind of thing we would accept as sufficient in rail, aviation, nautical or industrial safety.

Genuine regulation and control would involve any manner of proper discipline. Traffic reduction, restriction of licences by regular re-testing procedures, high quality law enforcement and deterrent sentencing, engineering highways to protect the non-violent are possibilities. The smart GPS technology modern researchers like Woodcock *et al.* know about can be used as black box technology to monitor crashes and assist in the legal process: such technologies have been known about for years (Road Danger Reduction Forum, 2001, pp. 50 – 52).

Ultimately cars could be driven in a more or less fully automatic mode: with instructions tapped in to

the on-board computer, motorists could sit back and enjoy levels of safety for all road users at least as high as for rail travel. They could play 'Formula One' on *Playstations* and derive autoerotic pleasure without endangering others on the road.

But in order to achieve this the motorised have to be seen as the problem, rather than the victims. Without this modern technologies are used (as with motorway docking) to promote more car usage, and more freedom without responsibility for the motorised.

Indeed, with a necessary cultural change to seeing motorisation as the problem it would be a lot more possible to reduce road danger without technological changes or transformation of legal and engineering procedures. We know from analysis of motorist behaviour that most are capable of driving a lot more carefully if they want to².

Most of the people reading this will be members of that minority of humanity who have female loved ones who are car occupants. We want as much safety as possible for them. Consider the '*Refuse to be a victim*' programme promoted by the National Rifle Association (2001) in the U.S.A. There is substantial evidence there that firearms are frequently used for self-defence, that the accidents associated with their use are tiny in number, and that the deaths and injuries resulting from their intentional use – much of which would happen with strong gun control laws anyway – is less than is associated with other social problems such as road crashes. Indeed, some countries such as Switzerland and New Zealand seem to have minimal problems with easily available guns including high-powered automatic weapons (See, for example, Kleck & Kates, 2001).

But we do not think of women's security in the U.K. in terms of having the 'right' to possess guns, including high-powered automatic weapons, and with the 'right' to carry them concealed in public. Many of us see a culture that does – despite a history of its gun culture going back well before the motor car – as having serious problems. We do not see the solution to the problems of the gun-toters as giving them comfortable bullet proof clothing and neglecting their potential or actual victims.

² Writers like Adams, Wilde and myself are often accused of a 'pessimistic' attitude towards road crashes. In fact risk compensation suggests that in the same way that motorists tend to drive worse when they perceive themselves as better protected, they will drive better when they perceive their environment as more threatening. This would explain why the creation of a more dangerous road environment when the side of the road drivers were required to drive on changed in Sweden did not lead to the officially expected rise in casualties. See Adams (1985) op.cit.

If we did, many of us would see this as getting hold of the wrong end of the stick, of seeing things upside-down. We would want to turn things the right way up. That is what we should do with the 'road safety' culture of the type presented by Woodcock *et al.* That

means a variety of measures which flow from a correct understanding of the need to reduce danger on the road by making motorist privilege properly accountable. It means that the defenders of motorist privilege should show some humility and less self-pity.

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Determinants of air travel growth

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Abstract

This article identifies the main determinants of air travel growth focusing on drivers and impeters. Major drivers of air travel growth are increased personal incomes combined with reduced real airfares, the latter furthered by airline marketing strategies and government subsidies to the aviation industry. Other drivers are increasing market liberalisation and globalisation of manufacture, trade, personal relations and economic and political systems, as well as changing geography, population growth and migration. Working structures and changing age- and wealth distribution in the population also play a role, as well as changes in social norms and values and individual needs, wants and desires. Future policies for impeding air travel growth may aim at reducing growth in personal incomes while increasing real airfares, limiting the expansion of aviation's socio-technical system and setting up per capita quotas for air travel. Promotion of alternative lifestyles, as well as restrictions to globalisation and market forces may

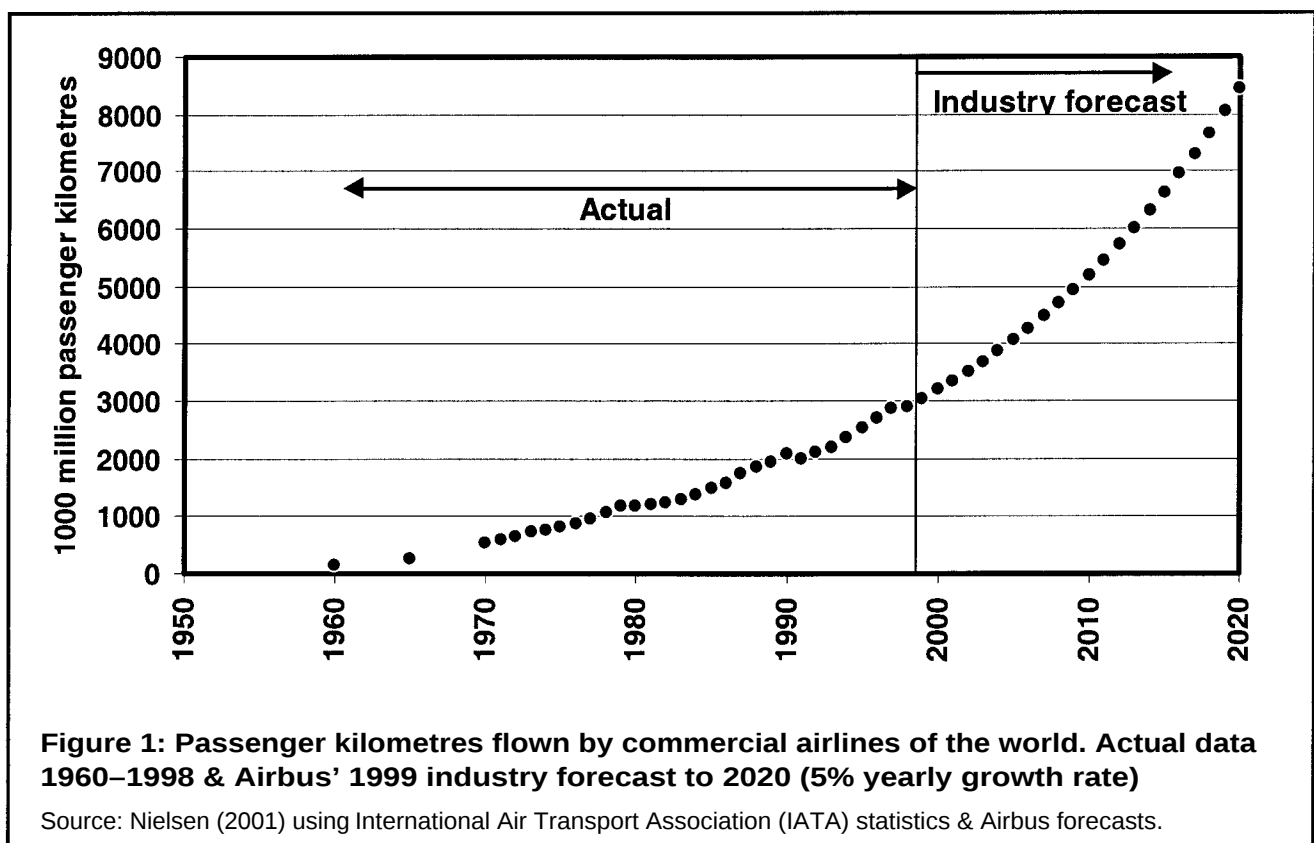
also prove useful in the longer term.

Keywords

Aviation, air travel, environment, growth.

Background – Growth in the environmental impact of aviation

Global air travel is envisaged by the aviation industry to increase almost threefold by 2020 (Figure 1). Air travel grows strongly than aircraft fuel efficiency, leading to increased fuel consumption and increased emissions of aviation greenhouse gases. Today, aircraft emit about 12% of CO₂ emissions from all transportation sources. The overall impact on global warming may be 2 – 4 times as great as CO₂ emissions alone, because aircraft emit water vapour and nitrogen oxides at high altitude which act as greenhouse gases and greenhouse gas precursors (IPCC, 1999). In the next decades aviation fuel use is expected to grow by around 3% per annum. For environmental reasons it therefore seems necessary to discuss possibilities for reducing air travel growth in the



future. In this context it is relevant to investigate the forces promoting and sustaining air travel, as well as factors impeding air travel.

Determinants of air travel growth

Some important economic, physical, social and political determinants of air travel growth are illustrated in Figure 2. The circle in the figure illustrates the size of air travel demand. The arrows pointing out from the circle represent drivers of air travel growth, while the arrows pointing towards the circle centre depict impiders. The drivers and impiders of air travel growth are described below with some empirical examples.

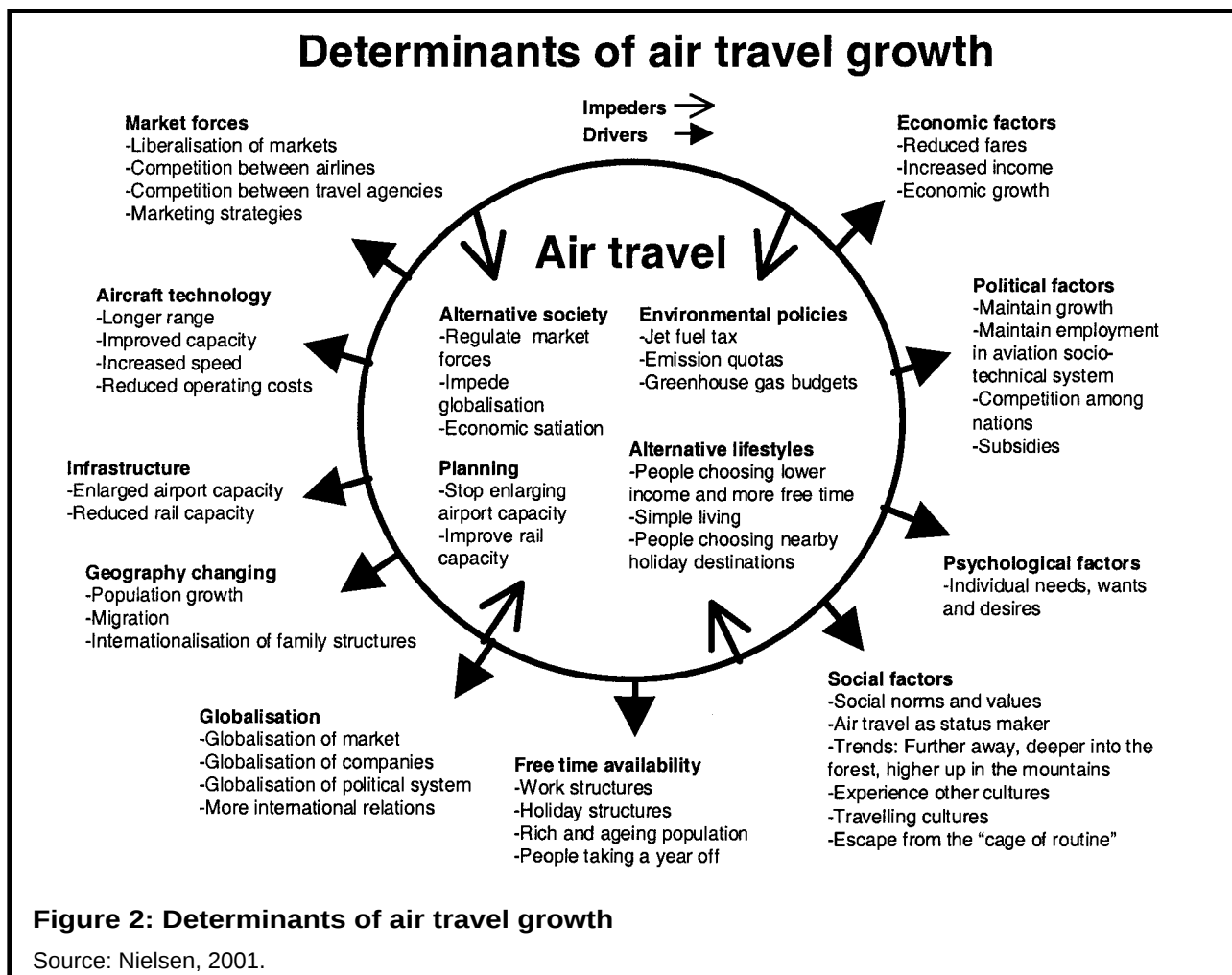
Drivers of air travel growth

While some air travel is specifically for leisure, shopping, business activities, or visiting friends and family purposes much of it has more than one motive. People are driven towards travel by personal desires to explore new territory and cultures and create new professional and social contacts. A precondition for air travel, however, is availability of aircraft and airports and of the aviation industry's 'socio-technical system' which surrounds and governs these. Air travel growth is furthered by constantly enlarging the physical capacity of the aviation system and

improving its productivity while cutting real costs. Improved airline productivity brings reduced real airfares, and increasing income allows a greater number of people to fly. Economic growth, in general, as well as globalisation of economies, companies, markets, political systems and personal contacts leads to increased and increasing demand for more frequent travel over longer distances. Increasing migration, marriages across national borders and population growth are further aspects.

