

LAND USE, WALKING AND CYCLING: A Review of Recent Research, Australian Policies and Suggestions for Further Work

**Ian Radbone and Steve Hamnett
Transport Systems Centre, University of South Australia**

1. INTRODUCTION

This paper draws primarily on a wide-ranging examination of empirical studies on ways in which urban form affects public health, specifically through the ways in which the built environment encourages or discourages physical activity and the use of more sustainable modes of travel. The paper summarises the results of this review and reflects upon the current balance between theory and practice in planning for walking and cycling. Against this background, the second part of the paper provides a brief exposition of the many measures that are being taken in Australia to promote more sustainable travel, and particularly walking and cycling, focusing on measures that have received most attention in the literature. The paper concludes with suggestions for further research.

Land uses and transport infrastructure interact in ways that have a major influence on the form and character of the built environment. The location of roads and rail or tram lines influences where development occurs. Likewise, the location of new development — housing estates, shopping centres or industrial parks — influences the location of transportation investments, while the character of that development — whether it is pedestrian-friendly and well-served by public transport or car-oriented, for example — influences travel options and behaviour. To the extent that patterns of land use and transport infrastructure limit potential for walking and cycling for all or parts of journeys, they influence levels of physical activity and therefore public health. There have been several substantial literature reviews in recent years that have examined land use-transport relationships. There is also a growing literature on the health benefits to be derived from regular exercise as part of daily life. The literature review on which this paper is based sought to bring these fields of enquiry together.

2. LITERATURE REVIEW¹

2.1 PHYSICAL ACTIVITY AND HEALTH

Australian research suggests that about 40 per cent of urban New South Wales residents are not sufficiently physically active according to levels of activity recommended for good health (Public Health Division, 2001a). Among urban New South Wales residents, 41 per cent are overweight or obese (Public Health Division, 2001b). Approximately 20 per cent of Australian children and adolescents are overweight or

¹ This paper summarises two extensive literature reviews, one of which was undertaken as part of an ARC SPIRT grant and the other under a project funded under the Australian National Greenhouse Strategy. Anyone interested in the full versions of these reviews should contact the authors. There are also several excellent 'reviews of reviews' which have been produced in recent times – in particular, Crane (2000); Stead and Marshall (1998); Steiner(1994); and Apogee(1998)

obese (Booth, Wake et al, 2001). Women, middle-aged and older adults, non-English speaking groups, parents of young children and those with lower educational attainment are less likely to be physically active (Bauman, Bellew, Booth et al, 1996; Booth, Owen, Bauman and Gore, 1997). Data from recent national surveys suggest that the proportion of the population doing sufficient activity for health benefit declined from 62 per cent in 1997 to 57 per cent in 1999 (Heart Foundation of Australia, 2001; Armstrong, T., Bauman, A. and Davies, J., 2000). Physical inactivity is associated with direct health costs estimated at around \$400 million each year. There are estimated to be about 8,000 preventable deaths each year in Australia associated with physical inactivity and it makes a large contribution to the overall burden of disease (Getting Australia Active, 2002).

There is a high level of agreement that structured, vigorous forms of exercise, such as jogging or aerobics, are not the only ways to achieve health benefits from physical activity. Attempts to encourage people to increase their daily levels of walking and cycling are increasingly focusing on changes to the physical environment on the assumption that the ability to sustain an active lifestyle may partially hinge on the characteristics of the built environments in which we live, work, and play. Planning and urban design policies and practices need to place more emphasis, therefore, on the provision of environments that support physical activity as a normal part of daily life. (Heart Foundation of Australia, 2001)

2.2 THE INFLUENCE OF LAND USE PATTERNS AND ACTIVITIES ON PEOPLE'S PROPENSITY TO WALK AND CYCLE

Travel behaviour theorists have long assumed that people travel because they need or want to do something at another location— work or shop, for example. Few trips, it is commonly believed, are exclusively recreational or taken for their own sake. Walking trips are an exception, however, in that the purpose of many walking trips may be the walk itself rather than the destination. Additionally, because the pedestrian is exposed to the elements in the way that a driver is not, he or she is more aware of the sights, sounds, smells, and surroundings than is the typical motorist.

As a consequence, pedestrians and also cyclists may be more influenced by detailed local design or 'micro-design' variables than motorists. Environmental barriers to using non-motorised modes could include a lack of cycle lanes or walking paths, or the local topography. Napier (2000) identified barriers to walking as time needed; danger from motor vehicles; fears about personal security; inclement weather; poor health/unfit; quality and amenity of pedestrian facilities; impracticality due to distances; having dependents or baggage; and perceptions of a 'lack of glamour' associated with walking compared with other travel modes. A Canadian survey had similar results. (Go for Green/Enviro-nics, 1998)

These surveys suggest that some barriers are attitudinal; others are environmental. It seems plausible that a mix of policies combines to influence levels of physical activity through educational programs and through the creation of supportive environments. Transport departments and urban planners can change road design standards and built environments to support walking and cycling. Behavioural change programs can assist by providing better information about the health benefits of physical activity and about local travel options.

The typical built environment in Australia and other low-density car-based cultures strongly encourages travel by the car. The street network is designed primarily for the car and cheap parking is widely available. While behavioural change and environmental change programs are likely to be complementary, changes to the physical environment are probably necessary conditions for significant changes to behaviour.

2.2.1 Density

There has been intense academic debate in recent years on questions of how urban form, land uses and activity patterns influence people's use of sustainable modes of travel. More compact urban areas are generally argued to be supportive of more sustainable modes on the grounds that they

- Provide for shorter trip lengths than in a dispersed city and that walking and cycling become more feasible
- Allow for the provision of a wider choice of facilities within easy walking/cycling distance (accessibility being higher and healthier modes of travel more likely),
- Make public transport more viable and allow investments in public transport infrastructure to be justified.

While apparently straightforward, density presents some problems for researchers. Data on density at a local scale (as opposed to city-wide density figures) are difficult to obtain. This limits the research on the impact of density at a local level. Also density may represent only one of a combination of influences on travel behaviour or may simply be an indicator of the presence of other urban form attributes which are of more direct influence on travel behaviour. Higher density areas generally are areas with smaller houses, lower levels of car ownership, variable incomes, better public transport services, and a greater mixture of land uses (Kitamura, Mokhtarian, and Laidet 1994).

