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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.

WTPP embraces a different approach to science and through science to publishing. This view is based on an honest evaluation of the track record of transport planning, engineering and economics. All too often, these interrelated disciplines have embraced quantitative, elitist or mechanistic views of society, space and infrastructure and have eliminated people from the analysis.

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I Quit*Patrick Kinnersly*

Patrick Kinnersly has been campaigning for sane, safe, integrated transport for most of the 1990s in Southern England. He has realised that regardless of the strength of his argument, the Government has chosen to ignore him and others and continue with the discredited 'predict and provide' approach to transport infrastructure. Here we publish his open letter to Halcrow, the consultants contracted by the Government to conduct the London to South West & South Wales Multi-Modal Study.

Keywords

Consultation, democracy, government, multi-modal study, participation, railways, roads, Wiltshire.

Walking & cycling – does common neglect equal common interests?*Philine Gaffron*

Walking and cycling are beginning to receive more attention in transport planning in Great Britain. But although they are generally described with similar attributes, they often receive differing treatment in the public and political arena. This article explores the main differences as well as similarities between the modes and explains why these should be seen as mutual strengths enabling them to grow together to each other's (and everyone else's) mutual benefit.

Keywords

Walking, cycling, Great Britain, national policy, facilities, synergy.

The Safety & Security issues of Women drivers & passengers*Andrée Woodcock, James Lenard & Ruth Welsh*

This research was commissioned by the Mobility Unit of the Department of the Environment, Transport and the Regions to address the in-car safety and security needs of women drivers and their passengers. The research was multifaceted. It sought to establish whether cars which have been designed and tested around male manikins and anthropometry were less protective to female drivers and their passengers; whether such vehicles met the requirements of the growing number of female users, and the experiences of female drivers on the road. Lastly we considered means of disseminating our results to a wide audience, through the use of posters and web sites (see Woodcock, Galer Flyte & Garner, 2001). The research presented here considers the first two issues and concluding with recommendations for future policy.

Keywords

Cars, design, safety, security, women.

The effects of car sharing on travel behaviour: analysis of CarSharing Portland's first year*Richard Katzev, David Brook & Matthew Nice*

A review and analysis of the mobility behaviour of CarSharing Portland (CSP) members during its first year of operation. Comprehensive surveys and one-week trip diaries were administered before individuals joined the organisation and at the end of the first year. A periodic need for a vehicle was their principal reason for joining CSP. The effect of membership in CSP on overall vehicle travel was either no change or a slight increase in VMT. However, members reported an increasing frequency of bus trips, walking and cycling. In addition 26% sold their personal vehicle and 53% were able to avoid purchasing one. These results were discussed in terms of the psychology of the car sharing experience and how membership in the organisation affected travel behaviour.

Keywords

Car sharing, Mobility, Portland, Travel Behaviour.

Pedestrian flow characteristics at an intermodal transfer terminal in Calcutta*A.K. Sarkar & K.S.V.S. Janardhan*

In recent years, walking as a transportation mode has gained recognition as a basic building block in urban design. It is highly suitable for a certain kinds of journeys. To encourage walking and to make it more safe, convenient and attractive, the physical facilities must be available to support the physiological and social needs of pedestrians. It is important, therefore, that the flow characteristics of pedestrians be understood properly to aid the planning and design of facilities. Keeping in view the above facts, a study has been conducted at an inter-modal transfer terminal in the Calcutta Metropolitan District, and relationships of speed, density, flow and space have been developed. The paper also discusses the problems of pedestrian movement in Calcutta and suggests a few policy decisions for providing safe, convenient and pleasant movement.

Keywords

Calcutta, density, flow, pedestrians, space, speed, walking.

This issue of the journal revisits some of our strongest themes. Once again we take a close look at Calcutta in the paper by Sarkar. Calcutta is still very much the weather vane or 'canary in the cage' of world transport. It is one of the finest examples in the world of an accessible city. All of the recent rhetoric about creating livable cities or sustainable cities in Europe and North America is nothing compared to the reality of Calcutta which can provide thousands of everyday destinations for its 14 million citizens within walking and rickshaw distances that can be covered in less than half an hour. If North American cities (Toronto excepted) could be as efficient as this world transport problems would be much less. Because of this – and in spite of this – US-led engineers and Japanese road builders are bringing to this great city the misery, inefficiency and inequity prevalent in their own countries. Sarkar's paper is very timely indeed in drawing attention to the importance of pedestrian trips in Calcutta and the paper by Nesamani and Deb shows that the debate on private vehicle restraint in Asia is alive and well.

In this issue we publish in full a letter from a citizen in South-west England. The letter is a resignation letter in which the author publicly withdraws from all future consultation and participation in the debate about transport futures in South-west England. This is an important subject. All over the world tentative steps are being taken to involve the public in the decision making processes that most affect everyday life. This is clearly a good idea in basic democracy and human rights terms but in the context of sustainable development and Local Agenda 21 it is even more important. Solutions must be built from the bottom up. All of us must work in partnership and citizens have a basic right to be part of a decision making process in a real sense and not just the unwilling recipients of expert opinion from above or the unwilling victims of half baked and fraudulent consultation procedures.

No one has asked the citizens of Calcutta whether or not they want the Japanese funded flyovers. If they did they would get a resounding rejection. The citizens of South-west England (and the rest of the UK as

well) have been asked to take part in consultation procedures leading to the production of 5 year strategic Local Transport Plans or LTPs. Many individuals and groups have responded, given up a great deal of time, read lengthy documents, attended long meetings in their spare time and given their views. In the vast majority of cases these views have been ignored. Citizens want better public transport, much better walking facilities, less traffic and safer cycling and they have been given expensive, grandiose and ultimately useless new roads. Just like the residents of Calcutta they have been ignored. At least the government of West Bengal was more honest. It is clearly of the view that citizen views are not wanted so it didn't ask for them.

The letter by Patrick Kinnersly puts this whole sorry saga into clear relief. An involved, aware citizen has withdrawn from a false and deceitful participation process. The UK government has raised expectations by launching into numerous public consultations and participation exercises but the results are a callous disregard of the views of ordinary citizens. This is very damaging indeed and it undermines democracy itself in a way that that will be very difficult to put right.

Consultation and participation are crucial skills for transport professionals and largely absent in the UK. Politicians working within representative democracy principles have also forgotten what this means and as a result transport problems multiply like a virus while virtuous solutions die as a result of lack of attention, lack of a willingness to listen and lack of a determination to be bold and creative. A better track record in this neglected area of transport planning would rescue cycling, give women better transport choices and ensure that car sharing was a rampant success in developed countries. As the articles by Gaffron, Woodcock and Katzev show reality is somewhat different.

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I Quit

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Abstract

Patrick Kinnersly has been campaigning for sane, safe, integrated transport for most of the 1990s in Southern England. He has realised that regardless of the strength of his argument, the Government has chosen to ignore him and others and continue with the discredited 'predict and provide' approach to transport infrastructure. Here we publish his open letter to Halcrow, the consultants contracted by the Government to conduct the London to South West & South Wales Multi-Modal Study.

Keywords

Consultation, democracy, government, multi-modal study, participation, railways, roads, Wiltshire.

Dear Gareth Walters

London to South West & South Wales Multi-Modal Study ('SWARMMS')

Thank you for your letter of 27 February and the earlier letter of 12 December, describing changes to the participation programme.

I have decided that I personally do not wish to take any further part in this process and would ask you in future to direct all correspondence to Pam Rouquette, Co-ordinator of Salisbury District Transport 2000. The group will then decide whether it wishes to continue participating and, if so, who should represent it at future workshops. This leaves me free to give you my personal reasons for withdrawing from this process.

After seven years of campaigning against major road construction in Salisbury and along the A36/46 corridor, and nearly four years trying to promote sustainable transport in this part of the world, I have concluded that the input made by environmental and transport campaigners has no effect whatsoever on the decisions made.

Consider the following examples:

The Salisbury Transport Study

The Government Office for the South-west was instructed to find solutions to the traffic problems of Salisbury without building roads. At the first exhibition in the City Hall the public was asked for its preferences on three strategies. Sixty per cent favoured the two non-road options.

The government has now approved, subject to statutory process, the funding of the Brunel Link and

Harnham 'Relief Road' (approximately three miles and £13 million) and has encouraged Wiltshire to develop detailed plans for a four-mile relief road in the Wylye Valley.

Wiltshire LTP

The guidance on LTPs issued to local authorities by the Department of the Environment Transport and the Regions said that roads were to be considered only as a last resort after examining all other options. Integrated transport was to be the priority and consultation was to be central to developing appropriate solutions.

We thoroughly approved of this approach and participated fully. We were pleased to find that stakeholder groups in Wiltshire shared our priorities, ranking investment in public transport first and new road construction last in a list of seven options.

So what happened? Despite our protestations at every stage, the Wiltshire LTP ended up reversing these priorities, putting massive sums into road building in Salisbury and West Wiltshire and trivial amounts into public transport.

Multi-modal studies

While stakeholders make their earnest contributions to 'workshops' it is clear that they are not part of the actual decision-making process, any more than Halcrow is. If you study the minutes and background documents for the South-west Regional Assembly's Transport Sub-group meeting in November you will see correspondence between the Government Office for the South-west, the Highways Agency and the officers of the Transport Sub-group from which it is clear that strategy on transport in the region is developed in an arena far removed from our little workshops and any recommendations that might emerge from SWARMMS or other multi-modal studies. While lip service is paid to 'not pre-empting the multi-modal studies' it is clear that this is what is going on.