Building up aviation's socio-technical system

Global air travel growth is accompanied and supported by the rise of a large socio-technical system surrounding aviation. This system is made up of aluminium, steel and plastic (aircraft), concrete (roads, airports and runways), computers and satellites (for navigation, control, administration and ticket sales), law (traffic rules), and culture (the value and meaning of personal mobility). A 'seamless web' combining very different elements (artifacts, aircraft producers and suppliers, airlines, airports, travel agents, regulations, politicians, users, etc.) is built up (see Rip & Kemp, 1998, for a description of the building up of socio-technical systems and seamless webs). Consumers have become accustomed to travel over ever longer distances at increasing speeds and



lower costs. Aviation contributes directly, as well as indirectly, to a relatively large share of global and local economies. Aircraft and airport production, maintenance and operation, as well as travel agents, suppliers, etc., are large work places, not to mention the importance of tourism to local economies and the importance of business travel for global business. In this way users, the aviation industry, politicians, environmental non-governmental organisations (NGOs) and other actors connected in some way or another to the seamless web of the aviation system contribute to shape, promote, sustain and impede the rise of air travel and the socio-technical system. The building up of this socio-technical system is to a large extent supported by economic subsidies from governments which see aerospace industries, airlines and airports as job-creation programmes. See Figure 3 for an illustration of the socio-technical system.

Technological change

Air travel growth is furthered by constantly enlarging the physical capacity of the aircraft fleet while improving productivity and cutting real costs. By far the most important aspect in the historic improvement of airline productivity and subsequent reduction in airline costs and fares is technological change. Since the invention of powered flight

aeronautical engineering has brought ever-improved aircraft offering higher productivity (i.e. higher payload, higher passenger capacity, greater range and higher speed) at ever lower operating costs per seat and freight capacity unit (Doganis, 1985; Heppenheimer, 1995). Indices of technological change for long-range subsonic aircraft are given in Figure 4. Real direct operating costs per revenue passenger kilometre of long-range aircraft has been reduced by a factor of about 10 when comparing today's most efficient wide-body jets to piston powered aircraft used in the mid-1920s.

Competition among nations

Aircraft production is a highly prestigious venture, and nations compete to produce the most efficient types. One example is the American, European and Soviet Union competition to produce the first civil aircraft cruising at supersonic speed. Today production of large aircraft is divided between the American and European aircraft producers, Boeing and Airbus. Currently Boeing produces the largest long-range, high-capacity aircraft, namely the B747, seating normally 330-360 passengers. Airbus has launched the 555-seat A380 wishing to compete with Boeing in the market for very large aircraft. European politicians back the project with cheap loans. The A380 may

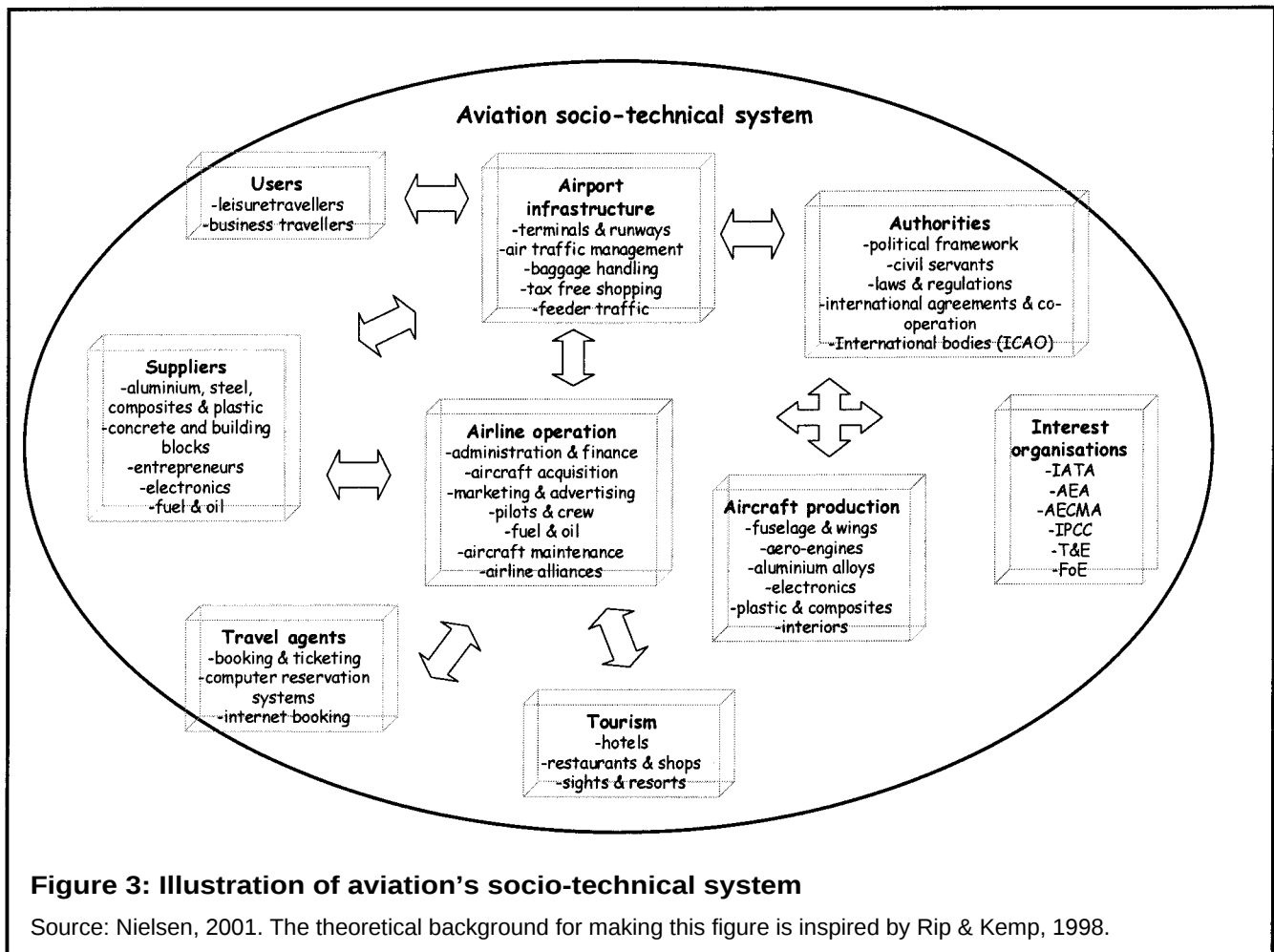


Figure 3: Illustration of aviation's socio-technical system

Source: Nielsen, 2001. The theoretical background for making this figure is inspired by Rip & Kemp, 1998.

enable Europe to gain market dominance as well as the prestige connected with producing the largest passenger aircraft in the world. Airbus' introduction of the A380 may force Boeing into introducing the so-called 'sonic cruiser' being able to cruise near the speed of sound several kilometres higher than current subsonics, using more fuel and emitting more pollution. Production of large aircraft may be locked in for decades before investments have paid off, thereby giving aircraft producers less incentive to develop radically more fuel-efficient aircraft- and engine types, such as flying-wing shaped aircraft powered by propfans.

Subsidising aviation's socio-technical system

Development of new technology aircraft, airports and other infrastructure, as well as air traffic management systems, are important preconditions for air travel growth. By developing more efficient aircraft and building new airport capacity air travel becomes cheaper and more widely available and this is all supported with public funding by governments (Heppenheimer, 1995). Accordingly, costs of technology and infrastructure are not fully reflected in airfares. Furthermore, many airlines are national flag carriers owned partly or fully by nation states. Most flag carriers have seen periods with very low profitability and even losses, and have often received government funding (Hanlon, 1996). Consequently,

political decisions to subsidise the aviation industry leads to lower airfares than would have been possible if the aviation industry was fully commercialised and functioning in a liberalised market without subsidies. Furthermore, airlines are given indirect subsidies by not paying jet fuel tax or VAT on tickets and by being allowed duty-free sales. Environmental NGOs furthermore claim that airlines ought to pay environmental taxes to cover external environmental costs associated with airline operation (FoE, 1998).

Economic growth policy

Probably the most important aspect of air travel growth is political focus on economic growth, it being the main political goal for many governments throughout the world. Economic growth contributes to rising travel for both business and leisure. Business travel is furthered by economic growth in the sense that increasing flows of products and money generates the need to communicate more and more. Rising disposable incomes, being a direct result of economic growth, further leisure travel by allowing people to choose to buy more luxurious goods and services, such as air travel. Propensity for leisure travel by air is highest for people living in high-GDP countries, see Figure 5, and also is highest among the wealthiest people within a country (Pitt, 1999). Therefore, as long as economic growth is given top priority and continues to generate increased communication needs for

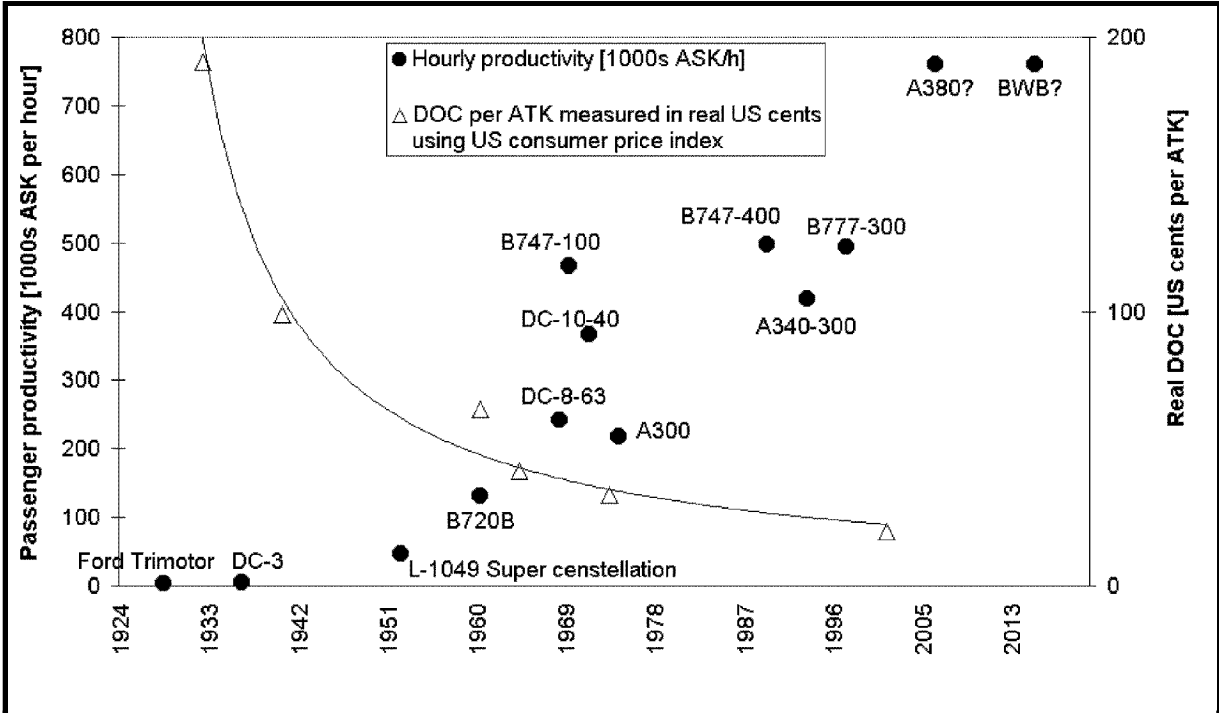


Figure 4: Passenger productivity & real Direct Operating Costs (DOC) for selected long-range aircraft introduced from the 1920s onwards

Note that Available Seat Kilometres (ASK) per hour is aircraft cruising speed multiplied by seat-capacity. Examples here are for selected aircraft, primarily maximum seat-configuration models. Derivatives of the same aircraft type will typically show lower passenger productivity in, for example, three-class seat-configuration.