There is a large number of empirical studies which have found that density and motorized travel behaviour *do appear to be* significantly related. A study by Holtzclaw (1994) concluded that a doubling of density levels produces 25 to 30 per cent less driving per household *when all of the conditions generally accompanying density*, including better public transport, more local shopping, and a pedestrian-friendly environment, are present. Dunphy and Fisher (1994) reached similar conclusions about the influence of density on vehicle miles travelled (VMT). A simple comparison of survey data from the 1990 US NPTS with density statistics from different cities suggested to the authors that increasing density levels will reduce VMT, but only above a certain threshold level. And, after citing many studies on density and vehicle miles travelled, Ewing concluded that "doubling urban density results in a 25-30 per cent reduction in VMT, or a slightly smaller reduction when the effects of other variables are controlled" (Ewing, 1997).

It is also argued that high density makes public transport accessible to more people, thereby creating a critical mass of public transport users. Public transport stops or stations placed in high density areas will be accessible to more people within a particular radius around the station (Apogee, 1998) This is a central idea in the notion of transit-

oriented design (TOD). Public transport and walking are considered to be mutually supportive (Calthorpe,1993).

Perhaps the simplest hypothesized relationship between density and travel modes is that between higher density levels and the propensity to walk and cycle. It is taken as axiomatic that higher density levels will produce more walking and cycling, and especially walking. This is due to the presumed shortening of distances between trip origins and destinations, and the impact this has on shifting modal choice away from driving and toward walking and public transport use (Apogee 1998). However, as noted earlier, density is often measured at a spatial level that is too large to capture much of the travel behaviour that occurs at small geographic scales, precisely the level at which walking and cycling trips occur. Most walking trips, for example, are very short, with most under a kilometre (Antonakos 1995).

Nevertheless, Dunphy and Fisher's 1994 study compared American cities by density and found a link with the mode of transport used, including walking and cycling. Their results indicate that the total number of trips does decline (slightly) with density, while trips by public transport, walking, cycling and taxi increase.

Table 1

Person daily trip rates by Mode, USA standard metropolitan statistical areas, 1990

Density*	Trip rates or range of trip rates by density				
	Private vehicle	Public transport	Walk/cycle	Taxi	Total*
<2000	3.28-3.53	0.02-0.08	0.21-0.33	0.0	3.77-3.96
2000-4000	3.34-3.46	0.07-0.08	0.28-0.29	0.0	3.81-3.92
4500	3.51	0.06	0.30	0.0	3.95
6250	3.29	0.11	0.36	0.01	3.83
8750	2.92	0.16	0.45	0.02	3.62
30000	1.90	0.50	0.95	0.03	3.42
60000	0.59	1.03	1.55	0.16	3.40

* Persons per square mile. density information in the National Personal Transportation Survey was calculated for each household's postal code.

Source: table adapted from Dunphy, R. T. and K. Fisher (1994) "Transportation, congestion, and density: new insights" *Transportation Research Record* Vol. (1552): 89-96. Cited, Black, John, 1996

In reading Dunphy and Fisher's figures it should be noted that only about 10 per cent of urbanised America lives at densities above 7500 persons per square mile, the point at which travel patterns start to change. By comparison, Adelaide's density was recorded in Newman and Kenworthy's 1989 study as 3367 people per square mile, suggesting that density would have to be doubled before we reached the point at which mode shares would start to change (Newman and Kenworthy, 1989)

A major criticism of the work of advocates of higher density such as Newman and Kenworthy is that a link between density and travel patterns is not necessarily a causal link and that, once socio-economic factors are accounted for, the relationship between density and transport may lack much explanatory force. Schimeck's 1996 study of data from the US 1990 Nationwide Personal Transportation Survey found that, once social and economic factors were controlled for, density did not account for much. Schimek found that a ten percent increase in density leads to only a 0.7 percent reduction in household automobile travel. However, a ten percent increase in household income leads to a three percent increase in automobile travel.

The Impact of Density in Encouraging Sustainable Travel

Areas of agreement

Higher densities lead to shorter distances between origins and destinations

Aggregate walking and cycling levels increase with density

Modal share of trips by walking and cycling rises with increased density

Issues

Density is less significant than socio-economic factors in influencing travel behaviour

Density may often be a proxy for other urban form variables

2.2.2 Mixed Use

The second measure considered here is the mix of land uses and activities. Measures of land use mix attempt to describe the proportions of commercial and residential uses within a given geographic area. While modernist planning over the post-war period has separated land uses by zoning, 'New Urbanists', and other proponents of more traditional urban layouts, believe that if travel by more sustainable modes is to increase, the shorter distances between trip origins and destinations that mixed use developments create are absolutely necessary to induce such behaviour (Calthorpe, 1993).

There are two different notions of mixed use, both in the literature and in policies adopted by governments. The term "vertical mix" implies that there is more than one use within a structure and that these uses are vertically stacked (e.g. retail shops at street level and residential uses above). This approach to land development, a favoured technique of New Urbanists, used to be common, yet is rarely seen in newer developments in Australian cities. An alternative notion of land use mix relates to how far one needs to travel between places of residence, employment, recreation, entertainment, and shopping. The scale at which land use mix is measured is critical because it will determine how many of these complementary uses are captured and the potential impact that the distance between uses has on the choice to walk or not.

As with density, the empirical literature generally supports the conclusion that land use mix and travel behaviour are linked in certain ways. A variety of studies, including Cervero and Radisch (1995), Ewing, Haliyur, and Page (1994), Friedman, Gordon, and Peers (1994), and Handy (1992) matched travel survey data to travel behaviours for residents in a select number of neighbourhoods with mixed and single-use characteristics. These studies consistently found associations between mixed use

development and non-motorised travel behaviour. Once again, however, the mixed use neighbourhoods tended to possess other urban form characteristics that might also explain lower levels of car dependence. Traditional neighbourhoods tend to be higher in density, for example, and often have grid-like street networks.