A formidable shopping list of roads has now emerged as local authority fantasy schemes, such as the Salisbury bypass, the A4-A46 link at Bath, and the entire Dorset County Council 'back-list' apparently become 'regional policy'.

Without public consultation on the strategic nature of its plans, Wiltshire is pursuing its ambitions for the

A350 to become a high-speed route through West Wiltshire. As environmental constraints lessen the chances of Dorset being allowed to extend this new highway to the South Coast at Poole, Wiltshire is switching its efforts to an alternative 'north-south' corridor. This would be achieved by linking an upgraded A350 to an upgraded A36, via an entirely new road at Westbury. The schemes required to create these strategic through routes are, as ever, promoted as local bypasses bringing traffic relief to local communities.

Neither the Regional Assembly, nor the county councils involved in these grand road designs has an equivalent list of strategic rail projects, or bus networks, or freight terminals. Indeed Wiltshire rejected its consultants' proposals for both freight and passenger rail developments in West Wiltshire and has kept its total budget for such items to a thrifty £1 million.

The Highways Agency route management strategy study of the 'route' between the M5 near Exeter & the M27 near Southampton

Mono-modal with feeble gestures towards an unspecified rail network, this curious exercise appears to be predicated on old ambitions for a strategic road corridor along the South Coast. Money has been found (without democratic discussion) for consultants to consult local stakeholders about 'improvements' they might want along the A30/35/31 'route'. No funds have ever been found for the strategic *rail* equivalent proposed by environmental transport campaigners. The parallel train service (Exeter-Southampton, change at Salisbury) remains a disgrace of single-track working and obsolete signalling. While it can be safely predicted that the Highways Agency will take it upon itself to study the next leg of the south-coast route – Southampton to the proposed bypass at Hastings, via a widened M27 – it is equally certain that no-one is considering how to speed up the rattling crawl along the railway from Southampton to Brighton, Lewes and Hastings.

Democracy

It should by now be clear to anyone with the slightest knowledge of transport planning, sustainable development, or democracy that decisions are being made without reference to rational criteria or to public opinion. For example, in the Salisbury Transport Study, consultants WS Atkins concluded that reopening Wilton railway station 5 km west of Salisbury (a project that had made some progress up the greasy pole of the planning process) would not be good value for money, but it would be justified to spend £13 million on building two roads to get HGVs in and out of the Churchfields Industrial Estate. How many heavy vehicles a day would justify such a project?

Thousands? No – around 600. How many of these are actually HGVs? Nobody can say, but it likely that the majority were actually six-tyred vans and small lorries. Only 120 or so actually went through the town; the rest managed the 'very difficult' route to and from the ring road. The estate thrives, attracting the very kind of businesses that one might expect to be inhibited by difficult access – the car dealers whose double-deck transporters cannot pass under Fisherton railway bridge!

At the end of a study reportedly costing £300,000 we still do not know how many of these vehicles enter and leave the estate each day, nor where they come from or go to. No one has asked the car dealers if they could bring vehicles in by rail if the facilities were provided in the adjacent goods yards. So much for the application of objective transport planning methods in Wiltshire! One wonders how many people in Wiltshire's County Hall have heard of SACTRA, let alone its reports confirming that new roads induce traffic growth and may not actually induce economic growth.

If expert opinion is now to be ignored at local and national level, public opinion has fared no better. A MORI poll conducted for the Commission for Integrated Transport and published in July gave results remarkably similar to the Salisbury transport study and Wiltshire LTP consultation: 60% of the population put investment in public transport ahead of investment in new roads (CfIT, 2000).

After four years of a Labour government we still have no public transport equivalent to COBA for assessing value for money of rail and bus projects – let alone a common environmental balance sheet that might allow direct comparison between modes. And in the unlikely event that such criteria had been developed, they would no doubt, like the LTP guidance, have been buried under a spray of loose chippings as the government executed its handbrake turn into Acacia Close, where it imagines, wrongly as it transpires, that the heart of Middle England beats excitedly for Tony 'n' Gus's special pre-election roads offer.

Conclusion

So, to conclude, it is now abundantly clear that transport provision has become once again a purely political process, divorced from rational methodology and actual – as opposed to media-confected – public opinion. Whatever we might 'decide' locally and regionally (for example to upgrade the Salisbury–Exeter railway line), implementation will depend on funding priorities decided elsewhere. It remains to be seen whether Blair's recent "green" speech heralds a further U-turn in transport policy; the spin doctors and political focus groups – not you or

I – will decide whether the money should follow the green rhetoric into public transport instead of private transport.

In this situation, therefore, I judge it a complete waste of time to engage in any further consultation on time I can spare for campaigning must follow Labour's U-turn, away from promoting sustainable transport and local, regional or national transport policy. Whatever time I can spare for campaigning must follow Labour's U-turn, away from promoting sustainable transport and back into the sterile oppositional environmentalism of the 1990s. Once again, it seems, our ambitions must be confined to prevention – stopping the worst of late 20th century greed dumping unsustainable infrastructure into the 21st.

I apologise for the length of this letter, much of which is outside the geographical and philosophical limits of your study, but I speak for many disillusioned 'stakeholders' in environmental transport groups, and quite a few of your fellow practitioners. I hope your study will be able to overcome the obstacles I have described and will somehow produce a report that you will not be ashamed to show to your grandchildren.

Yours sincerely,

Patrick Kinnersly.

Notes

The letter was sent to Gareth Walters, the Project Co-ordinator of the SWARMMS Study at Halcrow consultants in Swindon on 10th March 2001. It was copied to the Department of the Environment, Transport & the Regions, Government Office for the South-west and the Highways Agency.

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Walking & cycling – does common neglect equal common interests?

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Abstract

Walking and cycling are beginning to receive more attention in transport planning in Great Britain. But although they are generally described with similar attributes, they often receive differing treatment in the public and political arena. This article explores the main differences as well as similarities between the modes and explains why these should be seen as mutual strengths enabling them to grow together to each other's (and everyone else's) mutual benefit.

Keywords

Walking, cycling, Great Britain, national policy, facilities, synergy

Introduction

Walking and cycling are important. Pedestrians and cyclists are vulnerable road users but walking and cycling are also sustainable, healthy, cheap to use and cheap to provide for. Most people would agree with these statements. But how about: pedestrians and cyclists are incompatible, shared facilities do not work, cyclists belong on the roads? Or: the two modes should be catered for within reason but they are only used for short trips and will never make a significant contribution to solving our transport crisis? Or: we, the government, will keep quoting the National Cycling Strategy in major transport policy documents but we think there is no need for a national strategy for walking?

Although walking and cycling are often mentioned in the same sentence, there are surprising levels of differences in the way they are perceived and catered for. There are, however, also many similarities and there is much potential for the two modes to enhance each other – potential which often goes unexplored.

This article will compare how the two modes are faring in Britain at the moment; it will highlight their similarities and differences and explore the potential for both conflicts and synergies. It will draw out the issues which should be considered when dealing with walking and cycling so that the two modes can be interwoven carefully and to mutual benefit but without limiting the potential of either or both modes.

Walking & cycling – how do they compare?

Together, walking and cycling currently account for 28% of all journeys made in the UK (DETR, 2001) – but only 2% of these journeys are made by bike, the other 26% are made on foot. While bike journeys are evenly distributed across the distance bands up to 8 kilometres, the vast majority of walking journeys are under 1.6 km (Hillman, 1996). That is the situation in the UK. It is very different in other European countries, where the two modes combine to as much as 48% of all trips in the Netherlands (30% cycling, 18% walking) and England and Wales are bottom of the list (Pucher, 1997).

It is generally agreed that in order to increase the numbers of both pedestrians and cyclists in this country, we would need not only better facilities for these two modes but also would have to introduce speed and traffic reducing measures similar to those in countries such as Denmark, Germany and the Netherlands where high rates of walking and particularly cycling are the norm (Davies *et al.*, 1998, Pucher, 1997 & 1998). However, there seems to be a great political shyness in Britain to tackle speed and traffic levels head on – witness the imaginatively titled Road Traffic Reduction Act 1997, which makes neither targets for an overall reduction in traffic levels nor any actions towards such a goal a legally binding requirement. The focus has been mostly on the much more easily agreed reduction in road traffic accidents. It is for this reason, that the label 'vulnerable road user' is attached most frequently to pedestrians and cyclists.

It is of course a sad truth, that for every kilometre travelled, pedestrians are eight times more at risk of becoming a road casualty than people in cars or vans. For cyclists that risk is more than twice as high again (Table 1). Due to the fact that they lack a protective metal shell, both pedestrians and cyclists are also more likely to sustain serious injuries when involved in a crash than the people inside a vehicle (Cleary & Hillman, 1992). However, these figures should not lead to the conclusion that walking and cycling are in themselves dangerous activities – people, who walk and cycle frequently are in fact healthier and have a

longer life expectancy than those, who do not (Health Education Authority, 1998).