Source: Nielsen, 2001; using a number of statistical sources.

businesses as well as real income rise, people are likely to fly more.

Increasing income & reduced real airfares

Since the early days of aviation income has been rising while airlines have seen constant productivity improvements, the latter mainly due to technological change such as improved aircraft capacity, range and speed (Doganis, 1985; Heppenheimer, 1995). Therefore, real airfares are reducing all the time. This is one of the main reasons why the number of people who can afford to travel by air is rising, leading to increasing air travel. Indices of the reduction of real airline yield per revenue passenger kilometre (RPK) is shown in Figure 6 based on world and U.S. scheduled airlines average yield per RPK since 1960 and 1950 respectively. These data suggest that real average airline yields have been reduced by something like a factor of four in the 50 year period. While personal disposable income per capita grew by a factor of 17 in this period, U.S. airline yield per RPK only doubled, both measured in current \$U.S.

Airline yield management systems

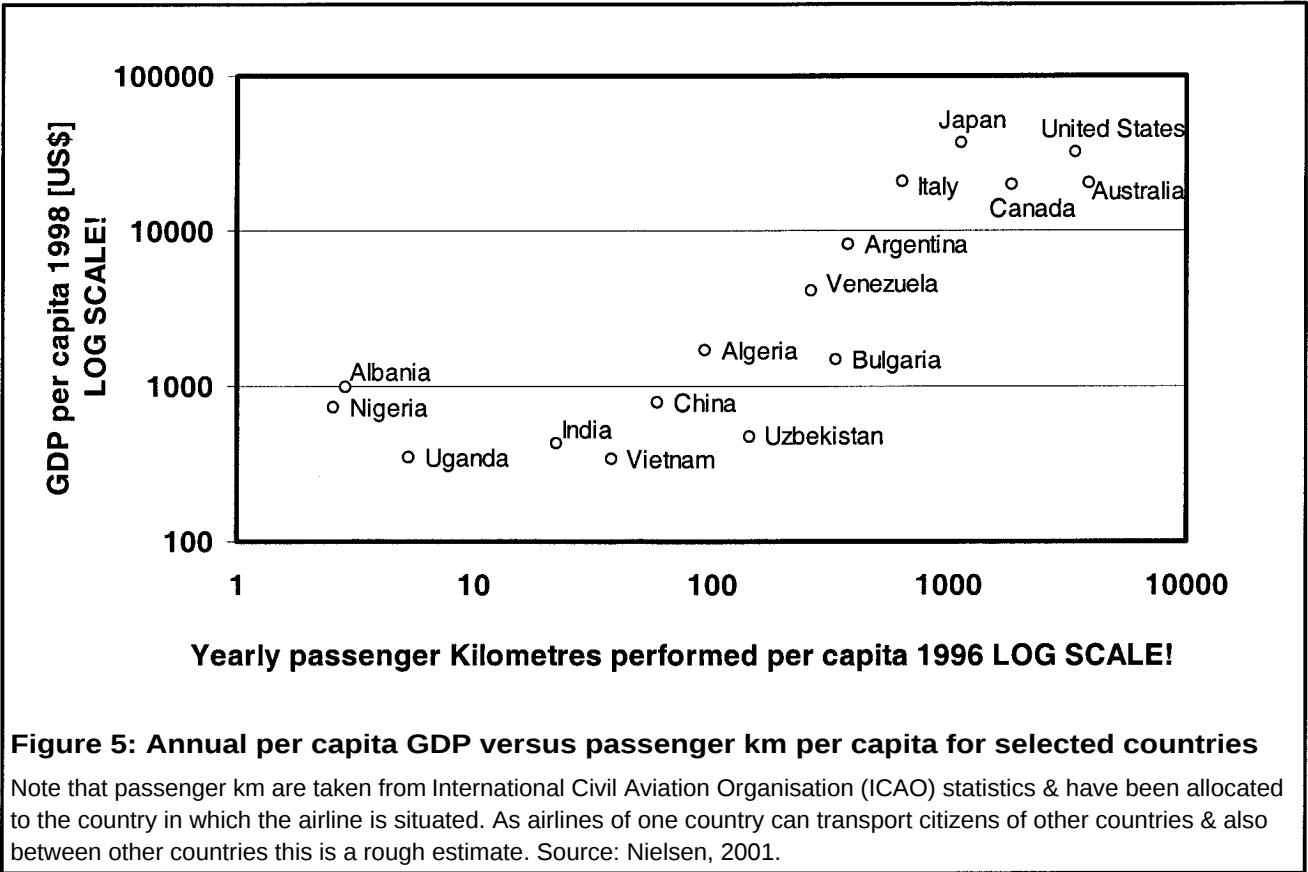
One important aspect in understanding the impact of fares on air travel growth is that airlines optimise fare structures to attract as much yield per flight as possible by using different yield management tools. Most notably, airlines often offer a range of different fares on each flight, business travellers paying a much higher fare than leisure travellers. This is because

business travellers are generally willing to pay higher fares, making business traveller demand less price- and income elastic than leisure travel. The last tickets sold for a given flight can, in principle, be sold at very low prices so as to optimise revenue marginally. This is one important factor contributing to air travel growth. Passengers travelling at reduced economy fares are subsidised by business travellers and economy passengers travelling at full fare (Shaw, 1983; O'Connor, 1995; Hanlon, 1996). Furthermore business travel in itself is subsidised because companies can deduct travel expenses against taxes (Shaw, 1983, p. 18).

Another important aspect is ‘frequent flier programmes’ aimed at generating loyalty among high-fare customers towards a particular airline. Customers earn ‘airmiles’ that can later be exchanged for free tickets. Often airmiles are used for private leisure trips even though earned in business travel. In this way business travel generates and subsidises additional leisure travel (Shaw, 1983; Hanlon, 1996).

Advertising

Another aspect closely related to airline yield management is advertising which creates additional demand for air travel by influencing people’s preferences for air travel and holiday destinations. Advertising is an important tool for informing people about discounted fares and last minute offers. Air travel advertising has become an important part of the



media picture. Most newspapers advertise air travel, and increasingly new media, such as the internet and teletext, is used. An advantage of the internet is the ability to book and buy tickets directly using personal computers at home or work, thereby cutting out travel agents and reducing airline costs. Increasingly, tickets are sold cheaper through the internet than through travel agencies, as airlines seek the cost advantage.

Airline market competition

Competition among airlines leads to lower fares which helps to generate more air travel. Historically, the airline market has grown up with national flag carriers dominating and enjoying more or less monopolistic status in many countries. In recent decades the U.S.A. and Europe have liberalised domestic markets, allowing new airlines to emerge, some of which offer low-cost no-frills service. Fierce cut-throat competition has developed on certain routes with established flag carriers being forced to slash fares. To the extent that market liberalisation increases competition in the future, fares are likely to be reduced. Counteracting tendencies are airline mergers and alliances. Most major airlines are today part of strategic international airline alliances.

Low airline profitability

Despite being a high growth sector, the global airline industry is generally not as profitable as other industries with yields being very close to costs and with significant losses in several periods, most markedly the early 1980s and early 1990s, see Figure 7.

This leaves the impression that if also taking account of government subsidies for aviation's socio-technical system, as such the civil aviation sector may not be profitable and therefore operating at 'artificially' low prices, which again helps to generate and maintain air travel growth.

Globalisation

Increasingly, political forums and large business corporations become part of a global system. The liberalisation of markets and the creation of multinational trade agreements further the globalisation of business. Alongside, political forums such as the World Trade Organisation, the European Union and the United Nations are built up. Globalisation of businesses and political institutions furthers the need for communication across national borders, thereby spurring air travel growth. One further aspect of this is that an increasing amount of people are employed abroad, generating additional leisure travel for visiting relatives and friends in their home countries. Furthermore, networks of friends become increasingly global, and more people meet their spouse abroad, generating migration and new family ties across borders and over longer distances. Corporate employees, as well as politicians and civil servants, tend to be high-yield customers travelling business- and first class, indirectly subsidise low-yield economy-class leisure travellers. Globalisation of trade, corporations and political forums have become strong drivers for air travel growth.

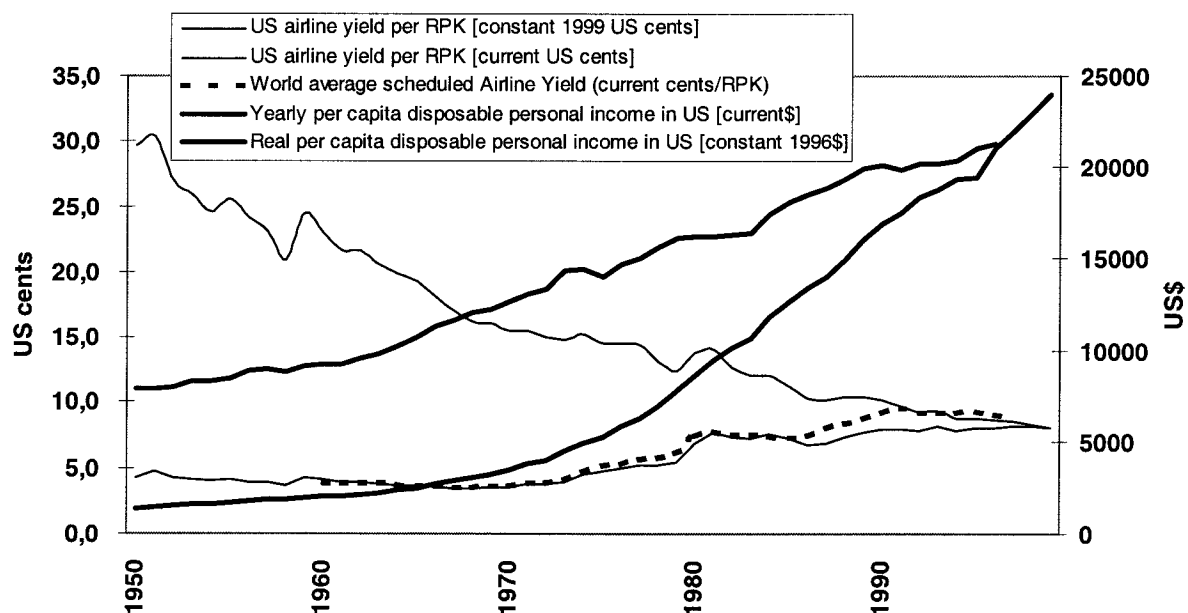


Figure 6: Development in average US airline yield per RPK and average US disposable personal income 1950-1999 compared with world average yield 1960-1997

Source: Nielsen, 2001; using statistics from the International Civil Aviation Organisation (ICAO), the American Air Transport Association & the US Bureau of Labour Statistics..

Population growth & distribution of wealth

The World's population doubled from 3 billion people to 6 billion in the forty-year period between 1960 and 2000, and is projected to increase to 9 billion by the middle of this century. Clearly, population growth is an important aspect of air travel growth. Neither air travel nor population growth is evenly distributed among countries. People living in highly industrialised countries perform the bulk of air travel (see Figure 5) while the distribution of population growth is generally reversed. The effect of population growth as a driver for air travel growth is strongest when population is growing in industrialised countries. However, countries that are currently less industrialised may achieve stronger economic growth in the future, thereby generating air travel growth. For example, if people living in China and India begin flying as much per capita per annum as Europeans currently do on average, then they alone would generate as much air traffic per annum as is currently generated globally. Another driver is increasing migration leading to increased air travel when immigrants visit friends and family in their home countries.