To address this issue, a study by Frank and Pivo (1994) employed multiple regression techniques to analyze data collected on a regional basis. Independent variables included measures of density (as discussed above) and land use mix. Partial correlations showed that both density and land use mix were significantly and positively related to mode share by public transport and walking for work trips, and negatively to work trips by car. However land use mix was not significantly related to shopping trips by any of the three modes. After controlling for demographic variables, land use mix was no longer significantly related to work trips by public transport or car. Its relationship to work trips by foot remained significant, however.

Related to the notion of promoting mixed use development as a way of encouraging more use of sustainable modes of travel is the long-established planning goal of seeking to have people living close to where they work. Recent research has tended to undermine the usefulness of this as a planning principle in the light of observed changes in the locational behaviour and employment patterns of different groups. The changing nature of employment – more short-term contract work, in particular – makes this a problematic policy variable. (Levine, 1998) There is also greater understanding now of the diversity of travel patterns of women, older people and children and of the diminishing proportion of trips which are work-related.

The Impact of Mixed Use in Encouraging Sustainable Travel

Areas of agreement

Mix of use, like higher density, can lead to shorter distances between origins and destinations

Shorter local shopping and entertainment trips may replace longer trips to regional centres

Aggregate walking and cycling levels increase with increasing mix of uses

Modal share of trips by walking and cycling rises with mixed use

Issues

Limited number of studies of the impact of mixed use in employment centres, as distinct from neighbourhoods

Mixed use developments may provide local facilities, but people still need to choose to use them

Living close to work seems less relevant these days because of the changing nature of employment and the diminishing importance of work-related trips as a proportion of all trips

2.2.3 Street Layout and Micro-design issues

This section considers the relationship between the form and character of street networks or layouts on the propensity to walk or cycle. The literature suggests that street

layouts are significant in two principal ways: through the ways in which streets connect trip origins and destinations; and through the ways in which street design encourages or discourages trips on foot or by bicycle, particularly by the presence or absence of separate, safe dedicated pedestrian and bicycle paths. Street networks that have straight roads, relatively few cul-de-sacs, and small block sizes reduce distances between trip origins and destinations and increase feasible trip routes, thereby providing more opportunities for pedestrian and cyclist travel. Street design affects trip quality. Streets that are designed in a way that reduces motor vehicle speeds are likely to provide more attractive routes for non-motorists.

Hierarchical, cul-de-sac based street network designs have come under a good deal of critical scrutiny in Australia in recent years. Suburbs designed on these principles are claimed to create a set of physical barriers to movement across and between neighbourhoods and different parts of the city. The separation of neighbourhoods by arterials creates islands for local residents, in effect walling them off and making travel across neighbourhood boundaries on foot or by bicycle dangerous (Untermann 1987). Further, as the number of cars has increased, the car has come to dominate even the internal residential streets, also to the detriment of cyclists and pedestrians (Wolfe 1987). 'New Urbanists', in particular, have challenged the design philosophy behind the disconnected, hierarchical street network. 'Traditional Neighbourhood Design' (or TND) is much the same as New Urbanism and, as the name implies, TND deliberately attempts to recreate the characteristics of the older parts of cities and, simultaneously, to reject the design principles that dominate more recent suburban developments. Another variant, 'Transit-oriented Development' or 'TOD'), emphasises 'walkability' and convenient access to shopping and, in particular, to public transport. In all of these variants of neo-traditional design, the emphasis is on reducing the distances between trip origin and destination.

The New Urbanist argument for the traditional grid street pattern is that, by offering motorists and other road users alternatives, the grid distributes traffic more evenly, with less congestion. Also the traditional roads are relatively narrow, intersections are frequent and the 90° intersection angles make for sharper turning, thereby slowing traffic down. Wide streets are seen as a waste of space in a local neighbourhood.

There has been a number of studies which have attempted systematic comparisons of neo-traditional and hierarchical suburban neighbourhood types, and specifically of the grid layouts of traditional neighbourhoods and the curvilinear, or 'dendritic', street networks of the suburban neighbourhoods, (see, for example Frank, 2000; Southworth and Owens, 1993; Randall and Baetz, 2001). Once again, however, firm conclusions founder on the difficulty of isolating the effect of the street network from other factors, both environmental and socio-demographic, that may influence the result.

A separate set of studies looks beyond the general characteristics of street networks – grid or hierarchical – to consider the influence of detailed street design. This includes factors such as the street surface, its width, the existence of continuous bike lanes or footpaths and the quality of associated features, such as building designs and appropriate tree planting. As with street networks, certain types of street designs are held to encourage walking and cycling by, for example, providing barriers to motorised vehicles in order to reduce speeds.

Many streets in newer residential subdivisions do not provide facilities for walkers and cyclists, nor do they attempt to slow traffic. For most of the post-war period street design has been heavily influenced by the road design standards adopted by traffic engineers.

These standards have favoured the construction of streets that are wide, smooth, and straight, conditions that encourage high-speed, motorised travel and discourage walking and cycling (Untermann 1987). Traffic engineers are generally seen (caricatured?) as viewing pedestrians and cyclists as obstructions that impede the smooth flow of traffic.

There is considerable support for the notion that pedestrian travel is influenced by the characteristics of buildings and other site-level design attributes. Pedestrian-oriented site design is an integral component of the neo-traditional design philosophy. 'New Urbanist' communities seek to encourage walking through a narrow, highly-connected street network, and through a design philosophy that emphasises the creation of interesting environments for the pedestrian. (Berman 1996; Corbett and Velasquez 1994).

The Impact of Micro-design issues in Encouraging Sustainable Travel

Areas of agreement

Grid street patterns create higher levels of connectivity and decrease distances between origins and destinations

Empirical studies have found higher modal shares for walking and cycling in areas designed around grids

A wide range of detailed design features – shelter, safe storage facilities, detailed attention to street and footpath surfaces increase people's propensity to use more sustainable modes of travel. Micro-design is important in creating environments supportive of physical activity

Issues

Several studies of the impact of grid layouts on mode share are inconclusive

Few rigorous studies of the effects of street design on travel behaviour

Regional accessibility issues may be more influential on travel decisions than local street network characteristics

Location of grid-based suburbs likely to be significant – grid-based suburbs at the urban fringe may have less evidence of sustainable modes of travel than suburbs with similar features in inner urban areas

Pedestrian and bike amenities tend to be co-located with other urban form elements – higher densities, grid street patterns etc. Hard once again to separate out causes and effects.