What these figures do illustrate is that pedestrians and cyclists suffer disproportionately from the dangers created by motorised transport. They also have to bear the consequences of having been marginalised to such an extent that car drivers no longer consider cyclists as legitimate road users with equal rights (Snelson *et al.*, 1993) and pedestrians are increasingly stuck on islands surrounded by endless stream of traffic.

So instead of fighting the symptoms by fencing pedestrians in behind 'protective' barriers and taking cyclists off the roads wherever we can, more serious efforts must be directed at addressing the causes. Other European countries like Sweden or the Netherlands for example, have succeeded in improving safety and freedom of movement for pedestrians and cyclists by reducing overall speed and traffic levels in town centres and residential areas (Preston, 1990). At the same time, these measures have also made the roads safer for those using motorised modes of travel.

Are pedestrians & cyclists partners or competitors?

The skewed perception of walking and cycling as inherently dangerous activities has had two unfortunate consequences. Firstly, many transport planners and engineers – as well as politicians – are reluctant to try openly to increase levels of walking and cycling in particular for fear of increased accident rates. But the continued lack of adequate facilities coupled with dangerous traffic means that many people who have a choice – and many do not – prefer to use motorised transport thus contributing to the dangers they are trying to escape. In addition, inadequately designed shared use facilities and illegal pavement cycling motivated by fear of traffic can lead to conflicts between pedestrians and cyclists thus dividing two groups, which should be united by common goals.

The President of the Pedestrians Association, Terence Bendixson, remarked in an interview: "Putting pedestrians and cyclists together makes the fundamentally incorrect assumption that they are cosily compatible. They are not. [...] cyclists pose a serious risk to pedestrians." (*Local Transport Today*, 1999). While making it clear, that he was not anti-

cycling, he went on to attribute the fear of elderly people to go out walking to illegal pavement cycling, which had been encouraged through locating cycle tracks on footways and footpaths. Most researchers agree, however, that elderly people are much more limited by their fear of motorised road traffic or personal attack (Gaffron *et al.*, 2000).

It shall not be argued here that shared facilities, which are badly designed or inappropriately located cannot cause conflicts between those on foot and those on bicycles. But it should also be remembered that although 17% of all pedestrian injuries occur on the footway, central refuge or pedestrian crossing, the vast majority of even these casualties are caused by motor vehicles. Less than one percent of pedestrian injuries involve a pedal cyclist (Cyclists' Touring Club & Pedestrians Association, 1995) and a five-year study of three pedestrianised town centres in England recorded no accidents between pedestrians and cyclists in these areas, even though cyclists often passed through illegally and without having their own facilities. (Davies *et al.*, 1998). Other studies have also shown, that well considered use of design elements and space allocation can result in a successful co-existence of pedestrian and bicycle traffic. So instead of competing for the limited space left by motor traffic, pedestrians and cyclists should together call for solutions which make cycling on the roads safer and which provide enough room to make any shared use facilities a success for both modes.

National strategies for local modes – important framework or a waste of time?

So for a long time, the two modes had in common that they were neglected to a large extent by transport planners and were considered mostly – if at all – in the context of road safety. But now that perceptions are changing it is becoming clear that walking and cycling are receiving very different treatment in the national political arena rather than being moved up the agenda side by side.

In the mid-1990s talk about sustainability had become commonplace amongst politicians and the bicycle was becoming a popular symbol for sustainable local transport. Other European nations were demonstrating prominently that a very large

Table 1: Relative risk and severity of road casualties for different modes

	Pedestrians	Cyclists	Car & van drivers & passengers
Casualties per 10 million passenger kilometres travelled by mode, 1999	25	55	3

Notes The total distance travelled by road, including pedestrians, in 1999 was 692 billion km.

Figures calculated from Transport Statistics Great Britain, DETR, 2000.

proportion of shorter (urban) trips could be made by bike, if the right culture and infrastructure were promoted. Furthermore, some English cities – such as York and Cambridge – had achieved a high modal share by bike and so in 1996, the last Conservative Government published its National Cycling Strategy (Department of Transport, 1996). In the words of the then transport minister Steven Norris, it had become ‘crystal clear, that the bicycle has been underrated and underused in the United Kingdom for many years’. The strategy was to outline ‘how the status quo can be altered in favour of the bicycle’ and to ‘generate a culture change for cycling’.

The strategy’s main objective was to achieve a doubling in cycle use – on 1996 figures – by 2002 and another doubling by 2012. To this end, the National Cycling Forum was created to encourage the implementation of the Strategy through widespread involvement of relevant stakeholders and to monitor progress through annual reports.

One year after the National Cycling Strategy, the government brought out a consultation document entitled *Developing a Strategy for Walking* (Department of Transport, 1997). This strategy – originally to be published in April 1998 – after considerable delay was promised firmly for early July 1999 but eventually was declared dead in March 2001. The Labour Government’s Transport Minister, Lord Gus MacDonald, decreed that it was ‘a bit overblown’ to suggest that walking needed a national strategy to promote it (*Local Transport Today*, 2001). This was in

spite of the urgent recommendation from the House of Commons’ Transport and Regional Affairs Committee that a Walking Strategy should be produced as soon as possible.

But would a national strategy for walking really make a difference? The answer to this question lies in the effect, which the National Cycling Strategy has had on cycling. It is becoming clear for example, that the aim of doubling national cycle use by 2002 will not be achieved, although it seems that the rate of decline in cycling is being slowed if not quite halted or reversed. Maybe the reason for this failure to achieve the stated aims lies in the fact that cycling is used mostly for local trips on that part of the road network for which local authorities are responsible and that most action for cycling must be taken at a local level? Maybe a national strategy really cannot make a difference in such a set-up? Maybe then we should agree with those who feel that a national strategy for walking could do nothing to influence either the travel choices of individuals or the activity of local authorities? Research by this author suggests otherwise. It shows that the National Cycling Strategy has indeed had an effect on activities in local authorities but that it might simply take longer to translate into rising levels in cycling than the authors of the strategy had intended.

A recent survey of British local authorities has shown that 46% have currently adopted their own cycling strategy but only 12% have a standalone walking strategy. Walking officers are employed by

Table 2: Summary of comparison between walking and cycling

	Walking	Cycling
Modal share	26% of all journeys in the UK	2% of all journeys in the UK
Risk of becoming a casualty	8 times higher than car/van drivers or passengers	18 times higher than car/van drivers or passengers
Does a national strategy for the mode exist?	no	yes
Do national targets for increasing the modal share exist?	no	yes
Percentage of local authorities with a stand alone strategy for the mode	12%	46%
Percentage of local authorities, which employ an officer for the mode	23%	52%
Existence of an extensive dedicated route network	yes (pavements)	no
Potential areas of conflict	poorly designed shared use facilitates, illegal pavement cycling, pedestrians walking on cycle paths	
Measures, which can benefit both modes	traffic restriction and calming, lower speed limits, better enforcement of existing traffic laws, better maintenance of existing facilities, reallocation of road space, Home Zones, Safe(r) Routes to School	

23% of local authorities but 52% have a cycling officer. In addition to this clear but perhaps circumstantial evidence, 77% of authorities felt that the National Cycling Strategy had played a significant role in their adoption of policies for cycling and 64% said the national policy framework for cycling had helped them in the successful implementation of such policies. Only 41% of authorities had found the national policy framework helpful in the implementation of walking policies and 30% had found the absence of national targets for increasing walking a significant obstacle in catering for the mode.

One further indicator of the importance of a policy lead at national level for local activities is the fact many cycling officer posts have existed on average since 1997 – one year after the publication of the National Cycling Strategy. Walking officers, on the other hand, have generally been employed since 1999 only, one year after the publication of the Transport White Paper. This document, with its enabling legislation, committed local authorities to prepare Local Transport Plans and Strategies which would outline measures to promote walking and cycling and might also include local targets for these modes.

Calling all pedestrians...

It is thus factually wrong to suggest that national policies for local transport modes have no effect. But there might be other reasons why it seemed so comparatively easy for a Conservative government to dedicate a national strategy to cycling while the Labour government appears to find it impossible to do the same for walking. One is the question of user group definition. Most people will be able to say whether or not they are 'a cyclist', and those that are might even be able to tell you whether they are a utility or a leisure cyclist. But while many more people walk, they do not necessarily consider themselves pedestrians. They may not have a car but want one – so they are a potential driver or a reluctant pedestrian. They may walk to buy the paper but take the car to work – so they are a driver. They may walk to the bus stop and then get on the bus – so they are a public transport user. Walking is the natural mode of propulsion for most people and not really a conscious choice, whereas cycling (and especially cycling regularly) involves many more choices and decisions which serve to foster the sense of belonging to a group of people – which can include local politicians – who have also gone through this process. This difference in self-identification is further reflected in the modes' representation by interest groups.

At national level there is the Cyclists' Touring Club, which in spite of its name does not limit its activities to leisure cycling. It is joined at the local and regional level by a plethora of cycling lobby groups. In

addition to that there is Sustrans which, although it was set up to improve facilities for all sustainable transport mode, has become best known for its achievements in creating a network of long distance cycle routes across the country. Many parts of this network are also used for local travel and are open to pedestrians as well as cyclists – but it is the cyclists who have really made them their own.

Pedestrians on the other hand are largely represented by the Ramblers' Association (which is much truer to its name than the CTC and concentrates on leisure and distance walking) and the Pedestrians' Association, which has comparatively few active local branches and much fewer members than the cycling groups.