Ageing population

Population is ageing in industrialised countries. Ageing populations may generate more air travel, especially if elderly people who are retired from work have the resources to travel by air. People on retirement generally have the time to travel, and many are also in a better economic situation than previous generations. Therefore, an ageing population

may generate additional leisure travel in the future.

Younger generations travelling ever more

Air travel demand is generally not evenly distributed among age groups within a population. Younger to middle-aged generations tend to fly more trips in a year than children and elderly people on retirement. However, current trends show that younger generations tend to travel more than what was the case for the previous generation at the same age. Some sociologists assume that air travel will grow in the future because each new generation tends to fly more than the previous generation, and because each generation is assumed to sustain travelling culture as they become older (Carlsson-Kanyama, 1999).

Working culture

Working culture can be seen as an important precondition for air travel in industrialised countries by allowing employees to take time off for weekends and holidays. Before industrialisation most people were, for several reasons, more or less bound to their homes. However, to some extent today people have become disengaged from their home and tend to have an increasing amount of free time available (Frändberg, 1998). Furthermore, a stressful working culture generates the need for people to take some time off, to escape the 'cage of routine' (Læssøe, 1999). Another aspect of our working culture is people being able to take a year off from work to travel the globe.

Individual needs, wants & desires

Basically holidays often fulfil many types of individual needs, wants and desires; some common types of holiday purposes being relaxation,

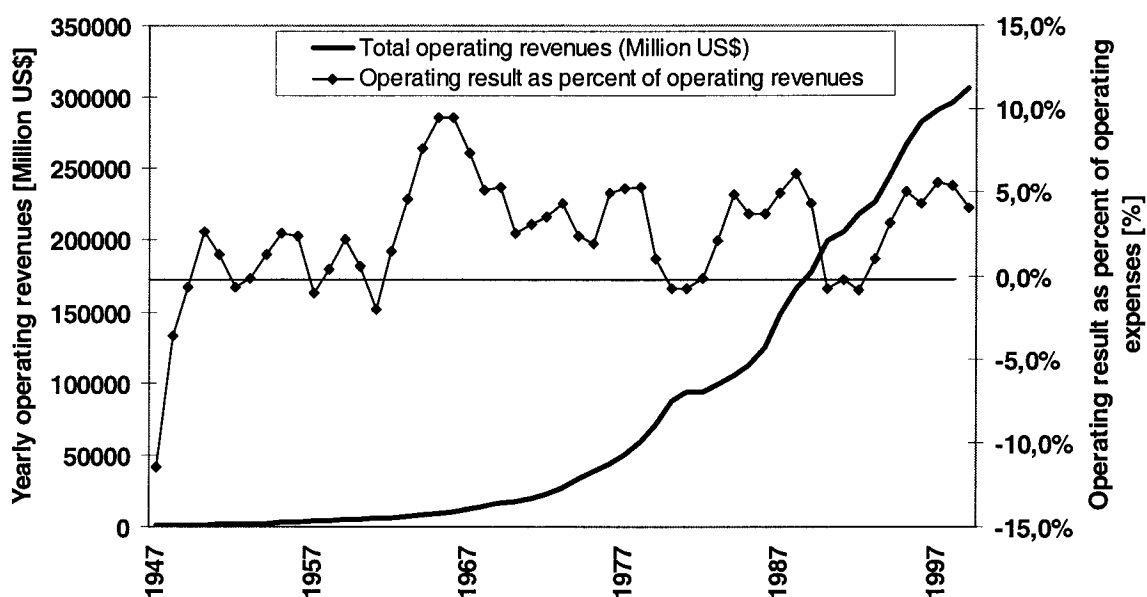


Figure 7: Operating revenue & operating result of ICAO scheduled airlines 1947-1999

Source: Nielsen, 2001; using statistics from ICAO.

adventure, personal relations, education, etc. Some common types of activities performed during holidays are sunbathing, eating, drinking, talking, sightseeing, shopping, walking, driving, hiking, climbing, swimming, etc. – the list is endless. Travellers create new private or professional relationships with people in other countries while exploring sites and cultures of interest. Another purpose is to visit family and friends and doing something together with travelling companions, e.g. everyday routines may impede parent-child relationships. A holiday abroad provides the opportunity to create and share memories.

Social status

People are driven by personal desire to explore new territory and cultures and create new professional and social relationships. Individual needs, wants and desires are to a large extent shaped by social values and norms (Douglas, 1998; Kuehn, 1999). For example, air travel is a significant social status maker and choice of destination depends on what is fashionable and trendy. One such trend is a tendency to travel further away, deeper into the jungle and higher up in the mountains. Nearby holiday destinations that used to be popular are supplemented and to some extent substituted by far away places. Air travel has become an important part of people's identity creating 'travelling cultures'. Young generations in industrialised countries are born into a travelling culture finding it natural to travel by air (Urry, 1999).

Individuals seek to position themselves in their social surroundings by choosing prestigious types of holidays and destinations (Kuehn, 1999). For example, backpackers often choose types of travel and destinations that mainstream charter tourists do not. Backpackers often seek new territories off the beaten track and therefore considered more original. Backpacker travel and accommodation is often basic and cheap, and often consumes more time for getting around than mainstream charter travel. Likewise, high-yield leisure travellers tend to prefer types of travel, destinations and hotels that are more expensive and considered more luxurious or exotic than the cheaper mainstream mass-tourism resorts. Expensive Caribbean Sea cruises and transatlantic Concorde flights reign among the types of holiday travel that may be considered extremely luxurious and prestigious. To some extent people choose the type of holiday that fits their lifestyle and social class, basic limitations being available time and economic and social resources.

Impeders to air travel growth

People are basically restricted from air travel by financial and time constraints as well as technology and geography. Financial constraints are mainly

connected to airfares and personal incomes. Technology is an important constraint in the sense that aircraft speed, range and capacity limit the distance people are able to fly within the time available. Geographical characteristics also play an important part in the sense that the earth is a limited geographical area, and unless space-flight becomes available for a broad part of the population, there seem to be upper limits as to how far each person might want to travel in a year. Current impeders to air travel growth are congested airports and airspace. In the future, new environmental policies might emerge and, in the long term, reduction or saturation of global economic- and population growth could reduce air travel growth.

Airport congestion

Many of the world's busiest airports are congested. Long-term air travel growth therefore depends on enlargement of airport infrastructure and new, more efficient, air traffic management systems. Especially in the U.S.A. and Europe, many airports are now operating at their maximum capacity through peak-hours. Some airports wish to expand capacity, but find it increasingly difficult to get approval for new runways and terminals, mainly because of environmental or land-use constraints. Planning initiatives to stop enlarging airport capacity – as well as strategies aimed at favouring alternative modes of travel such as rail, sea and road based transport – may in the future contribute to reduce air travel growth.

Emerging environmental policies

The aviation industry may soon be facing new environmental policies to some extent contributing to reducing air travel growth. European NGOs have for many years been pressing for tax on jet fuel or aircraft emissions (FoE, 1998). The EU seems to be in favour of aviation taxes or other types of instruments such as voluntary agreements on average aircraft fuel-efficiency (similar to its agreement with the car industry) or emission trading schemes (CEC, 1999). A tax on kerosene or emissions will increase the price of air travel, impeding air travel growth, while also giving airlines incentives to operate more fuel-efficient aircraft and to optimise load factors and other operational features. The possible effect of a tax will obviously depend much on the level of tax applied. Most studies expect that the reduction in air travel demand will be rather insignificant because ticket prices will not rise much unless a rather high tax level is implemented (Nielsen, 2001). The aviation industry hopes to avoid taxes, and propose voluntary agreements for future emission reductions (AEA & AECMA, 1999) or emission trading, allowing it to increase emissions while buying reductions in other sectors. In the long term however, some definite cap on

the total allowable greenhouse gas emissions from aviation may be needed leading, for instance, to emission quotas per capita. Any of these policies are likely to slow down air travel growth.

Figure 8 depicts a proposed annual quota for air travel per capita allowing each person to emit 124 – 350 kg of greenhouse gas measured as CO₂-equivalent. The quota is based on the assumption that average annual per capita greenhouse gas emissions from the combustion of fossil fuels should be reduced to 1.38 tonnes from the present level of 4 tonnes, and that air travel can be allowed to emit 9% – 25% of the total in 2050. Furthermore the greenhouse gas intensity of aircraft engine emissions is set in Figure 8 to be almost three times as high as CO₂ emissions alone, i.e. aircraft are assumed to contribute three times as much to global warming as sources at ground level per kg of fuel burned. The upper curve suggests that each person can be allowed to fly 265 – 737 km at the average greenhouse gas intensity of the global aircraft fleet in 1992 and the lower curve suggests that this can be doubled if greenhouse gas intensity is halved by 2050 relative to 1992. Point 1 on the upper curve illustrates that current annual per capita air travel of around 487 km emits 228 kg of CO₂-equivalent; it already exceeds the lower quota. Points 2 and 3 illustrate that European and U.S. citizens already exceed the higher quota by travelling around 1200 km and 3400 km per capita per annum respectively (Nielsen, 2001). The lower curve suggests that by the middle of this century current European levels of air travel – which are below the high sustainability target of 350 kg – may be

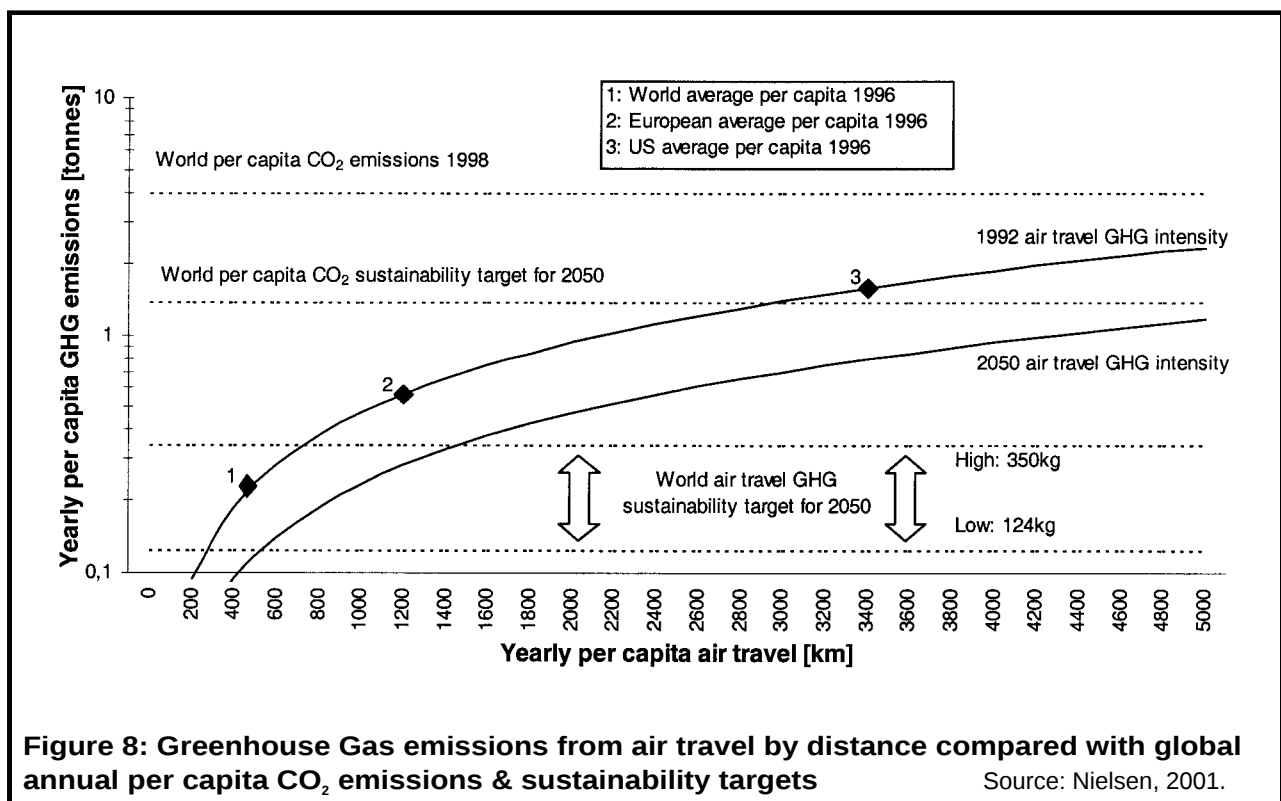
achievable for all the world's citizens.