2.3 SUMMARY

Overall then, the literature review summarised above suggests that the intuitive notion that higher density may encourage less car use is being replaced by the notion that density, mixed use and micro-design elements in some combination are most likely to influence people's willingness to use more sustainable modes of travel. Increasing levels of density alone will not serve to promote more walking without increased mixing of uses which brings services and other destinations closer to where people live and work. Areas that are dense and mixed often exist without the required linkages between uses. And,

while increased proximity can be achieved through higher levels of density and mix, the ability to efficiently move between activities requires an interconnected street network that is supported at the micro scale through site design.

This review has described a number of studies that indicate some relationship between land uses, street layouts and travel behaviour. Clearly, just because these vary together, it does not follow that one causes the other. It may well be that people who live in higher density, or mixed use, or older, parts of the city use the car less, but to what extent are the land use circumstances actually *causing* their behaviour? When comparing a “traditional” neighbourhood with a “conventional” suburban neighbourhood, many different factors need to be considered. A traditional neighbourhood will typically have higher densities, less parking, a greater variety of land use, more people on the streets, houses and shops which are not setback from the street, footpaths, straight roads, small blocks, and — because they are closer to the downtown area — better public transport services. It is very difficult to isolate the impact of any one of these factors.

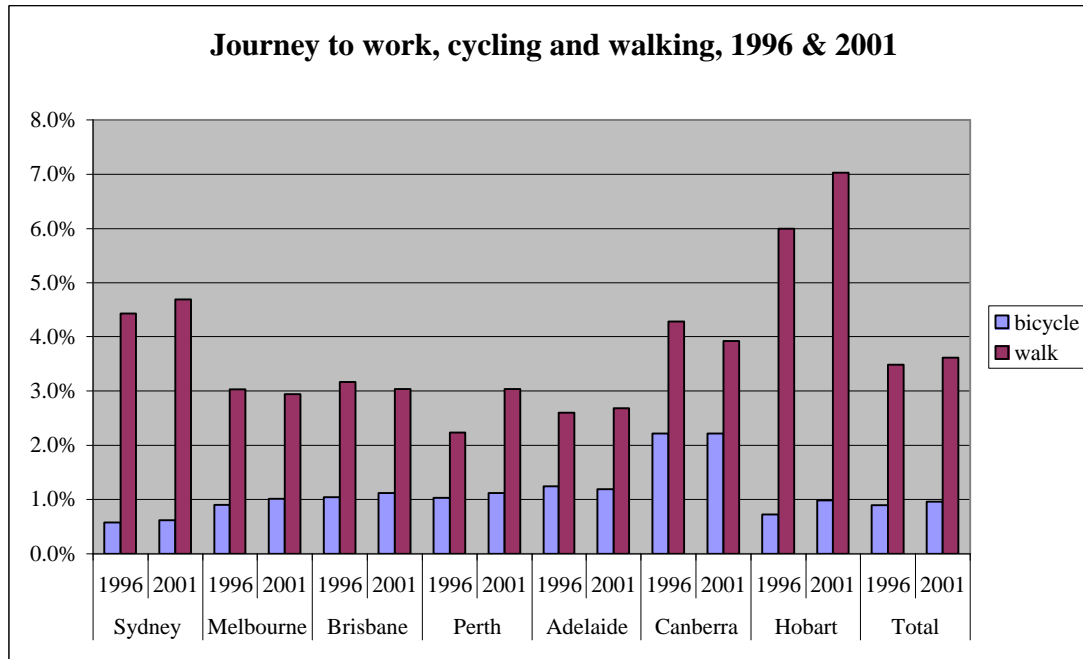
Socio-economic, demographic and attitudinal factors will also influence reported travel patterns. People may live in small houses on small allotments because that is what they can afford. The same people may well use the car less and public transport more because they cannot afford to use the car. Large households with younger children find it easier to manage their daily activities by using the car. Many such households also locate themselves in newer suburban areas with houses with large back yards. If, for some reason, they were forced to live in a small house with little or no garden in an inner suburb, they might use the car less, but still more than residents who were there through choice. Some people may locate in suburbs that have good public transport and are close to shops, services and the city *because* they do not want to rely on the car. Prevedouros (1992). Women’s travel patterns may vary from men’s and, in general, we are more conscious these days of the travel needs of diverse groups. Before that, t

The next part of the paper provides a brief overview of current walking and cycling patterns and policies in Australia in order to provide some basis for comparing theory with practice.

3. WALKING AND CYCLING IN AUSTRALIA

The journey to work (JTW) data provided by the census indicate that walking and cycling have a very low transport mode share in Australia. See Figure 1.

Figure 1



There is some compensation:

- these figures are likely to be underestimates in all states but Queensland, as the census is conducted in the wet winter months
- weather variability notwithstanding, there has been a slight increase in walking and cycling in most cities.

Using data based on all trips, we find that only one per cent of Sydney's population cycles each day, despite the total number of bicycles owned by Sydney residents being nearly two million (RTA, 1999) and the proportion of households with a bicycle having risen from 32 per cent in 1991 to 39 per cent in 1998 (Transport Data Centre, 2000). Data from the 1999 Metropolitan Adelaide Household Travel Survey showed that, since the previous survey in 1986, while the total number of trips in the study area had remained relatively unchanged, the proportion made by car increased from 73 per cent to 81 per cent, the number of walking trips declined from 16 to 13 per cent and the number of cycling trips declined from 2 per cent to 1 per cent. (Transport SA, 2002)

The variations between capital cities revealed in Table 1 are slight but interesting. There is a general pattern that the bigger the city, the higher the levels of walking, but not cycling. The spectacular exception is Hobart, the smallest city, yet with easily the highest levels of walking to work. Anyone knowing the topography and climate of Hobart could explain the low level of cycling, but why the high level of walking?