This relative dearth of pressure groups need not necessarily represent a lack of individuals who would like to see conditions made better for pedestrians, but it certainly appears that they could learn a lot from cyclists about getting together and influencing decision makers effectively. For not only do local authorities react to pressure and persistent arguing when it comes to allocating their usually limited resources – people on the inside often actually wish for it. There are enough keen and dedicated transport officers, who would like to do more for pedestrians but cannot seem to justify the expense to their committees. Not only do they not have a national strategy, which they can point to as a larger framework, they also do not have the active and well informed allies on the outside who will help to demonstrate that 'the public' actually wants money spent on facilities for pedestrians. Such outside support is particularly important where measures for walking might be seen to impact on the freedom of drivers, a traditionally very vociferous and well represented group.

Furthermore, if there is not enough momentum to form more local pedestrian interest groups, then good arguments could be made for pedestrians becoming active with the cycling lobby for the two do have much in common, despite some obvious differences.

Differences, conflicts & synergies

One important point is that pedestrians already have their own dedicated route network which, in urban areas at least, goes pretty much everywhere that roads go – the footways. These may be badly maintained, full of obstructions or too narrow, but at least they exist. That is a good starting point. Cyclists, on the other hand, are generally required to share space on the carriageway with fast moving, relatively heavy, powerful, motorised vehicles. Furthermore, it is often the carriageway margins which suffer most from poor maintenance, thus making cycling additionally unpleasant and dangerous. But pedestrians generally do not want to share what space

they have with cyclists. This is understandable, considering that it is not very much in the first place. On the other hand, fear of traffic is one of the major reasons people give for not cycling more (Lawson & Morris, 1999). So two areas where pedestrians and cyclists could campaign together would be for the maintenance of existing surfaces and the reallocation of carriageway space away from the car and towards sufficient dedicated space for both pedestrians and cyclists. Many European cities have demonstrated that it is possible to develop a fairly continuous network of cycle paths and traffic calmed areas, which allow cyclists to use road space safely and confidently (see, for example, Tolley, 1990). The combination of speed restrictions and measures for overall traffic reduction also generates a more pleasant environment for pedestrians which is less polluted, less noisy and less dangerous.

But in addition to providing for the two modes individually, it is also possible to cater successfully for both in one project or even one facility. There are pedestrian areas in Germany and the Netherlands, which allow cyclists (Pucher, 1998; Zacharias, 1999), but generally they are avoided if pedestrian traffic is too high. If this self-regulation effect is allowed for and combined with alternative cycling routes, speed restrictions and one-way systems around an area, then both modes can benefit. One prerequisite is of course the availability of sufficient space. The mediaeval core in cities like York is so restricted in space and so heavily used by pedestrians that cycling through the Footstreets – the day-time traffic exclusion zone – is not a feasible option. But cyclists do have the benefit of an extensive and well maintained network of cycle paths. In addition, many cities, such as Münster in northern Germany which has a historic street arrangement, have taken the decision to give priority to pedestrians and cyclists in large areas both in and around the central pedestrian zone thus allowing the two modes to co-exist happily. Thus, it is important to remember that good facilities for pedestrians and cyclists do not necessarily just depend on the absolute space available but also on the way existing space is used and distributed between modes.

In 1995, the Pedestrians Association and the Cyclists' Touring Club published a Joint Statement on

providing for walking and cycling as transport and travel. They pointed out, that as well as having common problems – such as design, planning and funding priorities which were weighted against their modes – there were also many common solutions, which went beyond the mere provision of facilities for the modes. In fact, they are the core themes of sustainable transport (see Table 3).

The need for these approaches and the advantages, which they would yield for everyone in terms of travel choices and the quality of our environment and life in general have been discussed at length elsewhere. What should be stressed in the context of this article, however, is that pedestrians and cyclists together could form a formidable lobby for these solutions to be taken more seriously.

Conclusion

There are undeniable differences between the two modes. Cyclists are much faster than pedestrians, they use a vehicle and they have a stronger sense of identity as users of their mode. Pedestrians on the other hand already have their own route network but no national strategy to cater for them and while many more people walk, they are less well represented in the political arena. But these differences can be turned into mutual strengths.

Projects such as Home Zones and Safe(r) Routes to School show that combining the interests of those who walk and cycle can lead to great benefits for both. Home Zones should ideally give both modes priority over the car and speed restrictions and traffic calming around schools and on the routes leading to them will make both walking and cycling there a much safer and enjoyable experience. Why not translate these experiences into 'pedestrian and cycle friendly town centre' projects, for example?

Walking and cycling have more in common with each other than any other two modes and the way in which a society caters for its pedestrians and cyclists is ultimately a litmus test of how far it has gone along the way of achieving a sustainable transport system. Any successes in redressing the balance, which for so long has been tipped in favour of the motorised modes, will ultimately benefit each and every one of us.

Table 3: Core themes of sustainable transport

- a more balanced approach to transport
- traffic restraint and traffic calming in urban and residential areas
- land-use planning for non-motorised accessibility
- more pedestrian and cycle friendly lay-out of crossing facilities and junctions
- better enforcement of the existing Highway Code which, while bestowing many rights and protections on pedestrians and cyclists, is not enjoyed in practice

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The Safety & Security issues of Women drivers & passengers

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Abstract

This research was commissioned by the Mobility Unit of the Department of the Environment, Transport and the Regions to address the in-car safety and security needs of women drivers and their passengers. The research was multifaceted. It sought to establish whether cars which have been designed and tested around male manikins and anthropometry were less protective to female drivers and their passengers; whether such vehicles met the requirements of the growing number of female users, and the experiences of female drivers on the road. Lastly we considered means of disseminating our results to a wide audience, through the use of posters and web sites (see Woodcock, Galer Flyte & Garner, 2001). The research presented here considers the first two issues and concluding with recommendations for future policy.

Keywords

Cars, design, safety, security, women.

Introduction

Research has been conducted both in the automotive industry and academic institutions into car safety, crash survival and analysis. This has indicated that women are injured more in cars and sustain a different injury pattern to their male counterparts (Hill & Mackay, 1997). This might be due to the type of journeys undertaken, car type (e.g. women, on average, drive smaller cars) or car design (e.g. the position of the occupants relative to safety structures and hard points within the vehicle). Whilst there have been calls to design cars and vehicle packages from the occupant out (e.g. Porter & Porter, 2000) the emphasis remains on male occupants in both vehicle design and crash testing. This might not necessarily disadvantage smaller, female occupants, who can be adequately (if not always comfortably) accommodated by the ranges of adjustability provided. However, can a small woman (2.5% percentile) be assumed to be equivalent to a small man? Will her body behave in a similar manner in crash impacts? The analysis of accident

data sought to discover sex differences in the injury patterns of male and female drivers and passengers, sustained in similar types of accidents.

In terms of social and behavioural issues, cars and road environments have been designed to accommodate male drivers. Previous research has shown a gender bias with studies emphasising young, male drivers, the effectiveness of different forms of deterrents in reducing car related accidents; social, ageing and cognitive effects on driving. In most of the studies the primary focus has been on the male driver. Male behaviour patterns are emphasised with women's driving compared to that of their male counterpart. Media coverage, experiences, ability and the design of the car and the traffic environment may contribute to feelings of insecurity. Therefore, the second part of the research investigated issues concerning women's requirements of cars, when they felt insecure and vulnerable in their vehicles, and what aspects of car and road design could be improved upon. To consider these issues we used predominantly qualitative research methods (including diary studies, focus groups and an internet survey) to ascertain requirements, driving patterns and experience. The results from these studies are summarised below.

This more user centred design approach to automotive design and usage is seen as essential if vehicles and road environments are to be designed to suit the requirements of all transport users. Concept sketches (Figure 1) and other material (e.g. poster campaign, Figure 2) were produced to raise awareness of women's requirements in terms of safety and security.

Analysis of Accident Statistics

Hill and Mackay (1997) identified a number of safety issues relevant to female car occupants. For example:

- women are more likely to be killed in car accidents, have more neck, kneecap, ankle and certain types of foot injury than men;

- women tend to sit closer to the steering wheel which may expose them to potential injury from a deploying airbag;
- osteoporosis in post-menopausal women increases their vulnerability to injury; and
- seat belts are beneficial to pregnant women but the advice to wear the belt low down across the abdomen is not necessarily widely given.

However, no analysis has been reported regarding gender differences in car accidents. To this end, accident injury data from two British databases was examined by Lenard & Welsh (2001) to examine gender differences in accident circumstances and injury outcomes.

The databases were, firstly, Stats 19 database compiled from police reports for any accident resulting in human injury or death. The data used covered 1996-1998 and totalled 944,638 drivers. Of these 324,215 were female and 620,423 male. The analysis considered the measure of exposure, circumstances surrounding the accident, injury outcome and female vulnerability.