Alternative lifestyles & alternative society modes

Social factors such as changing values and norms may reverse trends in air travel. Social acceptance of air travel may dampen if signs of climate change become more apparent. Furthermore, as travelling by air becomes more common, and more people can afford to travel to remote parts of the globe, the social prestige of air travel might well diminish. Long-term impeders to air travel may be the emergence of alternative lifestyles and alternative society modes. New working structures including fewer but perhaps longer-lasting holidays might emerge as a first step. In the long term changing values and preferences might emerge. People may choose more simple modes of living, with less work, more free time and less income. In such a scenario people may well reduce their travel patterns by choosing, for instance, holiday destinations nearer home. The stride for economic growth and the current disposition towards market forces and globalisation may change.

Conclusion

If air transport continues growing at the current rate it will be a significant source of greenhouse gas emissions within the next few decades. The availability of airports and aircraft are important preconditions for air travel growth, and further enlargement of airport infrastructure seems to be needed to sustain long-term growth. Policies to reduce air travel growth may therefore be directed towards not increasing airport capacity any further, as well



as removing subsidies for the development of larger and faster types of aircraft. Therefore governments could stop subsidising the largest and fastest aircraft, for example, by discarding all plans for future supersonic aircraft, sonic cruisers and next-generation ultra-large super-jumbo jets. Furthermore, there is the possibility of promoting alternative modes of transport, for instance by enlarging rail capacity and by using fast train systems.

Some major drivers of air travel growth are the reduction of real fares as well as the tendency to sell leisure tickets at discounted prices. Air travel is currently not taxed to the same degree as other transport modes, not to mention other consumption. Furthermore aircraft producers, airlines and airports are often subsidised directly or indirectly by governments. Therefore environmental policies could be aimed at increasing prices by removing aviation subsidies and taxing air travel.

Governments could try to alter some of the structural

determinants driving air travel growth, e.g. by promoting longer holidays, instead of giving people an incentive to split up their free time into smaller entities.

Much air travel relates to globalisation, changing geography and population dynamics. Therefore any policy aimed at counteracting these factors may help to reduce air travel growth. Another way to reduce demand for air travel is to promote alternative lifestyles and ways of life. If the social status connected to travelling far away diminishes people might choose nearby holiday destinations. Similarly, if people choose a less materialistic approach to life by working less and earning less – but having more free time available – there is clearly potential for change. In the long term governments may seek to find alternative ways of measuring progress and growth (other than Gross Domestic Product) thus allowing nations to develop in more sustainable directions than when planning mainly to achieve economic growth.

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Liveable Neighbourhoods

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Abstract

Liveable Neighbourhoods is a new policy of the Western Australian Government to combat the high car dependency, lack of public transport and poor walking conditions in suburban sprawl. This paper gives an overview of the urban design and structuring principles behind the policy.

Liveable Neighbourhoods is based on an urban structure built with walkable, mixed-use neighbourhoods. These neighbourhoods cluster around a town centre to give sufficient population catchment to support main street retail, office and community facilities, and support public transit.

A traditional movement network in *Liveable Neighbourhoods* overcomes the disconnected street system, lack of footpaths, unsafe routes and long walking distances to most destinations that characterise conventional suburban developments. *Liveable Neighbourhoods* encourages people to walk by providing an environment of high pedestrian amenity and efficiency, and one that is stimulating, legible and safe for pedestrians.

Liveable Neighbourhoods recognises the complexity of daily movement patterns and the need to make pedestrian trips as short and pleasant as possible. The primary pedestrian network is the street system, which is detailed to support pedestrian movement.

Keywords

Liveable Neighbourhoods, pedestrians, Perth, urban design, walking, Western Australia.

Introduction

The Western Australian Government is countering suburban sprawl through a new policy called *Liveable Neighbourhoods*. The policy promotes sustainable growth practices at the urban fringe of Perth and country regional centres through an holistic approach at regional and local scales.

Liveable Neighbourhoods introduces a compact urban structure based on walkable towns and neighbourhoods, and includes the mixture of land uses, and the interconnecting of street patterns to facilitate all modes of movement. Residents are encouraged to walk because facilities and amenities can be provided in reasonable proximity to most houses, and routes are made direct, safe, amenable

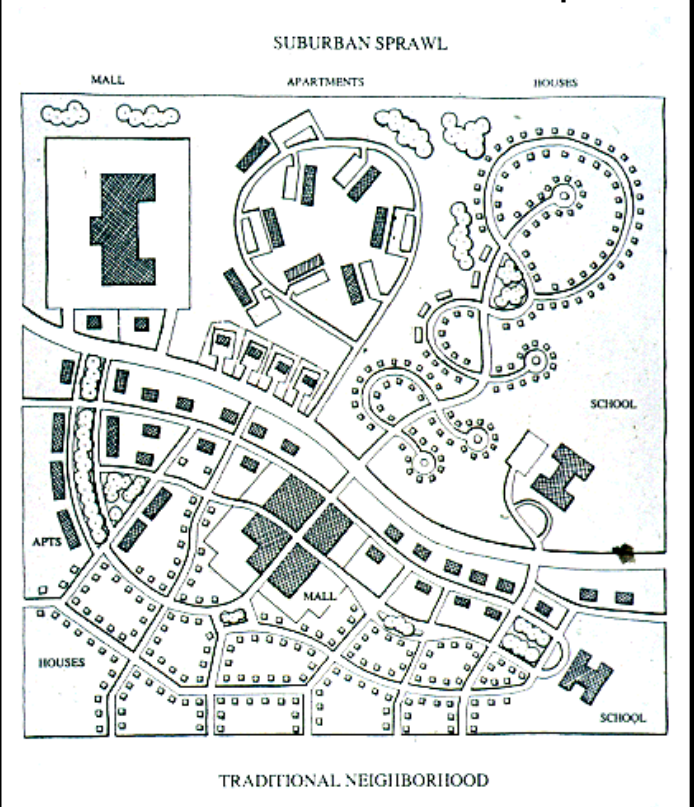
and interesting. If many people are encouraged to walk in pleasant and safe streets for every day needs as well as recreation, it is argued that community life is improved, and personal safety levels increase.

Liveable Neighbourhoods promotes safe, stimulating and sustainable urban environments, and ones that are friendly for pedestrians.

Background To *Liveable Neighbourhoods*

Perth has a unique planning and development history compared to other Australian capitals in several respects. The residential base of Perth has a comparatively small traditional inner suburban component, with rapid suburbanisation occurring later than other Australian cities in the 1960s. The spatial layout of these suburbs was very responsive to the garden city movement, segregation of land uses and modern transport engineering principles to cater for a rapid increase in car ownership and usages. Perth has embraced suburban development much more strongly than other cities in Australia and its influence on

Figure 1. A comparison of conventional suburban and traditional urban development



lifestyle and quality of life is pervasive.

The Western Australian community is changing and planning needs to respond to these changes. The majority of households are one and two person households and yet the majority of houses built are three and four bedroom with two car garages. This does not reflect as good a fit as is needed. In Western Australia, 95% of new jobs are now in the service sector. Of new businesses, 97% are small firms, and 21% of all businesses are home-based, with self-employment increasing by 59% between 1976 and 1991. Older women aged between 45 and 54 now constitute a major proportion of the workforce. By 2010, some sources estimate that the majority of the workforce will be part-time workers. It is likely that more people will work at, or near home and will demand more goods and services at the neighbourhood level.

The design of Perth's residential suburbs has a direct influence on the issues that Perth faces, and, in turn, on the sense of community and quality of life. Conventional suburban subdivision and development in Perth and elsewhere is characterised by several factors which increasingly are being questioned. These include enforced segregation of land uses through zoning, low residential density, lack of local employment and long commute distances, lack of services, high car dependence, disconnected street systems, limited public transport and poor walking environments.

There has been considerable community discussion on the need for planning to respond to these issues and, at the same time, improve the design of suburban development to make it safe, sustainable, attractive and memorable. We need to create a strong site responsive identity supportive of local community. Although re-urbanisation is taking hold, the majority of the production of the built environment in Perth still occurs at the metropolitan fringe. Therefore, it was with greenfield developments in mind that sustainable development policies were first created and applied through *Liveable Neighbourhoods*.

The policy is also sufficiently flexible to be used for cities and towns in regional Western Australia where climatic conditions vary considerably, but the need for community and walkable environments does not.

Urban Form Comparison

There are two organisational systems for the structure of urban places. The first is the 'traditional' city that has been with us for many hundreds of years. It includes those cities and areas of cities that were based on walking and, when it became available, fixed transit. These places were characterised by

- nodes of development on streets that connected to other places in the district,
- concentration of uses and activities that were often densely mixed,
- a network of streets and lively public places, and
- ease of pedestrian movement throughout the whole system.

The second urban place structure is the rigid systems of conventional suburban development (suburban sprawl). This structure typically has

- peripheral expansion,
- hierarchical and curvilinear residential streets
- dead-end culs-de-sac,
- segregation of land uses,
- large single ownerships, and
- privatisation of public meeting spaces into shopping centres surrounded by car parking.

The comparison of urban structures has been graphically portrayed by Andres Duany and Elizabeth Plater-Zyberk (see Figure 1). In the figure, land to the north of the arterial is structured on the conventional suburban development (suburban sprawl) model where access from one land use to another is

Figure 2 Availability of daily milk need in Perth's northern suburbs



Figure 3. Availability of daily milk need in Perth's CBD & traditional inner suburbs



only available by driving via a busy arterial road, forcing congestion, pollution and social isolation. Land to the south of the arterial is configured in the traditional urban structure where the same uses are compatibly mixed on an interconnected street system. Access to facilities and services are within walkable proximity of where people live. Traffic congestion is relieved through less need for car use and by diffusion throughout the street network.

Evidence of the comparative performance of the two types of urbanism is also portrayed graphically for Perth in Figures 2 & 3. They show a comparison of the availability of daily needs (such as milk) in the conventional and traditional suburbs of Perth.

Figure 2 shows Perth's northern suburbs, which have been designed on the conventional suburban development model. Figure 3 shows the Perth CBD and traditional neighbourhood suburbs.

Access to shops in the conventional suburbs is very difficult for people without a car. Here the shops are infrequent, and virtually impossible to access other than by car for most people – even if they live nearby. The young, the elderly, people with disabilities that prevent them from driving, and those without the financial means to afford a car (or a second car) are isolated from essential facilities. Access to local shops for daily needs by people without access to a car is relatively easy in the traditional suburbs, as the shops are frequent and well located in accessible locations. Even if shops are nearby, access to the front door by non-car means may not be easy.

Ped-Sheds

Walkable catchments, sometimes referred to as 'ped-sheds', are maps showing the actual area within a five-minute walking distance from any centre, or ten minutes from any major transport stop such as a railway station. The centre could be a neighbourhood or town centre. The walkable catchment is simply a technique for comparative evaluation of how easy it is to move through an urban area in order to get to and from these centres or facilities. These maps are the best estimates of walkability, and as such are an indication of energy efficiency.

Walkable catchment calculations are expressed as the actual area within five-minute walking distance as a percentage of the theoretical area within five-minute walking distance. The theoretical five-minute walking distance is shown as a circle with a radius of about 400 m drawn around any particular centre. This is an area of 50 ha. When calculating a ten-minute walking distance, the radius used is about 800 m, resulting in a circle area with an area of 200 ha.

The higher the percentage, the better the

walkability and hence the likely energy efficiency of any urban area. A good target for a walkable catchment is to have 60% of the area within a five-minute walking distance, or ten minutes in the case of stations. Figures 4 & 5 compare the walkability performance using ped-sheds of a new Perth neighbourhood based on the conventional development pattern and a traditional neighbourhood in an old established suburb in Perth.

In the case of the Ballajura neighbourhood centre (Figure 4), the ped-shed is very poor at only 17%. The curvilinear road system and culs-de-sac make accessibility from the adjacent housing very difficult. The measured performance could be increased if the existing pedestrian access ways are included; but these have been excluded as they are considered unsafe for many users because of their narrowness, the lack of sight lines and surveillance, particularly in the evenings and at night. Footpaths are generally not available, making the journey less comfortable for those people who do choose to walk.