Australian governments are trying to encourage walking and cycling on a number of fronts. The following account deals with the planning measures, addressing the themes of the previous literature review. We also deal briefly with the approaches taken by health and transport related organisations. These are focussed on promotion, education and the provision of infrastructure.

3.1 LAND USE STRATEGIES

3.1.1 Compact cities

The concept of compact cities has been embraced in a number of Australian cities. The first “direction” presented in Melbourne’s 2030 strategy has been to create a more compact city, including the development of mixed-use centres that are convenient for transport. Melbourne’s 2030 strategy has adopted an interim growth boundary. Although an objective for this has been to create a “compact city”, the supporting discussion refers to the need for greater predictability in future land uses, the reduction of speculation and the retention of open land near the city. (Victorian Department of Sustainability and Environment, 2002)

Both the past and present South Australian governments have supported urban growth boundaries, and there is currently a Plan Amendment Report to bring this into effect. The Western Australian government is examining the need for infill development and possibly an urban growth boundary for Perth. (Western Australia, 2003)

The NSW government, perhaps bearing in mind the unfortunate history of the green belt of the 1956 County of Cumberland Plan, (Morison, 2000) has been more cautious in its intentions, proclaiming the need to “balance” land release with urban renewal. (Planning NSW, 2003). However, as we note below, it does have a policy of requiring at least 15 dwellings per hectare on the urban fringe.

There has been some evidence that our cities are becoming more compact. Using ABS definitions of the metropolitan statistical areas, the average increase in density of the Australian capitals was 6.7% between 1996 and 2001. This “densification” has mainly been driven by market forces, as developers have realized that healthy profits can be made from subdividing quarter acre blocks that are no longer the dream of Australian suburbanites, and that fashion for urban living has created demand for central city apartments.

The role of the planning process in this is ambiguous and complex. Decrying “urban sprawl”, State governments have supported high density living, most visibly in their promotion of relatively high density infill developments on disused land and through “land harvesting”, in which government owned blocks are being sub-divided. Redevelopment of areas of government-owned housing has also featured slightly higher housing densities, though this has been more due to the need to cater for smaller household sizes than a desire to increase density per se. In fact density as measured by population may have decreased after the redevelopment.

In general local councils have proved much more reluctant to support higher density living, responding to their electorates’ concerns about the loss of “character” inherent in the commercial practices of bull-dozing old houses and replacing them with modern, often unsympathetic buildings. Councils’ use of planning rules imposing minimum block sizes and plot ratios to control this development has been stymied by State governments using their powers of approval over local-initiated planning rules.

Things become more complex when we look at the situation in city centres and in greenfields developments. Both state government and local councils have welcomed and promoted the move toward living in the city centre, favouring high density residential development with planning dispensations and rate cuts, for example -Melbourne City Council's PostCode 3000 project is the best example of this. Small blocks and apartments are generally not attractive to the market in outer areas and here the impetus towards higher densities has been state government-led. Without an existing electorate to complain about the loss of development, local councils have been compliant with state government policies. New housing developments in which the state government has played a part will tend to be designed with somewhat higher densities, though the market response may result in a weakening of this commitment over the life of the project.

Council planning codes that are used to assess new developments reflect the ambiguity of the planning process in dealing with higher densities. While often prefaced with rhetoric about sustainable living and promoting walking and cycling, the historic bias toward low density living is still evident in the rules about minimum but not maximum block sizes, minimum setbacks, maximum plot ratios, separating land uses by zone, "adequate" road widths and parking, open space requirements and so on.

There are moves for change, but how successful these will be is open to question. The NSW draft SEPP 66, promoting integrated transport and land use, provides for a policy of no less than 15 dwellings to the hectare for new developments — along with building forms and street layouts that support cycling and walking. Such densities will not happen unless commercial developers see these as financially attractive, or unless the government itself steps in to provide such housing.

Even if achieved, the higher densities will do little to promote walking and cycling if there are no facilities nearby to walk and cycle to. Ensuring the provision of local shops is even more difficult than ensuring higher densities. State governments have attempted to provide shopping facilities at the neighbourhood level (e.g. South Australia's Centres Policy and Western Australia's 'Living Neighbourhoods', which is discussed below.) In South Australia at least the experience is that such centres, like the corner shop, have struggled in the face of the agglomeration advantages of larger centres. Arguably, the sale of convenience goods from service stations is the only aspect of walkable shopping that has improved. (Interestingly the 'Right Places' element of New South Wales' Integrating Transport and Land Use policy seeks to restrict the sale of convenience goods from service stations that are not located in a centre.) (NSW Department of Urban Affairs and Planning, and Transport NSW, 2002a)

3.1.2 Mixed use development

While planning strategies to promote walking and cycling will take a very long time before they have an impact at a metropolitan-wide level, the concept of mixed use development is politically popular. There are urban design projects throughout Australia that have the promotion of walking and cycling as one of their goals. The features of these projects are their higher density, mixed use nature and proximity to public transport nodes.

Sydney has many examples of high density development around its train stations, to the point that it has been described as "fast becoming the predominant form of new development in Sydney" (Institute for Sustainable Futures, 2001, s 4.4). *Melbourne*

2030 states that features of the program will include “encouraging and making it easier for people to walk or cycle to Transit Cities”. (Victorian Department of Sustainability and Environment, 2002) The NSW government has chosen the new Chatswood-Parramatta rail corridor, Macquarie Park/ North Ryde as some of its “Living Centres”, with mixed use development featuring in each of these cases. (Department of Infrastructure, Planning and Natural Resources, n.d.) The Bracks government in Victoria has announced that it is spending \$10.5 million on its Transit Cities program, which includes higher density mixed use developments, in the following centres: Ringwood, Dandenong, Frankston, Footscray and Sydenham. (Victorian Minister for Planning, 2003) The East Perth development is also notable for attempts to mix developments through shop-top housing.