Secondly, the Cooperative Crash Injury Study (CCIS) database was used. This includes retrospective in-depth information gathered mainly from the examination of crashed vehicles (away from the crash scene) and hospital records or autopsy reports. All vehicles from accidents classified as serious or fatal in police notifications are eligible for inclusion in CCIS. As it is not feasible to put this level of effort into every crash in the UK the CCIS takes a sample of accidents from certain regions. For these regions it includes almost all fatal accidents, 80-90% of serious accidents, and around 20-30% of slight accidents. The sampling criteria is very well suited for identifying differences in the accident and injury circumstances between men and women. Operating since 1983, the database contains about 8000 drivers in which at least one occupant from a vehicle involved in the accident is injured, and at least one vehicle is less than seven years old and towed away from the accident scene. The

goal of this part of the analysis was to identify gender differences in accident circumstances and injury outcomes. An emphasis was placed on situations for which it is most likely to design countermeasures for the benefit of women: e.g. restrained occupants in frontal impacts, struck-side impacts, rear impacts and rollovers. In addition, three other topics of special interest to women were also included: airbags, over-50 year olds, and pregnancy. The two databases complemented each other and provided a very strong foundation for examining road safety issues.

Results of Analysis

In terms of road usage and crashes women constitute about 40% of car occupants involved in crashes and outnumber men in the passenger seats. Female drivers aged 17-29 are as likely to be involved in an accident as those aged 30-59, with those over 60 having a lower accident involvement rate. Male drivers' accident involvement rate decreases with age through the three age bands. Female drivers are more likely to have a crash during the day (8 a.m. to 6 p.m.), during weekends and the months of October, November and February. Women drivers tend to be involved in slightly more rear end collisions than men and less frontal impacts. Seat belt use is lower amongst pregnant women.

Analysis of social & behavioural issues

The investigation of social and behavioural issues complemented the accident data by considering the manner in which cars were used, the circumstances under which women were or felt themselves to be less safe in the car and the road environment. Five methods were used to elicit information from different groups of women (such as the elderly and disabled, professional women, women with young and old children) – focus groups, diary studies, stakeholder analysis, analysis of best practice and internet analysis.

Requirements into Concepts

The requirements were fed immediately to two

Table 1: Women and crashes

- women in crashes were generally either equally or more vulnerable to injury than men in front, side and rear impacts. This difference cannot necessarily be attributed to women's use of smaller, lighter cars (which they drive more frequently than men)
- women had more soft tissue neck injury across all impact types
- in frontal impacts restrained female drivers had more skeletal, chest and neck injuries than men
- in side impacts women seated on the struck side of the vehicle had a higher incidence of skeletal and pelvic injury than men
- women continue to be more vulnerable to injury than men in the older age group but the gap between the sexes in terms of injury does not appear to widen in the over 50s
- in crashes female passengers are also more vulnerable to injury than male passengers, and form a higher percentage of this type of occupant

teams of automotive designers to inform their vehicle concepts. Both vehicles took advantage of smart technology for intelligent mirror, pedal, steering wheel and airbag adjustment. As the structures of the car provided most protection when the occupant was seated in the recommended seat position, the seats were not adjustable.

Figure 1a shows the exterior of the small car detailing higher driver position, enhanced all round visibility, two level boot for easy loading, and three seats for rear occupants. Figure 1b, is a sketch of the interior of the executive car, again showing the accommodation of three passengers in the rear seats which are fully and individually adjustable, and incorporate storage units. The focus groups indicated that women do not always adjust their head rests to the appropriate height. This was a facility of both vehicles and would be taken over by the smart technology envisioned by the designers.

It must be stressed that the designs were not developed as final or optimum solutions to the requirements but were developed as a communication device for discussion with automotive designers and manufacturers

The internet survey

An internet survey was used to investigate the experiences of women motorists, especially those times when they felt threatened, vulnerable or uncomfortable during their journeys. This augmented the focus group and diary studies (Woodcock *et al.*, 2001) and considered broader issues of driver behaviour across the globe. Although small (175 responses), it is

emphasised in this report for three reasons; firstly out of respect for those who responded freely and honestly to the survey and wished the results to be publicised and their voices heard; secondly because, as an international survey, it shows an alarming trend in the use of the road environment; and thirdly, to highlight the need for further work, to capture the requirements of further user groups (such as women truck drivers in the U.S.A. and community groups) for whom cars may provide an important lifeline.

Respondents were from South America, Europe, Scandinavia, Australia and New Zealand, Africa (e.g. South Africa, Zambia, Mozambique), and others (e.g. Taiwan, Jamaica, United Arab Emirates, Indonesia). 75% of the respondents considered themselves confident or very confident drivers, the rest expressed lack of confidence in certain conditions (e.g. driving alone, at night or in cities). In these cases the fear of breakdown and attack featured highly, and was in some cases attributed to media coverage.

Safety & security features

Table 2 shows the most desired safety and security features. Many of these are standard on newer models, not all of which the respondents had access to. These are similar to those which emerged from the focus groups. This was seen as indicating a sophisticated and discerning market.

Crashes

Many of the respondents had had personal experience of a need for the features. Approximately 75% of the sample had been involved in at least one

Table 2: Most desired in-car safety and security features

<i>Features</i>	<i>Examples</i>
Impact protection	air bags for all occupants, side air bags, adjustable air bags, side impact bars, reinforced body work, crumple zones, bouncing bumpers (front and rear), rigid bumpers, pedestrian/cycle friendly, soft dashboards
Seat belts	rear seatbelts, especially full ones, seat belts designed for children, more adjustability, automatic seatbelts
Comfort	better seat belts, seats with greater range of adjustability, easier fastening for child seats, integral child seats, higher roof, padded roof, more leg room, tinted windows so can't see a woman driver
Emergency	integral phone, in-car panic button, direct access to emergency systems (and home), personal alarm, CB radio, alarm which cuts off fuel on impact, emergency kits
Security (for car)	central locking, immobiliser, alarm, better locks, anti-hijack/anti theft devices, code keys, tracking system, automatic locking linked to lights (interior and exterior), smash proof glass
Vehicle (mechanical)	greater reliability, better tyres and brakes, power steering, anti-lock brakes, traction control
Other road users	Automatic signalling when making a manoeuvre (as people often forget), warning sign for tailgaters, improved identification of police
Vehicle design	better visibility, window demisters all round, displays to detect freezing/ice on roads and low fluid levels, automatic lights when approach car also better interior lights, collision avoidance system, rear bumper distance warning, daytime driving lights, vehicle in motion lights, incremental brake lights, head up displays, radio control on wheel, fire alarm

crash, with approximately one-sixth having been involved in more than three crashes. From the descriptions, just under 20 could be characterised as serious (e.g. resulting in loss of life), with a further 70 consisting of minor scrapes and fender benders. Clearly, at least for this population, crashes were not a novel occurrence.

The analysis indicated a need for additional support for obstacle detection, which might reduce rear end and frontal collisions. 13 drivers admitted that they did not adapt correctly to the road conditions (e.g. skids, hitting brick walls) and a further 7 attributed the accident to their own inattention (falling asleep, tuning the radio, etc.). Reversing problems fell across two categories – visibility around the vehicle, or predicting the movement of another vehicle. Although it has been reported that women (in particular) do not like joining fast moving traffic, at least in this survey, this did not account for many accidents. This may be due to extra vigilance and care, or avoidance of these situations.

Threatened, uncomfortable & vulnerable

Respondents (both female and male) felt most threatened by the behaviour of other motorists. This related to the poor driving of others (e.g. weaving, tailgating, speeding and overtaking), aggressive and abusive acts (all drivers/all countries). Not surprisingly for an international survey, 'national' environmental issues such as extreme weather and 'no-go' urban areas (e.g. South Africa, USA, Colombia) were frequently cited.

In terms of discomfort and vulnerability a second category emerged relating to lack of control: e.g. when sitting as a passenger with a poor driver (most usually cited as colleague or spouse), being overtaken by large vehicles going too fast, not having the ability to perform vehicle repairs, and getting lost (especially when alone and at night), and being confronted by a large 'wild animal' (e.g. moose and deer)

Advice from internet respondents

An open ended question allowed respondents to provide advice for other motorists or add further comments relating to the research. The response rate was 75%, which was taken as an indication of the strength of feeling towards the need to address women's safety and security issues. A content analysis revealed 120 different recommendations to motorists. This echoed the advice elicited from the focus groups and was disseminated via the web site and posters produced by the graphic designers as part of the research (examples of which are shown in Figure 2). Advice related to :

- preparation for journeys – check the condition of the car, embark on regular maintenance, tell others where you going and when you expect to arrive, join

a vehicle emergency service;

- whilst in transit – lock all doors, check regularly to see if you are being followed, check the car before getting into it, do not give lifts to strangers or take advice from them, avoid eye contact with other motorists;
- be prepared – include a torch, map, disguise, mobile phone, SOS sign in glove compartment, carry emergency numbers, never leave children alone in the car;
- when parking – lock valuables out of sight;
- car purchase and maintenance – haggle with dealers, get more than one quote, make sure that the car you drive with the children is the best car the family owns (not the second one), buy an inconspicuous car; and
- keeping up confidence through insisting on regularly driving.

In terms of driving behaviour, recommendations included:

- positive attitudes to driving – courtesy, calm, confident, refusal to get annoyed, not showing fear, being less aggressive and more patient;
- considering other road users – thinking twice about small pedestrians when visibility is restricted because of car design, sometimes walk and cycle to be aware of the problems of these other users and use it to adapt your own behaviour;
- driving behaviour – adherence to rules and decent behaviour – signalling, stopping at junctions, looking at zebra crossings, keep up with other traffic, wear seat belts, be cautious at junctions, avoid driving long distances;
- let aggressive drivers through and have a plan of action if intimidated;
- stop for police;
- give yourself time and practice with new routes; and
- be sensitive and aware of what is happening on the road, respond appropriately, but do not expect other drivers to behave in well or predictably.