The neighbourhood centre of Shenton Park (Figure 5) performs dramatically better with a ped-shed of 65% due to the more direct street connections. Walking is supported by the detailing of the street with footpaths and shade trees.

The considerable challenge facing *Liveable Neighbourhoods* is to reverse the post-war urban structure of conventional suburban development and reintroduce traditional neighbourhood structure in contemporary circumstances.

Liveable Neighbourhoods

Structuring at the Regional Level

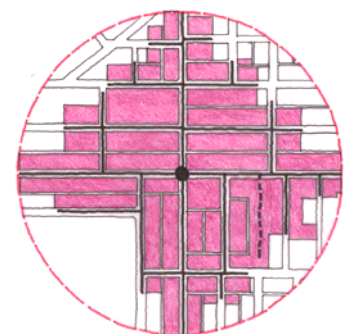
A contemporary approach to traditional urban structure has been developed in *Liveable Neighbourhoods* to achieve relative self-sufficiency for likely densities at the urban fringe of Perth.

The *Liveable Neighbourhoods* approach calls for an urban structure based on walkable, mixed use neighbourhoods with locally based employment and

Figure 4. 5-minute Ped-sheds in Ballajura



Figure 5. 5-minute Ped-sheds in Shenton Park



facilities. Neighbourhoods cluster around a town centre to give sufficient population catchment to support main street retail, offices and community facilities. The neighbourhood and town centres are located at junctions of arterial routes or important local streets, rather than having such roads define the edge of development. For transit oriented development, a railway station anchors one end of the town centre main street, if rail is available.

Arterial streets are well managed as 'integrator' streets and traffic lights provide for safe pedestrian crossing across arterial roads to neighbourhood centres. The town centre acts as a district level community focus with a compatible mix of uses which provide a range of weekly shopping needs, community facilities and local employment, whereas the neighbourhood centre caters more for the daily needs of a community.

Movement Network

Liveable Neighbourhoods promotes several major differences from conventional suburban street systems. It emphasises connectivity, amenity and integration to achieve safe, efficient and attractive street networks. The priority is to develop a street network that not only works for vehicles and public transport provision but specifically aims to attract a high level of use by pedestrians, cyclists and the disabled.

The street system in *Liveable Neighbourhoods* is highly interconnected. Arterial routes generally form the core or spine of neighbourhoods and towns, rather than the edges. Arterial streets are detailed to 'integrate' rather than divide with the use of service roads or other lot layout techniques to enable development rather than back fencing to front arterial routes. Culs-de-sac become less frequent, are located on the edge of neighbourhoods and are connected by a well surveilled minor street or laneway enabling safe pedestrian and bicycle access. Traffic is distributed more evenly through a flatter hierarchy of streets.

Bus routes are provided in a 'spider network' focussed on the town centre, with as many neighbourhood centres as possible connected en-route to other destinations.

Pedestrian Network

In recent conventional developments, walking has been made difficult or is simply not a feasible option for many journeys because of the disconnected street system, lack of footpaths, unsafe routes (such as pedestrian access

ways and segregated linear trails) and long distances to most destinations. To encourage people to walk, a place must have high pedestrian amenity and efficiency, be stimulating, legible and safe for pedestrians. *Liveable Neighbourhoods* recognises the complexity of daily movement patterns and the need to make pedestrian trips as short and pleasant as possible.

The primary pedestrian network in *Liveable Neighbourhoods* is the street system, which is detailed to support pedestrian movement. Streets have a significant role to play in relation to social interaction, public safety and amenity, but require contiguous development frontage to do this effectively. Development with frontage onto streets provides surveillance, activity and visual interest and, on busier streets, exposure which can assist commercial viability. Provision of frontage helps build community focus and enables streets to act as an integrating element within neighbourhoods and towns, rather than as a divider, which has often happened in conventional development.

Narrow pedestrian underpasses with poor sightlines are discouraged because of personal security problems. Traffic signal control rather than roundabouts is encouraged on major roads to improve pedestrian crossing opportunities both at the lights and in breaks of flow mid-block.

Footpaths should ideally be provided on both sides of all streets. However, for cost reasons, footpaths may be omitted from one side of a street where vehicle volumes and speeds are very low, and where use of the street is considered safe and comfortable for pedestrian use and by people with disabilities. Footpaths should

Figure 6. Liveable Neighbourhoods Regional Structure



have ramps at all kerb corners for wheelchairs and pram access and cater for people with disabilities. Street lighting should be present in all streets. Pedestrian crossing distances in local streets should be limited through kerb extensions and tight turning radii, which can cause vehicular traffic to slow to negotiate the tighter corners.

Safe routes to schools, bus stops and stations

A network of quiet local streets focussed on schools should be traffic calmed to ensure safe use by young pedestrians and cyclists. Secondary and private schools should be located to benefit from good public transport access with safe pedestrian routes between transport stops and schools.

Safe routes to stations require more consideration of surveillance to provide night time safety. Main routes should be fronted by housing and uses that are open at night (e.g. delis, gyms, recreation centres), with minimal gaps in surveillance. Bus stops and approaches thereto should be located with good surveillance and provided with adequate lighting.

Cyclist movement network

Good cycling conditions and encouragement of cycling should be designed into the urban fabric. This includes such measures as bike parking facilities, slower and lighter traffic, appropriate lane widths along local streets to allow cyclists to share travel lanes with cars, wide kerbside lanes on busy streets, and routes parallel to arterials with less traffic.

Much cycling for daily activities will be on streets. On busier streets close to schools, wider footpaths designed for dual use by cyclists and pedestrians are appropriate.

Long distance commuter cycling and recreational cycling may justify provision of special dual use paths, usually in accordance with a regional structure plan.

Movement network for users with disabilities

Access to and ease of use of the movement network for users with disabilities is an important emphasis of *Liveable Neighbourhoods*. Journeys can be carried out with dignity on the street network rather than through a separate open space network which is often poorly maintained and lacking surveillance. Footpaths are required for most roads on at least one side of the street, making journeys more comfortable and safer. Access to public transport is easier, more direct, closer and at grade. Finally, public transport should be more efficient and therefore more frequent.

Jindalee Comparison

An 'Inquiry-by-Design' exercise was undertaken to demonstrate a design based on the sustainable development principles being promoted in *Liveable Neighbourhoods*. This approach was compared with the built form which would result from conventional planning based on the present subdivision policies.

To make these comparisons, a 453 hectare site was chosen at Butler in the Northwest Corridor of Perth. The site was chosen as it is at the next stage of one the fastest moving development fronts and because there were preliminary conventional design proposals available for comparison. These design proposals were indicative of the likely form of conventional development that would result from the current suite of Commission residential policies. The site became known as Jindalee during the design exercise. The designs were measured and the relative performance of the conventional and *Liveable Neighbourhoods* designs were compared to establish the relative performance between the two approaches.

A *Liveable Neighbourhoods* option (Figure 6) was developed with regard to the natural land form and vegetation and a central railway station catchment,

Table 1. A summary of the design approaches

Characteristic	Conventional	Liveable Neighbourhoods
Land use diversity	Single use; Predominantly residential, with designated areas of clustered retail; segregated use base	Integrated mixed-use; Neighbourhood based with integrated residential, retail, commercial, and service industrial
Street pattern and type	Curvilinear and hierarchical from district distributors, to collectors, to access streets, to culs-de-sac; traffic collected and channelled	Inter-connected network; flatter hierarchy of types; traffic dispersed.
Residential lot size	600 sq. metres	500 sq. metres
Housing density	11 lots/ha	14 lots/ha
Dominant retail type	Regional 'big box' shopping centres, chain stores	Neighbourhood independent retailers
Dominant planning objective	Create comfortable housing	Create community; create affordable housing; jobs containment

Walking as a local transport modal choice in Adelaide

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Abstract

A glance at transport statistics for Australia indicates that 'walking' as a transport option is a relatively insignificant form of urban travel. For medium to long, intra-urban trips, this is probably indeed the case. This will continue so long as the morphology of Australian cities is predominantly shaped by the needs of motorised transport.

This paper provides an overview of the extent of walking as a transport option, at least in the journey to work. The characteristics of walking as a transport mode are discussed, which is important in setting the context of the walking permeability indices that are developed in the subsequent section. The walking permeability indices are the principal form of analysis used in assessing how well the City of Adelaide and the inner city residential development of Garden East and the new middle distant northern suburb of Mawson Lakes are in catering to walking as a local transport modal choice. The final section examines strategies to facilitate walking in Adelaide.

Keywords

Adelaide, urban design, walking, walking permeability distance index, walking permeability distance time index.

Introduction

Walking as an activity is critical in determining whether a person perceives an environment to be an urbane, civic place. Positive perceptions about the desirability of an urban environment normally exude out of experiencing the city as a walker rather than as a motorist, public transport commuter or even a cyclist. The relaxed nature of strolling at a stately 4 – 6 km/h is just fast enough to be purposeful in one's journey while allowing one to savour one's immediate environment more completely than any other travel mode. The unfortunate turn of phrase, that something or an experience is 'pedestrian', inferring dullness, has done much to harm the idea of pedestrian activity as an eminently enjoyable pastime.

This paper starts out by discussing walking as a local transport mode and examines cities that are designed for walking. The main theme in this paper is how well Adelaide as a city is catering to walking as a significant local transport mode in terms of an

analytical concept termed 'walking permeability indices'. Data from the 1996 census of population and housing for Adelaide's metropolitan area is examined to demonstrate the extent to which walking is used as a transport mode. Discussion of new higher density residential developments in Adelaide's inner city (Garden East) and in its suburbs (Mawson Lakes), are examined through the use of walking permeability indices to determine whether they theoretically facilitate walking as the preferred mode of transport. Finally, strategies designed to facilitate walking as the preferred local transport option are examined.

Characteristics of walking as a transport mode

With the exception of disabled people, walking is the fundamental means of transport for everyone. Walking allows people to have mobility in and around buildings, in open spaces and access to other means of transport. The healthy human body has marvellous all terrain characteristics in the way that it can climb steep slopes or stairs and cope with irregular surfaces and poor weather conditions. It does not need massively engineered infrastructure built to exacting tolerance to anywhere near the same extent as other mechanised transport modes. Nevertheless, large pedestrian numbers are better catered for if such infrastructure is provided for, but it is probably more for reasons of aesthetics, comfort and the minimisation of environmental damage rather than any intrinsic need. Planning for walking is critical because it is the transport mode that provides the fundamental interface between the land-uses and other transport modes. When motorists leave or access their cars, they do so as pedestrians.

Walking does have its limitations, however. The typical walking gait of a normal healthy adult would be about 6 km/h (i.e. 1.67 m/s). In unimpeded conditions, this would allow a range of 6 km in an hour; 3 km in 30 minutes; 2 km in 20 minutes; 1 km in 10 minutes; 500 m in 5 minutes; 100 m in one minute. However, a walker's speed for a person of average fitness would wane as fatigue begins to set in. Also, adverse weather conditions, such as heat or rain, may compromise walking performance. Hence, a walker may be able to maintain a steady 6 km/h walking gait for 20 minutes, but over 30 minutes this average may decline to 5 km/h and over an hour, drop to 4 km/h.

As a local transport modal choice, walking makes reasonable sense in many Australian urban environments for distances up to 2 km (20 minutes). Walking may be competitive with public transport over short distances (up to 2 km), assuming it is more direct and if the next bus / train / tram is not due for 20 minutes or more. Frustrating impediments to walking as a local transport option include the severance caused by roads, private property, physical barriers, long waits at traffic lights and a general lack of crossing opportunities.

Characteristics of a city designed for walking

The elements of a city that is designed for walking include: urban density; urbanity; heterogeneous land use zoning; facilities and public transit within close walking proximity to where people work, live and recreate; efficient, economic and comfortable public transit; an attractive public realm conducive to walking; dedicated pedestrian routes and pathways; and permeability in the urban fabric.