The Vision Statement for SEQ 2121 foresees that “Employment, human services, commercial and recreational facilities will be close to where people live to reduce the need for residents to travel long distances in private vehicles. (Government of Queensland and the South East Queensland Regional Organisation of Councils, 2001)”

Brisbane’s Kelvin Grove “urban village” adjacent to the city centre is an example of the promotion of mixed use development which also emphasises walking and cycling. The website for the project proclaims²:

“Kelvin Grove Urban Village marks a return to a community of people focused on a main street. Residents will be able to tap a diverse range of living, learning, leisure and recreational facilities – all within walking distance.

Cafes, restaurants, a supermarket and convenience stores will enable residents to dine, relax and shop just minutes away from their home.

The benefits of Urban Village living will also be enjoyed through easy access to local public and private schools, local hospitals, sporting venues, parks, a golf course, the Roma Street Parkland and Brisbane’s central business district”.

However mixed used developments still pose the same sorts of land use conflicts that led to the adoption of zoning policies. Local government development plans to deal with these problems have ranged from mixed use policies that have the effect of severely restricting the location of such developments, to using performance measures covering scale, noise, landscaping and overlooking in an attempt to avoid land use conflicts, and — in the case of Central Sydney’s Local Environment Plan — allowing for higher floor ratios for mixed use developments (schedule 6). Queensland has a Mixed Use Development Act devoted to dealing with the land use conflicts.

The idea of multi-use activity nodes, well served by public transport, is not new. Past history suggests, however, that the ability of governments to restrain commercial development from gravitating to areas characterised by cheap land and plentiful parking will be sorely tested. (McLoughlin, 1992)

3.1.3 Street Layout and Micro-design

The New Urbanist approach has also proved popular, implicitly or explicitly, with both governments and the market. Many new real estate projects feature neo-traditional housing designs and have street networks that feature variations on the grid. In-fill

² <http://www.kgurbanvillage.com.au/living.html>

projects promoted by governments have also had at least a superficial relationship with New Urbanism. While the pretensions of such projects can be criticised, they at least provide footpaths.

There have also been high-level efforts to incorporate New Urbanist principles into the development control process, most notably in the Australian Model Code for Residential Development (AMCORD) and the various state-level strategy documents that this has spawned. The best example of the new urbanist approach actually being translated to planning rules is Western Australia's 'Living Neighbourhoods', which provides an alternative to that state's conventional planning code. This has been used for both relatively central re-developments and for greenfields development north of Joondalup. The *Street Layout, Design and Traffic Management Guidelines* (Western Australia, 2000) provide numerous elements that should promote walking and cycling:

- culs-de-sac are generally avoided; where they do exist there is provision for cycling and walking through routes
- relatively short blocks, providing numerous alternative routes
- street designs that provide reasonably direct, continuous paths of travel to neighbourhood facilities and town centres
- control of traffic speed through street network design and intersection design
- 1.5 metre footpaths on all streets
- bike lanes on all collector and wide access (7.5 m) roads
- trees bordering all streets
- where medians are used to prevent 4-way junctions, the provision of cycle and footpaths across these.

Most ambitious is the provision for walkable communities with neighbourhood shopping centres located within 400 metres of practically all housing. There are also performance-based provisions to allow for mixed use areas. However the commercial viability of these neighbourhood shopping centres is questionable, particularly given that the guidelines do little to promote high density. The Design Code provides for a modest 10% reduction in the minimum size of blocks in certain circumstances. (Western Australian Planning Commission, 1997) The standard housing block on the plans is 700 square metres — a size ripe for subdivision in the “densification” process referred to earlier. Walking and cycling conditions should be good in the new suburbs, but will people have anywhere to walk to?

NSW's draft SEPP 66 is another example of a state planning policy designed to promote walking and cycling, including guidelines about creating “connected streets” and principles of pedestrian and cycling access. (NSW Department of Urban Affairs and

Planning, and Transport NSW, 2002b) It also tackles the issue of parking, instructing that:

“Any consideration of a study of the traffic or other transport implications of a rezoning proposal, a development control plan, master plan or precinct plan, or of a development application, should include consideration of the extent to which the study has:

- (a) assessed the accessibility of the site by a range of transport modes including public transport, walking and cycling, and
- (b) proposed reasonable ways of minimising travel demand especially by car and maximising the share of travel by modes other than the car.”

Most revolutionary is the provision for maximum car parking limits (rather than the usual minimum) at certain locations.

A large number of strategies now place emphasis on ‘micro-design’ aspects of neighbourhood and street design, in response to the arguments that, even when higher-densities lead to greater proximity between origins and destinations, people’s propensity to use more sustainable modes of travel will be influenced by *connectivity* and the quality of walking, cycling and public transport journeys. An excellent representative strategy here is Planning SA’s *Transport Choice and Urban Design: Design Issues for Accessible Neighbourhoods*, Department of Transport, Urban Planning and the Arts, South Australia, Adelaide. This provides a detailed set of guidelines covering micro-design elements of the urban fabric that can influence people in selecting their travel mode. Pedestrian issues addressed include

safety — avoiding conflicts with cars and safe crossings;

convenience — obvious or direct paths, continuity and permeability

pleasure — vibrant and varied surroundings; *protection* from the weather;

comfort — wider footpaths, good paving, places to wait and sit, opportunities for people-watching;

security — good lighting, active frontages, pedestrian routes not separated from roads; and

interest — fine grain shop and building frontages (for window shopping), landmarks, attention to detail in the paving surface and texture, art in public places, unfolding views.

The needs of cyclists are addressed under similar headings. *Safety* is again about avoiding conflict with cars through clearly marked lanes, lowering/calming the speed of adjacent traffic, safe crossings; *convenience* — speed maintenance, connectivity, clearance (a 1m envelope maintained for a speeding cyclist), smooth surfaces, appropriate vegetation, secure storage at the end of the trip and changing/shower facilities. *Transport Choice and Urban Design* notes that *mixing cyclists and pedestrians* is increasingly common and raises safety issues, and also that *hybrids* — *skateboards and rollerblades* — are also common in some areas and introduce additional considerations of paving, kerb edges and street furniture.

‘Transport Choice and Urban Design’ notes also that ‘bike racks and lockers, though convenient,...are not benign in the urban landscape and should be designed and positioned with the same care as other street furniture’.