Car design issues related to the need for

- affordable cars for large families so that each occupant had the same level of safety and security, cars were overpowered for the roads that they were driven on, development of hybrid cars, low pollution vehicles, air bags for all occupants, side impact bars;
- anthropometry – more adjustable seats, airbags for smaller occupants (under 1.57 m so that they did not have to be turned off), better seats;
- features – seat belts which children cannot undo during the journey, wheel nuts that can be undone,

split level boots;

- national and environmental differences to be taken into account during vehicle design; and
- better visibility out of the back of the car, better visibility for poor road conditions, headlights which do not dazzle.

In terms of education, the respondents felt that instruction was needed in safer driving, motorway driving, defensive/advanced driving, vehicle maintenance, how the car works, braking distances, and that not enough support was given for female disabled drivers.

Legislative issues were country specific. For example, in South Africa it was felt that there were many unsafe/old cars on the roads, while in many countries cars were just dumped on the side of the road without any fines being levied. Many voiced complaints about being forced to use cars because of inadequacies in public transport, which resulted in 1 user per car. It was felt that the victims of car crimes were being penalised (in terms of the need to buy extra safety features, take precautions) rather than the perpetrators of the crimes. One suggestion was for a government initiative to retrofit safety systems in old cars.

The press, media, insurance companies and retailers were believed by some respondents to be hyping up safety and security issues and distorting the facts. Opinion was mixed as to whether there were actually any gender differences, although it was believed that females were more likely to report feeling vulnerable, threatened and uncomfortable.

Focus group results

In terms of vehicle design the fit of the car to the female driver or passenger was inadequate. Typical problems related to difficulty positioning the seat so that all controls and displays could be accessed and the seatbelt remain comfortable. The elderly, pregnant women, babies, and young children were not adequately catered for.

When driving women felt that modern cars had been designed to reach and 'sit' at high speeds, and lacked manoeuvrability at low speeds. Central locking systems did not cater for having different sets of access routes open. Emergency egress was worrying. Most women felt vulnerable when parking or when they had broken down and would have liked a panic or emergency system based around GPS technology.

Both male and female drivers were worried about aggressive driving and felt clearly threatened by the behaviour of other motorists. Women were more likely to avoid using motorways, driving at night and travelling on unfamiliar routes. Female drivers also said that they would not know what to do if they broke down especially on motorways (evidence was

found of contradictory advice being offered). Where there was more than one car in the household women used the smaller car as this was seen as being more easy to manoeuvre, more economical and easier to drive. Where the smaller car was an older one, this might not necessarily be the case. One female respondent to the internet survey asserted that the woman who did the school run should place her safety and that of the children first, and always have the better car.

Summary of key findings

The main conclusion of the research was that women are significantly disadvantaged in the road and traffic environment:

- 1 Many women lack confidence in driving and feel vulnerable in the road and traffic environment. This was evidenced in the focus groups and the internet analysis;
- 2 Women are more vulnerable to injury in crashes than men. This is a key finding which emerged from accident data analysis;
- 3 Cars are not designed to suit women's anthropometric characteristics nor their journey requirements; and
- 4 Women do not receive adequate information on choosing, using and maintaining their car.

Recommendations & design implications

Clearly the data show that great benefits would be derived if the vehicle package was designed to fit the anthropometric characteristics of the female drivers and passengers, including those who are pregnant, elderly or who have reduced mobility. Likewise, the development of smart occupant protection has the potential to benefit women significantly in crashes, as does improvements in vehicle compatibility.

In terms of the road environment a combined engineering, design and enforcement strategy needs to address the increased levels of aggression on our roads. The internet survey showed this to be an international issue. Although our work emphasised female drivers it is quite possible that men may have similar experiences, especially when driving smaller cars. That such aggression is tolerated and even accepted is forcing motorists off the road. As the car is used increasingly as a mobile office, it is likely that the roads will become less safe.

Lastly, and most importantly, we would strongly advocate the removal of gender bias in automotive design. Preferential reference to male anthropometric specifications in regulations and research programmes is not justified by real world data. For example, sex bias in crash test programmes and computer modelling is sub-optimal. Crash test criteria should make equal

reference to 50th percentile male and female characteristics; research and experimentation should ensure that average females benefit equally from male oriented programmes and regulations should be encouraged.

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The effects of car sharing on travel behaviour: analysis of CarSharing Portland's first year

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Abstract

A review and analysis of the mobility behaviour of CarSharing Portland (CSP) members during its first year of operation. Comprehensive surveys and one-week trip diaries were administered before individuals joined the organisation and at the end of the first year. A periodic need for a vehicle was their principal reason for joining CSP. The effect of membership in CSP on overall vehicle travel was either no change or a slight increase in VMT. However, members reported an increasing frequency of bus trips, walking and cycling. In addition 26% sold their personal vehicle and 53% were able to avoid purchasing one. These results were discussed in terms of the psychology of the car sharing experience and how membership in the organisation affected travel behaviour.

Keywords

Car sharing, Mobility, Portland, Travel Behaviour

Introduction

During its first year of operation, CarSharing Portland (CSP) was the largest car sharing organisation in the United States. Like other neighbourhood-based shared fleet organisations, CSP sought to decrease unnecessary automobile travel by providing individuals, who did not own a vehicle or sought an alternative to owning a second one, with relatively convenient access to a vehicle when needed. The service provides short-term, hourly use of vehicles that are located in parking sites close to the member's household or place of work. Vehicle reservations are made by means of an automated telephone reservation system. Members are charged only for the time and mileage of each trip, with insurance, gasoline and maintenance included in these rates.

The introduction of car sharing in North America is of considerable interest because of its potential for reducing the mounting transportation problems of our urban communities. This expectation is based on the

belief that car sharing will (a) reduce the vehicle ownership needs of members, (b) decrease their vehicle miles travelled (VMT), and (c) increase their use of public transit and other alternative modes of transportation. While these effects have been observed in Western Europe (Munheim, 1998), where car sharing is growing rapidly (Shaheen, Sperling & Wagner, 1998), they have yet to be reported for the car sharing organisations that have recently been established in Canada and the United States.

This paper represents an effort to provide such evidence by examining the impact of membership in CSP on three broad classes of mobility behaviour: (1) frequency and predictors of service usage, (2) VMT and use of alternative travel modes, and (3) vehicle ownership and purchases.

Method

A total of 120 individuals joined CSP during its first year. They shared a fleet of 9 vehicles giving rise to a ratio of users to vehicles of 13.3:1. The vehicles were located at 7 separate close-in neighbourhood stations in each quadrant of the city.

Survey

CSP members were surveyed before they started to use the service and at the end of the first year. The Pre-Membership Survey sought basic demographic information about the members, their vehicles, and their customary travel behaviours. At the conclusion of the first year, the members were also asked to complete a more detailed survey which assessed their satisfaction with CSP's service, current vehicle ownership, attitudes about the requirements of sharing cars, transportation cost savings and daily travel patterns.

Trip Ticket

Evidence on service usage was obtained from a Trip Ticket that was completed by the members at the conclusion of each CSP vehicle trip. Members were asked to indicate their ID Number, the odometer

reading at the start and completion of their trip, the purpose of their trip, as well as additional information relevant to billing and vehicle performance.

Trip Diary

Additional information on mobility behaviour was obtained from a one week Trip Diary that members completed on a voluntary basis prior to using the service and then again at the end of the first year. The Trip Diary provided information on all vehicle and non-vehicle trips during a full week, including those made in a CSP vehicle during its second administration. This provided a pre- and post-test measure of the impact of car sharing on travel behaviour.

Results

Members

Table 1 summarises the basic demographic characteristics of the members, provided by the 87 respondents (72.5% return rate) to the initial, Pre-Membership Survey. The members ranged in age from 22 to 75 years, with a mean of 37.24 years. The age of the members was distributed bi-modally with a peak at 30 years and another at 50 years. They were also well educated, with an average highest completed grade in school of 16.4 years. At the end of the first year, all CSP members had completed high school and most had graduated from college. In addition, a sizable majority held professional positions (lawyers, health care, education, etc.) with a smaller number holding positions ranging across a wide variety of occupational categories.

The members were fairly evenly divided between females (47) and males (40). In addition, their monthly income cut across all levels with the reported median income level equal to \$3,001 – \$4,000. Of the 113 survey respondents, 69 (61%) indicated they either rented a home or apartment. The remaining 44 (39%) said they owned their residence. Finally, 41.1% of the respondents owned a personal vehicle at the time they joined the organisation, while 58.9% did not.

Taken together, these findings suggest that the early adopters of the car sharing concept in Portland, Oregon were a highly educated group who, in most other characteristics, represented a wide segment of the general population. They were not restricted to any single age group, or income level, nor were they more likely to represent one gender more than the other.

The members were also asked about their reasons for joining CSP. There has been a good deal of speculation about why individuals, imbued with the American transportation

ethic, would want to join an organisation that promoted the shared use of vehicles. While many suggest it would be largely motivated by environmental concerns, the evidence indicated this factor, while important for many of CSP's early adopters, was not the primary reason they decided to join.