Density, urbanity, zoning

Urbane cities encourage community and cultural interaction in a civilised manner. Urbane cities are likely to be more conducive to pedestrian activity because they encourage people to enjoy the city's public realm. Lozano (1990) believes, however, that a critical factor in achieving urbane cities is density because certain densities or minimum population thresholds are needed to generate the interactions needed to make many urban functions and activities viable. With urban transportation, higher urban densities are critical in order to allow public transit and walking to be feasible urban transport options. Lozano (1990) argues that the often widespread separation of activities that has been imposed on our cities by large-scale land use homogeneity and segregation has largely nullified the significance of local transport options such as walking or cycling. Lozano's work demonstrates that in designing a city that is amenable to walking, density and mixed urban use are critical components.

Public transit & pedestrians

Any strategy intended to make cities more attractive to pedestrians has to consider how to discourage an over-reliance on car use as the primary urban transport mode. However, given the size of modern cities, it is not practicable to expect walking to be anything more than a local transport option. The solution advocated by Newman and Kenworthy (1989) and the New Urbanism movement (Katz, 1994) in the United States in moving away from car-dominated cities, are transit-oriented cities with urban densities and grid style street patterns similar to those of European cities. Implicit in their solution is that

walking would be the critical mode of transport in local areas and in complementing public transit that would provide access beyond local areas.

Cervero (1997) has talked about the need for a paradigm shift in which there is a move away from transport planning that enhances automobility towards 'accessibility planning'. In this new paradigm, new performance indicators would be developed, such as the accessibility to public transit and to facilities by walking, which contrast with roadway level of service traffic performance indicators that are currently the focus of planning for motor transport. There would also be a focus on public and non-motorised transport on a local community scale. Transportation demand management would be needed to extract the maximum use of transport resources already in place and traffic calming could be employed to discourage car use.

Without an attractive public realm, however, it will be difficult to convince people to walk in preference to driving. Active street frontages are needed together with public spaces that are used by people either as a thoroughfare or to recreate. Landscaping and quality design of infrastructure that is both functional and aesthetically pleasing, can help to make walking a more pleasing local access option than the car. However, by itself, an attractive public realm may not be enough. Dedicated pedestrian routes may be needed where the conventional road network is hostile to pedestrians or insufficiently direct or where there is an impermeable urban fabric that inhibits pedestrian movement.

Permeability & the urban fabric

Walking as a local transport modal choice makes reasonable sense for distances up to about 2 km at a walking speed of 6 km / h. If an urban area around a pedestrian were completely unobstructed, theoretically, this would allow an urban area covering some 12.5 km² to be accessible to this pedestrian.

A city with a very fine urban grain that allows a high degree of pedestrian permeability and very direct routes may come close to this theoretical maximum. The reality is often very different, since many cities can have a coarse urban grain (i.e. large blocks impermeable to pedestrian access), that considerably restrict a pedestrian's ease of access. Bangkok's central area is a classical example of a local road network that lacks permeability for pedestrians where what should be a 400 m walk as the crow flies can easily become a 3 km marathon because of a lack of connecting pathways between long parallel streets. A very coarse urban grain or a city with impenetrable barriers to pedestrians can restrict a pedestrian's experience to a very limited linear experience of the city (i.e. 2 km in either direction along a street).

In designing for pedestrians, one has to remember that pedestrians do not have the time or stamina for unnecessarily circuitous routes. Pedestrian permeability is a concept that could be expressed as a Walking Permeability Distance Index (WPDI) for pedestrians (see Equation 1).

A WPDI = 1 is the ideal situation a planner would aim to achieve, and this would imply that the network is sufficiently permeable to allow pedestrians to walk directly to their intended destination. As an analytical planning tool, the Walking Permeability Distance Index could be used to explore trip characteristics between origins and destinations in a local area or suburb, with WPDI = 1.5 being set as the limit of accessibility for a development. The origin could be someone's home while the destination might be the local community centre or a railway station.

The Walking Permeability Distance Index could be presented in a slightly modified format to reflect the actual trip time. This would be important where a dedicated pedestrian network does not exist and pedestrians have to share the road network with other transport modes. Distance may no longer be the determining factor if roads have limited crossing opportunities and long waiting times at pedestrian crossings. Equation 1 would be modified as in Equation 2, and it would be called the Walking Permeability Time Index (WPTI).

The Walking Permeability Time Index analytical application would be the same as the Distance Index, except that it may offer a more realistic assessment of the actual situations a pedestrian is likely to encounter in the urban environment when walking. A higher WPTI of 2 may be needed to indicate the practical limit of pedestrian accessibility. With a walking gait of 6 km/h and a WPTI of 2, and a time endurance of 20 minutes, the maximum distance that could be covered would be 1 km. This is determined by dividing the direct distance walking range over 20 minutes at 6 km/h by the WPTI. Of course, empirically based research of statistically valid population samples would be needed to discover how pedestrians' walking gaits, endurance and response to impediments vary and what the average pedestrian's performance actually is. Nevertheless, in a theoretical sense, these indices are useful for determining accessibility characteristics in the urban environment. When mapped with a geographic information system package such as MAPINFO or ARCVIEW, the use of these indices can dramatically highlight the degree of accessibility offered in a particular area. For example, these indices could be mapped for all residences' accessibility to a local school, shops or community centre.

Walking as a transport mode in Metropolitan Adelaide

Table 1 details the proportion of the workforce for each Local Government Area (LGA) in 1996 that walked to work. This table also details the average distance from the city centre and workforce density of each Local Government Area.

Walking as a transport mode ranged from 0.7% for Happy Valley up to 15.6% for the City of Adelaide. Walking appears to be more likely with inner city LGAs at 4.5% or more (i.e. less than 4 km from the city centre) than it does for middle to outer LGAs where it ranged from 0.8% in Tea Tree Gully to 3.4% in Unley (i.e. 4 km or more from the city centre). Glenelg was an important exception at 4%, and this might be explained by its better than average public transport links, and the higher proportion of elderly residents, medium density housing and concentrated retailing activity when compared with other LGAs.

A moderate linear correlation was found (Pearson coefficient of -0.39, significant at the 5% level) between persons who walked to work and the distance the LGA in which they lived was from the Adelaide city centre. No statistically significant correlation was found between the workforce density of a particular LGA and the propensity to walk to work.

There did not appear to be any dramatic differences between males and females that walked to work, with the possible exceptions of Thebarton (5.3% males versus 3.8% females), Glenelg (3.4% males versus 4.8% females) and East Torrens (3.3% males versus 1.7% females). The explanations for this difference may be that Thebarton has a high proportion of male oriented industrial employment whereas in Glenelg, there is a higher female population with employment strongly oriented towards service and retailing opportunities.

Equation 1. Walking Permeability Distance Index

$$WPDI = \frac{DD}{AD}$$

DD = Direct Distance between origin and destination
AD = Actual Distance by most practical route

Equation 2. Walking Permeability Time Index

$$WPTI = \frac{ADT}{DDT}$$

ADT = Actual Direct distance in Time
DDT = Direct Distance in Time

It seems that in most LGAs, however, there was very little difference in the propensity to walk to work between the sexes, with this being the case in around 12 out of the 29 LGAs.

The very low rates of people walking to work in the case of Happy Valley (0.7%), Tea Tree Gully (0.8%), Noarlunga (1.1%) and Campbelltown (1.2%) are LGAs with conventional low density suburban developments, where high mortgages and two car households are the norm. In addition to the constraint provided by low urban densities, it may be that the imperatives of servicing large mortgages and few local opportunities for high-income employment preclude walking as a transport mode of choice in the journey to work.

Walking as transport mode in Adelaide City

Adelaide's city centre lends itself well to walking as the primary local transport mode. This is because the city centre is compact and level with a fine-grained, orthogonal grid network of streets and pedestrian pathways. Furthermore, major transport infrastructure or other impenetrable physical barriers do not disrupt the urban fabric of the city. The human scale of many of its public spaces and buildings, the aesthetically pleasing wide streets and the moderate traffic stresses confer on Adelaide's city centre a public realm that is well suited to walking. However, it has been identified that there are certain hot spots in the city (North Terrace, Grenfell, King William Street

Table 1. Proportion of the workforce that walked to work by local government area, average distance from city centre, workforce density and sex.

Local Government Area (LGA) in 1996	LGA size (sq. km)	Average distance (km) of LGA to city	Workforce - People/Ha	% Males who walked to work	% Females who walked to work	% Total who walked to work	Total Workforce
Adelaide	15.6	0	4.6	15.5	15.7	15.6	7,237
Kensington & Norwood	3.9	3	11.1	6.6	6.3	6.4	4,335
St Peters	3.8	3	10.1	4.8	4.4	4.6	3,833
Thebarton	4.2	3	7.2	5.3	3.8	4.6	3,028
Prospect	7.9	4	10.8	2.2	2.3	2.3	8,527
Unley	14.3	4	11.6	3.4	3.4	3.4	16,607
Walkerville	3.5	4	8.5	2.6	2.2	2.4	2,986
Payneham	7.4	5	8.2	2	2.6	2.2	6,078
Burnside	25.7	6	6.8	2	2	2	17,350
West Torrens	32.8	6	5.2	3	2.6	2.8	17,178
Hindmarsh & Woodville	48.1	7	6.9	2.2	2.3	2.2	33,261
Enfield	33.2	8	4.7	2.8	2.3	2.6	15,501
Campbelltown	24.4	9	7.8	1.1	1.3	1.2	18,929
Enfield-Part B	23.3	9	1.7	3.7	3	3.4	4,077
Henley & Grange	6.7	9	9.3	1.6	1.9	1.7	6,225
Glenelg	4.9	10	11.7	3.4	4.8	4	5,748
Mitcham	75.5	10	3.5	2.4	2.1	2.2	26,458
Brighton	8.8	13	8.2	2.4	1.9	2.1	7,177
East Torrens	117.3	14	0.3	3.3	1.7	2.6	3,273
Marion	55.4	14	5.6	1.8	1.6	1.7	30,856
Salisbury	157.6	16	2.8	1.4	1.3	1.4	44,064
Tea Tree Gully	95.5	16	4.7	0.8	0.9	0.8	44,646
Stirling	108.3	18	0.7	1.5	1.4	1.5	7,850
Happy Valley	172.7	24	1	0.7	0.7	0.7	18,127
Noarlunga	169.3	26	2.2	1	1.4	1.1	36,472
Elizabeth	20.4	27	3.4	2.4	2.9	2.6	6,925
Munno Para	324.2	28	0.4	1.9	1.9	1.9	14,125
Gawler	41.2	34	1.5	2.4	2.3	2.4	6,352
Willunga	275.5	40	0.2	2.4	2.7	2.5	5,368

Source: Commonwealth of Australia, 2000, Derived from Basic Community Profiles for South Australia from the ABS 1996 Census of Population and Housing; <http://www.abs.gov.au/>

and Pultney Street) that have relatively high traffic accident rates and other areas with high assault risks for pedestrians when compared with Adelaide's suburban locations (Adelaide City Council, 1999). This is not unexpected given the high volumes of vehicular traffic and pedestrian activity that occur in the city. Adelaide still retains a 60 km/h general speed limit even in areas of high pedestrian densities and crossing activity.

Adelaide's draft Pedestrian Strategy (Adelaide City Council, 1999) did provide some graphical analysis of the degree of permeability provided by Adelaide's grid network of streets. However, table 2 provides a quantitative analysis of the degree of walking permeability provided in the city. Essentially the approach adopted is to identify the main origins and destinations for pedestrian trips in the city centre originating from either the tram terminus in the centre of the city or the railway station along North Terrace. These origins result in the most extreme pedestrian trips required to access the city's attractions, whereas buses provide almost direct access to the city's commercial and retail heart, Rundle Mall.

Table 2 is divided into two halves. The left half compares the direct straight-line distances with the actual distances required to reach particular destinations in the far right column and then expresses this as the Walking Permeability Distance Index. The right half compares the time required to walk the straight-line distance at a constant 6 km/h with the actual time required by the shortest practicable pedestrian route, but with maximum delays encountered at traffic lights. An optimal situation would be to achieve indices of 1 for WPDI and WPTI if a straight-line path were possible. However, realistically, with an offset path (i.e. a diagonal route), this would increase to 1.12 using the Pythagoras Theorem for the length of a triangle's hypotenuse.