3.2 OTHER STRATEGIES:

3.2.1 Promotion and education

Promotional strategies have the advantages of being relatively cheap, designed to provide quick benefits and clearly indicate government’s apparent concern. There are many examples of these. They are typically promoted by quasi-governmental bodies

such as the Heart Foundation of Australia and the Pedestrian Council of Australia³. Examples of walking promotions include the Pedestrian Council of Australia's "Walk to Work Day, Queensland's "Just Walk It", a community program that encourages physical exercise through recreational group activities. Promotional activities such as publicity campaigns and resources for schools feature heavily in Western Australia's strategic planning document to promote walking in its capital: *Perth Walking*. This also includes campaigns to enforce existing laws to protect pedestrians, such as 'give way to pedestrian' rules. (WA Department of Transport, 2000) There are similar promotional exercises to encourage cycling. A number of states have bike weeks, which concentrate a variety of promotional activities. Fremantle in Perth has promoted a 'Shed Your Car' day since 2000

Transport agencies have become increasingly involved in educational activities, to promote walking and cycling — or at least safe walking and cycling. Examples include Bike-ed programs for school-age children that exist in a number of states. The 'Safe Routes to School' program forms partnerships between the school community, local council and the State transport agency to encourage walking and cycling. This typically includes minor engineering works on designated routes. Numerous schools have taken up the concept of the 'Walking School Bus'. This involves the organising of parents to walk specified routes to a timetable, gathering children on the way. This concept has been promoted by transport agencies, usually in conjunction with the local council.

More broad travel behaviour strategies have been bundled into a TravelSmart™ program adopted by transport agencies in a number of states after being trialled in Adelaide, Perth and Brisbane. The trials, using a variety of techniques such as provision of information about local services and ways to minimize car trips, the keeping of travel diaries and so on, have yielded impressive results in boosting walking and (to a lesser extent) cycling. (Perkins, 2001) Victoria's heavy emphasis on TravelSmart™ has included the adoption of Green Transport Plans to promote more sustainable employment-based trips. (Victorian Department of Sustainability and Environment, 2002)

3.2.2 Infrastructure and engineering strategies

In addition to promotional and educational strategies, state transport agencies have also stressed new infrastructure to encourage walking and cycling. Metropolitan-wide cycling "networks" feature in plans in Brisbane, (Brisbane City Council, n.d.), Perth, (Western Australia, 1996), Sydney (New South Wales, c 1998). Sydney's even refers to a "continuous and consistent footpath network". The bike networks are typically composed of linked streets of low traffic volumes, high quality bike paths on freeway and rail alignments and regional recreational paths. They fit in well with the engineer's concern for safety by separating walking and cycling from vehicular traffic.

However most existing and potential cycling and walking trips are very local and the impact of metropolitan-wide networks is likely to be limited therefore. More important will be the plans implemented by local councils. Here state governments have been funding local councils to provide infrastructure to support walking and cycling. For example, under its Pedestrian Access and Mobility Plans, the NSW Roads and Traffic Authority currently devotes about \$6 million to local government infrastructure. States will also

³ The Heart Foundation has also promoted walking by advocating appropriate land use and infrastructure strategies, in its Supportive Environments for Physical Activity program.

fund the development of bicycle plans by local councils. These plans call for engineering measures such as bike lanes and off-road recreational paths, bike parking. They may also call for other measures, such as end of trips facilities. Whether such measures are implemented depends on whether they are (a) taken up in the council's development control rules and (b) whether these rules are insisted upon in the development assessment process.

Local Area Traffic Management (LATM) plans are very widespread throughout Australia. Key features are consultation with the local community together with traffic management techniques such as traffic calming measures, pedestrian crossing facilities, intersection controls etc.. The effect of the local consultation process is, of course, to promote the redirection of traffic away from the local streets and on to higher level roads wherever possible. Whether pedestrian and cycling issues are raised will depend on the local planners and community. While reducing the number of cars on local streets should promote walking, traffic calming techniques such as squeeze points that don't provide for cyclists may in fact discourage cycling.

The plans and developments discussed above can all play a part in promoting cycling and walking. However by themselves, the effects will be modest. The TOD/ mixed use developments are not expected to change radically the way most of us get about. The quantified walking and cycling targets that have been set are very much with an Anglophone paradigm. The South Australian government's draft transport plan hopes that the number of cycling trips will double by 2018. If the total number of trips did not increase during this period, it would mean that 2.4% of trips would be by bike. (South Australia, 2003) Brisbane is more ambitious in targeting 8% of trips by cycling in 2016. (Brisbane City Council, n.d) But even this is very far from the cycling shares of between 20% and 40% recorded in northern European countries in the 1990s. (Pucher, 1997)

The SEPP 66 policy discussed above is prefaced by the rider "Nothing in this Policy affects clause 7 of *State Environmental Planning Policy No 11—Traffic Generating Developments*." This is a reference to the need to accommodate the levels of traffic predicted under the NSW Road and Traffic Authority's *Guide to Traffic-Generating Developments*. This document, along with the Austroads' *Guide to Traffic Engineering Practice*, forms the bible for planners and traffic engineers when assessing the suitability of developments. Developments that do not adequately cater for the increased traffic and parking needs predicted by these measures should be rejected. Overriding the goals and principles of the strategies discussed above, these standards have as their dominant concerns safety, smooth traffic flows and convenience. They have developed over the years as a ratchet that facilitates higher levels of vehicular traffic. As powerful as they are, the standards are essentially reactive. As vehicular traffic has grown, the assumption has developed that roads are for cars and the design standards of roads, traffic light phasing, intersections etc. should accommodate vehicular travel first and foremost. As buses, trucks and emergency vehicles have become larger, the standards have facilitated this by mandating wider traffic lanes, shallower turning circles and so on. Patterson and Hewitt have provided a recent case study of the difficulties such standards impose on bicycle planning. (Patterson and Hewitt, 2003)

The Austroads and RTA standards serve a complementary role to local development plans in shaping developments on the ground. We have noted that development plans are similar in the way they try to anticipate and accommodate vehicular traffic. We have also noted that there are some efforts to change this; to turn development plans into proactive documents seeking a desired future rather than reactive documents coping

with change. Similar changes are happening with the traffic standards. The RTA standard is being reviewed, as are several features of the Austroad standards, including those relating to cycling. Austroads itself has sponsored the valuable resource document, *Cities for Tomorrow*, which contains a huge number of ideas that can be used to promote cycling and walking. (Westerman, 1998)

4. CONCLUSIONS

Density

There is widespread support for compact cities at the strategic level — though whether this can be maintained in the face of political concerns to release more housing land to prevent house price inflation remains to be seen. More sustainable transport, including walking and cycling, is only one of a number of objectives behind such strategies. The slight increases in densities that we have observed in Australian cities to date appear to have been largely due to market forces, sometimes in the face of opposition from local councils.