Most (N = 32) respondents said they joined CSP because of their periodic need for an additional vehicle. This often occurred because of an unplanned change in their life, e.g. their car broke down, they obtained a new job, or moved to a residence close to a CSP vehicle station or their automobile insurance premiums increased. When asked for the second most important reason, the majority said it was the financial savings they expected to derive from not owning a vehicle.

CSP Service Usage

The evidence collected during the first year indicated that there were three classes of users – low, medium and high users of CSP's service. The analysis of these three user groups is complicated by the fact that the member's trip behaviour varied a great deal from month to month. A person could be a low user one month and a high user the next. Indeed, it was not uncommon for some members to go an entire month without taking a single CSP trip. During the first year, the monthly average of CSP members who did not book a single reservation was 30.6%.

While it masks this variation somewhat, CSP's membership can be characterised in terms of these user groups by taking the *average number of trips they took each month* since they joined the organisation. Table 2 describes each group and lists the number of members in each category. Independently of trip frequency, the evidence collected during the first year revealed that

Table 1: CarSharing Portland Member Profile

Attribute	Typical Characteristic
Age	Mean = 37 yrs; bi-modal peaks @ 30 & 50 yrs
Income	\$3,000 - \$4,000 per month
Education	College graduate
Occupation	Professional & service sectors
Vehicle Status	Do not own vehicle
Household Status	Rent home or apartment
Membership Goal	Periodic Need for Vehicle
Yearly Vehicle Mileage	Less than 4,000 mile

Table 2: Three User Groups

Group	Average Monthly Trips	Number (%) of Members
Low User	1 or fewer trips/month	36 (33%)
Medium User	2–3 trips/month	48 (44%)
Hi User	4 or more trips/month	25 (23%)

the *duration* of trips ranged from 3 to 4.5 hours. In addition, the average *distance* of a trip in a CSP vehicle varied from 18 to 30 miles with an overall mean of 22.66 miles.

Predictors of Usage

There were unexpected differences between the three user groups in the length of time they belonged to CSP. The members of the Low User group had been members for a significantly longer period than both the Medium, $t(328) = 3.01, p = .002$ or High User groups. This suggests that the longer individuals belong to CSP, the *fewer* trips they take. This outcome had not been expected. Rather, it was anticipated that growing familiarity with the service would foster greater use. This was based on the belief that over time individuals would *learn* to appreciate the convenience and cost savings of car sharing. In turn, this would increase the likelihood that they would make greater use of the service to meet their mobility needs.

However, the early adopters of car sharing in Portland, did not behave this way. Instead they seemed to be learning something quite different, namely the true cost of each automobile trip they took. Prior to reserving a CSP vehicle, they may have spent some time thinking about the cost of their forthcoming trip in a way they never had before. This may have led them to think twice about whether or not to travel by car and, instead, to consider deferring the trip or chose other means of transport.

This reasoning suggests that the impact of membership length on usage would be most clearly exhibited by those who had been members for the longest period. This is confirmed by the trip data of those who joined during CSP's first month. Of the 12 CSP members who belonged for the entire first year (12 months), 9 took more trips during their first three months than they did during the last three.

It was premature at the end of the first year to analyse the effect of membership length on the entire group of CSP members, since most had been members for only a short time. In fact, at the end of the first year, more than two-thirds of CSP's then-current members had belonged for 6 months or less. It appears that the tendency to take fewer and shorter trips in CSP vehicles

develops gradually during the course of the membership period. Thus, a more powerful test of this relationship will be possible over time, with increasing length of membership.

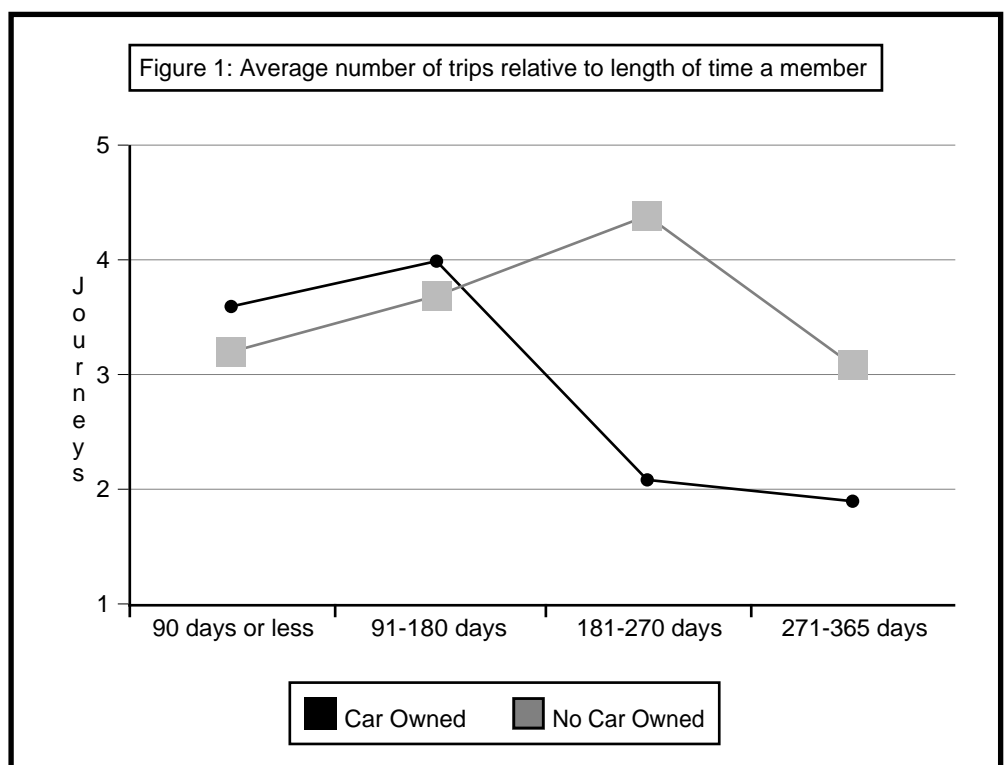
Distance to Station.

Utilisation of CSP vehicles was also a function of the distance from the member's household to the stations where the vehicles were parked. In response to a question on the Year-End Survey, the members reported they lived on average 14.35 blocks from the nearest CSP station. They also reported it took them an average of 10.75 minutes to get to the nearest station. More than three-quarters (76%) reported they walked to the station, while 15% said they biked there.

To determine the impact of proximity on usage, an independent measure of the member's distance to each of the CSP stations was calculated. Distance to the nearest station was a significant predictor of the frequency of usage, with the further a member's household from the nearest station, the fewer trips they took, $r = -.127, p = .003$. This relationship was significant even though not all trips were taken from the station closest to the member's household residence. For example, reservations were sometimes made for a vehicle at the station nearest the member's place of work.

Vehicle Ownership

The relationships between membership length and distance to station on CSP trip usage are more clearly seen by considering how both *interacted* with vehicle ownership. By itself, CSP usage was not influenced by



whether or not a member owned a vehicle. But it was influenced by the way in which vehicle ownership moderated the effect of membership length and distance to station.

This can be understood by considering the interaction shown in Figure 1 between the average number of trips per month and the length of CSP membership. It is evident that the impact of membership length varied as a function of whether or not a member owned a personal vehicle, $F(4, 434) = -2.85, p = .005$. Figure 1 reveals that the longer a member had belonged to CSP, the fewer trips they were likely to take. This relationship was strongest when members owned a personal vehicle; and while it was also true if they did not own one, with the limited data available, the relationship here was not statistically significant.

Similarly, vehicle ownership interacted significantly, $F(4, 434) = -3.15, p = .002$, with distance to station. This interaction is shown in Figure 2, which depicts the relationship between the average number of trips per month and distance to the nearest station as a function of vehicle ownership. Figure 2 reveals that if a member owned a car, the frequency of CSP trips decreased the further away he or she lived from the nearest station. But if a member did not own a car, frequency of usage was not affected by distance to station.

In summary, the evidence suggests that the impact of both membership length and distance to station on CSP trip usage depends critically on whether or not a member owned a personal vehicle. These factors played a far more important role for vehicle owners than non-owners. Perhaps, those who owned a vehicle concluded that they might as well arrange to use their personal vehicle, given the additional cost of a CSP trip or the long walk to the vehicle station.

Mobility Effects

Thirty-three (33) members of CSP completed the Trip Diaries on both trials. The pre- and post-Trip Diary findings of these respondents, differentiated in terms of whether or not they owned a vehicle at the time they completed the Pre-Membership survey, are shown in Table 3. As

expected, on each of the Trip Diary measures, CSP members who had a car drove more than those who did not. CSP vehicle owners took more personal vehicle trips, drove more miles during the week they completed the Trip Diary and estimated their yearly vehicle mileage was greater than non-owners. They also took *fewer* non-vehicle trips than non-owners. Each of these differences was observed during *both* administrations of the Trip Diary and all such comparisons were statistically significant.

Table 3 also indicates *there was very little change in the pre- and post-trip diary measures regardless of whether a person owned a vehicle*. There is one exception to this trend. Namely, the vehicle mileage during the week the Trip Diary was completed did *increase* sharply in the non-vehicle owners. The non-owners also took more other vehicle trips, which reflected those they were now able to take in CSP vehicles. However, *only the increase in vehicle miles was statistically significant*, $F(1, 17) = 9.84, p = .006$.