Because of Adelaide's fine-grained street grid, it generally performs well on the Distance Index (WPDI), less so with the Time Index (WPTI). North Terrace and the parallel street system of Hindley Street/Rundle Mall/Rundle Street are very effective environments in moving large numbers of pedestrians efficiently and quickly. For example, Adelaide Railway Station to the Botanic Gardens, a distance of

Table 2. Walking Permeability Indices for Adelaide City Centre

START LOCATION	DD (m)	AD (m)	WPDI	DDT (sec)	ADT (sec) (max. est.)	WPTI	END LOCATION
Adelaide Railway Station	220	320	1.45	132	230	1.74	Rundle Mall
Adelaide R.S.	930	1100	1.18	558	740	1.33	East End (Rundle St)
Adelaide R.S.	1200	1200	1	720	800	1.11	Botanic Gardens
Adelaide R.S.	1460	1960	1.34	876	1330	1.52	Hutt St
Adelaide R.S.	830	1100	1.33	498	810	1.63	Central Markets
Adelaide R.S.	160	160	1	96	120	1.25	Hindley St
Adelaide R.S.	540	540	1	324	370	1.14	Uni SA City West Campus
Victoria Square Tram Terminus	660	660	1	396	490	1.24	Rundle Mall
Victoria Sq. T.T.	820	940	1.15	492	720	1.46	Adelaide Railway Station
Victoria Sq. T.T.	1010	1450 (1290 via ped links)	1.44 (1.28)	606	1010 (910 via ped links)	1.67 (1.50)	East End (Rundle St)
Victoria Sq. T.T.	1290	1890 (1730 via ped links)	1.47 (1.34)	774	1280 (1190 via ped links)	1.65 (1.54)	Botanic Gardens
Victoria Sq. T.T.	1120	1120	1	672	767	1.14	Hutt St
Victoria Sq. T.T.	170	220	1.29	102	160	1.57	Central Markets
Victoria Sq. T.T.	660	660	1	396	490	1.24	Hindley St
Victoria Sq. T.T.	950	1320	1.39	570	945	1.66	Uni SA City West Campus
Victoria Sq. T.T.	1010	1430 (1250 via ped links)	1.42 (1.24)	606	990 (880 via ped links)	1.63 (1.45)	Uni SA City East Campus

Key

DD Direct distance (m)
 AD Actual distance (m) by most practicable route
 WPDI walking permeability distance index
 DDT Direct distance in time (seconds)
 ADT Actual direct distance in time (seconds)

Assumptions for Table 2

1. Based on a walking speed of 6 km/h
2. Maximum time delay estimated for pedestrians is 25 seconds at busiest traffic light controlled intersections; 20 seconds at minor traffic light controlled intersections; & 10 seconds for minor side streets off main road without lights

1200 m, has a WPDI of 1.00 and a WPTI of 1.11. The Victoria Square tram terminus in the heart of the city is 660 m from Rundle Mall / Hindley Street and has a WPDI of 1.00, and a WPTI of 1.24 due to the effects of numerous sets of traffic lights. It is also some 1120 m from the Hutt Street restaurant precinct and has a WPDI of 1.00 and a WPTI of 1.14.

An interesting finding to emerge from this analysis is that diagonal trips across the city centre are far from optimal when the Distance and Time indices are compared. Adelaide Railway Station to Hutt Street is 1960 m in walking distance and has a WPDI of 1.34 and a WPTI of 1.52. The Victoria Square Tram Terminus produces similar performances with the 1730 m walking distance to the Botanic Gardens producing a WPDI of 1.34 and a WPTI of 1.54 or, if pedestrian shortcuts in the network are not used, 1.47 and 1.65 respectively. The disadvantage in using the tram terminus to access most of the city's attractions, is that all of the trips appear to involve diagonal routes that intersect with numerous streets and traffic lights that impede the progress of pedestrians.

One of the poorest performing indices involved walking from Adelaide Railway Station to the Central Markets which is around 1100 m in walking distance and this trip has a WPDI of 1.33 and a WPTI of 1.63. The problem here is a lack of directness in the route and a large number of intersections constrain timely progress.

This analysis of the Distance and Time indices

demonstrates that while the Adelaide city centre performs reasonably well in terms of actual walking distances required in order to reach many of the city's key attractions on foot, in terms of the actual time required, its performance could be improved significantly. If 20 minutes is taken as a general limit of accessibility for pedestrians, poor WPTI values that approach 2 could restrict an average pedestrian's propensity to a walking range of little more than a kilometre, rather than the 2 km that should be possible at a 6 km / h walking gait.

Comparing permeability indices: Garden East versus Mawson Lakes

Walking permeability indices are potentially very useful in comparing how conducive an area is to walking to access facilities. Analysis of walking permeability indices for access to key facilities (see Table 3) was conducted for the Garden East residential development in the East End of the Adelaide city area and compared with those for the new Mawson Lakes suburban development 11 km north of the city. Mawson Lakes are the vestigial remains of Adelaide's once grand and now abandoned Multi-Function Polis concept of the mid-1990s. Mawson Lakes was chosen because Delfin have marketed this suburb under the slogan 'Live, work and play at Mawson Lakes', thereby implying that it is a balanced, integrated community with all essential community facilities provided locally, thereby allowing low reliance on cars for local transport.

Table 3. Walking Permeability Indices for Garden East & Mawson Lakes

FACILITY	Garden East, East Terrace (City Centre)			Mawson Lakes, Brookside Drive		
	Direct distance (metres)	WPDI	WPTI	Direct distance (metres)	WPDI	WPTI
Primary school	520	1.13	1.29	>2000	-	-
High School	520	1.13	1.29	1020	1.1	1.18
University	270	1.11	1.39	1000	1.13	1.24
Local supermarket	1200	1.34	1.53	805	1.19	1.3
Town centre	640	1	1.1	805	1.19	1.3
Cafe	60	1	1	1120	1.04	1.11
Local park	40	1.25	2.29	360	1.03	1.17
Lake	250	1.28	1.45	680	1.1	1.23
Golf course	2300	1.48	1.63	1340	1.2	1.3
train station	1060	1.16	1.32	1230	1.38	1.42
bus stop	150	1	1.22	805	1.19	1.3
employment	100	1	1.33	980	1.17	1.24
Notes	WPDI walking permeability distance index			Brookside Drive is 13 km north of the city		
	WPTI Walking permeability time index					

Garden East is located in the heart of Adelaide's East End quarter alongside the restaurant district of Rundle Street. It is a mixture of medium- to high density residential development ranging from townhouses to 8 storey tower blocks that approaches a dwelling density of around 50 dwellings/hectare on a 3 hectare site. Many dwellings have secure parking. However, the marketing of the development has stressed that the Garden East complex is luxurious 'city living' and, as with Mawson Lakes, the marketing implies that residents would have low reliance on cars for their local transport needs.

For most important facilities, both developments perform reasonably well in terms of their walking permeability indices, with no Distance Index exceeding 1.5 and just one Time Index exceeding 1.65. Although most permeability indices exceeded the practical optimum of 1.12, most indices were in the acceptable range (i.e. less than 1.5). The very high WPTI needed to access a local park from Garden East is due to the severance of a busy road, but this is offset by the short distance involved. Mawson Lakes does not yet have any primary schools; however, one is planned if demand is there in the longer term. The critical disadvantage for the Garden East development is the long distance needed to access the city's main food shops (1610 m), which when combined with the high Time Index due to the large number of intersections, renders it impractical for significant shopping expeditions.

It would be feasible for a resident to survive without a car in a fringe location of Mawson Lakes such as on Brookside Drive. Notwithstanding this, the resident in the worst case scenario analysed in Table 3 would have to be a very keen walker to live without a car. Traditional neighbourhood planning theory worked on a 400 m radius from facilities as being optimal (possibly 600 m in actual walking distances). Mawson Lakes falls significantly short of this ideal with many precincts outside the 400 m radius from the proposed town centre. Densities are higher than in conventional Australian suburban development (15 dwellings/hectare versus the usual 8 dwellings/hectare); however, densities would probably have to be double this to really make walking the most likely local travel mode of choice.

While Mawson Lakes' performance is acceptable in its current form, there are plans to expand it from its current population of about 4000 to 10,000. This means that the dwellings on the new expanded fringe in the future will perform considerably worse in terms of access, with maximum walking distances approaching 2 km to reach many facilities. The Distance Index may not be affected unduly because of the fine-grained orthogonal grid network of streets, but the Time Index can be expected to deteriorate considerably in a dense

street network without a dedicated pedestrian network.

Strategies for Facilitating Walking

Few local government councils prepare specific strategies to encourage walking within their jurisdictions. Adelaide City Council is an exception. In 1999, it prepared a draft 'Streets Ahead – City of Adelaide Pedestrian Strategy' and there is currently an integrated movement strategy being developed, called 'Adelaide on the Move' (Adelaide City Council, 2000). The main aim of these strategies from the perspective of pedestrian movement is to make the city safer, more pleasant, convenient and enjoyable for pedestrians at all hours and to encourage walking for health and pleasure. This is being achieved through improvements to the city's pedestrian routes, public spaces and landscaping.

Interestingly, there is an emphasis in the latest draft on an enhancement program of key minor streets and laneways to improve the permeability of the city for pedestrians, particularly in the vicinity of Rundle Mall. The focus then appears to be on improving the environment for pedestrians so that people are not inhibited from walking in the city. Be that as it may, little appears to be said about using marketing or educational campaigns to encourage people to walk instead of driving (Adelaide City Council, 2000).

The analysis of the Time indices for Adelaide do show however, that for diagonal walking trips or walking trips away from North Terrace and Rundle Mall, pedestrian trips are significantly affected by delays in crossing streets and waiting at intersections. Strategies that could be employed to overcome this are threefold:

- 1 traffic lights could be optimised to respond instantly to pedestrian crossing needs;
- 2 more streets could be pedestrianised to allow the creation of more dedicated pedestrian routes; and
- 3 a new level of pedestrian activity could be opened up either above or below ground to avoid potential conflict between traffic and pedestrians in situations where the elimination of vehicles is impractical or difficult.

Conclusions

The analysis of walking as a modal choice in metropolitan Adelaide showed that for the journey to work, only Adelaide City has sufficient local concentration of employment activity for a significant proportion of people (15%) to choose walking whereas in the suburbs only 1% – 3% of people walk to work. Dispersal of employment to the suburbs may be one way of improving walking as a local transport choice, but only if people choose to live where they work. Future national census surveys should be adapted to

include questions about the extent of walking activity in people's daily lives, to encourage people to appreciate the value of walking.

The main focus of this paper has been to demonstrate the value of walking permeability indices as a planning tool for assessing how well an urban area facilitates walking as a local transport option. This analysis was applied to the City of Adelaide generally and then to two case studies of residential developments, Garden East in the city and Mawson Lakes. Although both developments performed reasonably well, neither was sufficiently

good to allow people to do without their cars. For Garden East, this was due to the logistics of food shopping and for Mawson Lakes, it was because the distances are on the verge of being too large. It does demonstrate that more needs to be done, probably through increased densities and dedicated pedestrian routes, to ensure that walking becomes the more natural local travel choice of people. In the case of Adelaide's city centre, a starting point would be to make pedestrian crossings more responsive to pedestrian demands.

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Conference Announcement

Moving On 2001 Conference, 25-26 October 2001, Ashton Court, Bristol

Hosted by Bristol City Council and supported by the DTLR, the theme is *Urban Transport: winning the argument to encourage local authorities and their partners to be more creative if 21st century city centres are to be served with the transport systems they deserve.*

Aimed at key transport policy makers, opinion formers and stakeholders, speakers include Professor David Begg, Commissioner for Integrated Transport, Stephen Norris, Transport for London and Moir Lockhead, Chief Executive of First Group. Further details available from Conference Organisers, Benchmark Communications.

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- deal with global as well as local issues
- include the development of the ideas of sustainability, the design of cities and rural areas, transport corridors and international links to improve health, the economy and the environment.

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Articles should normally be between 2,000 and 4,000 words. Shorter articles can be published as 'Comment' pieces. Responses to papers which have appeared in the journal, either as letters to the Editor or as response articles, will be welcomed.

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