On the evidence provided by the literature, increased density by itself will not promote higher levels of walking. Heroic measures would be needed to achieve the sorts of densities that Dunphy and Fisher have indicated would make an impact on travel behaviour patterns. At current rates of increased density, it will be almost 60 years before this is achieved in Adelaide.

However the creation of higher densities will make walking and cycling a more viable transport option for people who choose to do so. There will be more opportunities for people to live in more densely settled parts of the city.

Mixed used Development

This is also a popular feature of planning strategies and of development marketing. Planning strategies identify the intention to restrain development to nodes well-served by public transport and to promote high density living near these nodes. There are numerous examples of transit-oriented developments being planned and funded. Performance planning measures are being developed to overcome the potential land use conflicts without resorting to spatial separation.

The academic evidence is that such developments will increase the amount of walking and cycling that is undertaken, but this will not necessarily be at the expense of less sustainable trips. It may simply be the case that more trips are undertaken as access becomes easier.

Street Layout and Micro-design

Once again, pedestrian and cycling-friendly street layouts and attention to micro-design are both well supported by state and local governments, as can be seen in design guidelines and numerous contemporary developments.

The effect of these developments on cycling and walking is not clear, with studies designed to test this being few and inconclusive. However, if adopted in conjunction with other measures, they would make again make walking and cycling more viable.

Non-land use measures

More explicit and direct promotion of walking and cycling has been through promotional measures, travel behaviour modification strategies and the provision of specialized

infrastructure. It has not been the purpose of this paper to assess how successful these will be in promoting more sustainable transport, but it can be safely assumed that success will be limited while governments at the same time require parking and infrastructure standards that ensure the motor vehicle is an attractive alternative.

It can be argued that the land use strategies that have been adopted to promote walking and cycling have been promotional in the sense that they focus on display and on the marketing of concern. Even the TOD and other mixed use projects mentioned above are still careful to see that parking is adequate. Until the engineering and planning standards and the attitudes of those implementing them change, we will see only marginal changes in the total amount of walking and cycling.

The fabric of our cities is also a barrier. Car-based travel has pushed out the distances people need to travel to reach facilities. The empirical work reviewed supports the claim that important relationships between urban form and travel behaviour do exist and that land use, locational and urban design changes can influence people's propensity to opt for more sustainable modes of travel. Reducing the physical separation of activities may very well reduce the amount of travel by car, whereas developing houses or shops in places that are mainly accessible by car is likely to add to the volume of road traffic. However, it seems likely in the short-term that changes to urban form and to land use patterns will only provide the *necessary* conditions for a shift to more sustainable modes of travel and to resulting increases in physical activity. For *sufficient* conditions to come about, some more profound changes seem to be required.

Land use planning does have an important role to play in promoting walking and cycling. While it cannot itself bring about reduced car travel, the propensity to travel shorter distances is a precondition for a system in which land use planning can be an effective instrument of transport policy. Put another way, locational planning that seeks to reduce the distances between activities is a robust approach, a precautionary measure against the day when the fuel runs out. The overall land use-transport package needs to combine land use planning with educational, engineering, regulatory and probably fiscal measures, as well as investment in environmentally friendly modes of travel. In the short-term, then, land use policies and urban design improvements intended to achieve more sustainable travel patterns that go against the grain of a system continuing to promote high mobility are unlikely to achieve a great deal. However, a less pessimistic conclusion might be that there has been a noticeable shift in debates and discourses around sustainability in recent times and that shifts towards less environmentally-damaging planning outcomes are beginning.

5. SETTING THE RESEARCH AGENDA

The promotion of cycling and walking needs to be underpinned by quality research. A recurring theme in the review is our lack of understanding of detailed local design effects. It is difficult to isolate the effects of urban form from other factors.

Statistical data on walking and cycling. Available data on travel behaviour and urban form is biased towards motorised transport and is not generally sufficient to test the impact of micro-design elements on travel behaviour. Too often walking and cycling are combined in any statistical analysis, or lumped together with taxis etc. as "other". Travel diary surveys do provide more detailed travel behaviour information but only for small samples throughout a metropolitan area. Detailed urban form information is patchy.

Local information that will inform land use planning. We should not have to rely on findings based on conditions different from our own. Overseas research, particularly in the United States, has set an agenda that can be built upon to examine local conditions. Geographic information systems provide powerful tools to make more use of the data we currently have about detailed urban form, applying it to the travel behaviour data that is available. In this sense, a good starting point would be some “meta-research” to promote research efficiency by identifying where are the bottlenecks in terms of *local* data collection and analysis.

Information on the effects of interventions by governments and developers. Gemzøe has stressed the importance of quality information about the impacts of projects in overcoming resistance to the gradual pedestrianisation of central Copenhagen. Such data focused on levels of activity (numbers of people walking etc.) before and after the intervention. (Gemzøe, 2001) We also need to know when interventions do not work. This applies to interventions both in terms of land use measures and more localised behavioural, urban design and engineering measures. What have such interventions done for mode splits in the area concerned? What has been the effect on business? Best practice can then be identified, not only in terms of what has intuitive appeal, but on the basis of what actually works.

Information that would lead to a more holistic understanding of the relationship between our travel and our health. Accident data is detailed, well-publicised and influential in creating ever more accident-proof environments. But if the creation of accident-proof environments discourage walking and cycling, what are their effects on our health?

And finally; *why is Hobart's level of walking so high?*

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