Some of the comparisons between the two periods were consistent with the expectations derived from the

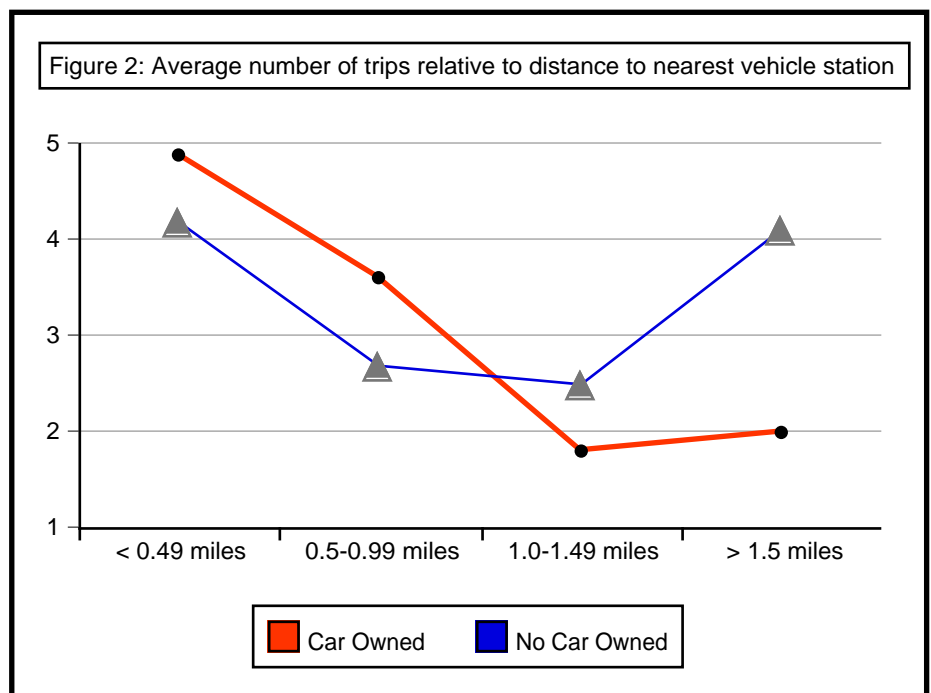


Table 3: Pre-Mean & Post-Mean Mobility Comparisons of CSP Car Owners & Non-Owners

	Car Owners		Non Car	
	Pre-Mean	Post-Mean	Pre-Mean	Post-Mean
Travel				
Personal-vehicle trips	9.53	6.733	0.00	0.33
Other-vehicle trips	13.46	16.06	10.00	13.05
Non-vehicle trips	8.86	11.00	20.22	21.11
Total travel mileage	139.86	127.05	90.33	92.05
Vehicle mileage	103.33	84.38	0.33	24.92
Year Mileage	5790.00	7230.00	50.00	138.88

European evidence. Thus, the owners did take *fewer* personal vehicle trips, *more* other vehicle trips, and did drive *fewer* miles at the end of the first year. Similarly, CSP members who did not own a vehicle, did take more other vehicle trips (presumably a CSP vehicle) and did estimate they drove more miles during the year. But in each case, the differences were small and in no case were they statistically significant.

In summary, the only statistically significant *change* in travel behaviour that could be detected during the second administration of the Trip Diary was the increase in the non-owner VMT. While these members drove more, those who had a car did not drive much less. In fact, in some cases the easy access of an additional vehicle may have led some to drive more. When combined with the increasing mileage of the non-owners, the *aggregate net effect of membership in CSP was either no change or a slight increase in VMT.*

Additional information about the member's mobility behaviour was obtained from both the Pre-Membership and Year-End Survey. Evidence was obtained on the (a) effect on transit ridership and non-vehicle travel and (b) changes in private vehicle ownership. It is widely reported in Europe that members of car sharing organisations make greater use of public transit and alternative travel than they did before joining the organisation. Lightfoot (1997) reports that in the Netherlands train ridership increased 7%, bicycle use 5% and bus use 18%. Similarly, Munheim (1998) reports that after becoming members of Mobility Car Sharing Switzerland, there was a 'reduction of no less than 72%' in use of a vehicle for transport. Instead, public transportation was used for over 50% of all mileage travelled, with the remaining distance travelled by means of bicycle, motor-scooters and walking.

Although the magnitude was considerably less, somewhat similar effects were found among the members of CSP. On the Year-End Survey, the members were asked about their use of alternative travel. While a sizable increase was not observed for any travel mode, a large number of respondents reported they used these alternative modes (transit, walking, bicycling) more often for commuting, shopping and personal errands. This finding is consistent with additional analyses of the travel mode estimates reported on both the Pre-Membership and Year-End Surveys, where the members were asked to indicate the *number of days per week* they used each major mode of travel. On the Year-End Survey members reported a significant increase in the frequency of bus use, $F(1, 46) = 26.06, p < .001$, walking $F(1, 43) = 106.68, p < .001$, and bicycling $F(1, 35) = 6.62, p = .014$.

A comparable trend was also observed in the Trip Diary data, where there was a small, increase in the number of 'non-vehicle' trips taken by both vehicle owners and non-owners after they had become members of CSP. In this respect our findings agree with the reports from Europe that members of car sharing organisations use 'green transportation' more than they did before they had become members.

A sharp reduction in vehicle ownership is also one of the most widely observed effects of car sharing in Europe. In a review of four commercial car sharing projects in The Netherlands, Lightfoot (1997) reported a 44% decrease in the number of car owners among the 847 participants of those programs. Munheim (1998) reported that among the members of Mobility Car Sharing Switzerland, '60% of the former car owners no longer have their car after a few years'.

Here again, while the magnitude was not as large, a similar effect was found among the vehicle owners of CSP. Of the 64 Year-End Survey respondents, 17 (26%) reported they *sold* a personal vehicle after joining CSP. In addition, 34 (53%) reported that membership in CSP led them or their household to *avoid purchasing* a personal vehicle. Indeed, almost all of the individuals ($N = 16$) who said, on the Pre-Membership Survey, that they intended to sell a personal vehicle after joining CSP did in fact do so.

Discussion

Contrary to expectations, a reduction of vehicle ownership did not directly lead to a reduction of VMT for the members of CSP. Nor was there anything in the surveys or Trip Diary data to indicate a decline in VMT. Walb and Loudon, (1986) reported similar effects in their evaluation of the Short Term Auto Rental (STAR) program, which operated in San Francisco for 18 months during 1984-85. The overall level of vehicle ownership among STAR users declined by 15.4 % during the first year of the project, with 8.2% of the households reporting a shift from two to one vehicle and 9% reporting a shift from one to no vehicle. Furthermore, a sizable number of households (43.1%) reported *No Car* that they decided to delay or cancel a planned vehicle purchase as a result of the availability of those in the STAR fleet.

However, the STAR user surveys indicated, as was true of the CSP Trip Diary measures, that the frequency of STAR vehicle trips either increased or remained the same as a result of the availability of the STAR vehicles. In addition, the data also indicated that STAR was associated with a *decrease* in transit ridership. While vehicle mileage data was not collected, these findings, like those reported for CSP, suggest there was 'an increasing level of vehicle miles of travel' after individuals became members of

the STAR organisation (Walb & Loudon, 1986). These results from the only two systematic evaluations of car sharing organisations in the United States stand in contrast to those widely reported for the European car sharing organisations. The fact that the findings were replicated over a span of more than ten years makes them even more provocative. How should they be viewed?

Methodological Caveats

First it is important to note that, with one exception, the published travel behaviour data from Europe is based on the retrospective estimates of *selective* samples of the members of some car sharing organisations. Such reports, like those of the American car sharing survey respondents, are not immune from any of the potential sources of error and bias that can intrude on their accuracy (Schwartz, Groves & Schuman, 1998). Like other recollections of distant events that are not normally coded with numerical precision, they should be viewed with some degree of caution. Similarly, one should view cautiously data obtained from individuals who had *expected* to drive less or who, because of their positive attitudes about car sharing, might thereby wish avoid the appearance of driving more after becoming members of a car sharing organisation.

Second, it should be remembered that the Trip Diary evidence was based on a relatively small sample of 33 *volunteer* respondents, who constituted 27% of CSP's membership. In addition, it was recorded during two weekly intervals that for most of the respondents were not separated by a great deal of time. A minimum of 3 months was set between the two administrations of the Trip Diaries. In some cases it was longer, but only for those who had joined CSP during its first few months. Ideally, a much larger sample of individuals, who had been CSP members for a longer period would had been preferred. Travel behaviour evidence obtained in this fashion would have greatly strengthened confidence in the results.

Transportation Systems

In spite of these methodological concerns and the provisional nature of the data, there may be some very real transportation-based constraints that make it difficult at this time to replicate the European car sharing mobility effects in the United States. One need only point to the dense transit infrastructure that exists within and between European cities to suggest how much more convenient it is to avoid travelling by automobile there than it is in most American urban communities. As a result, members of European car sharing organisations are much less dependent on vehicles, either their own or

those in the shared fleet, to meet their mobility needs. Changes in mobility attitudes and shifts to alternative modes of transport that develop after one becomes a member of a car sharing organisation, can be translated into action much more readily in Europe than in the United States. Perhaps it is inevitable, then, that until this situation changes, it will be some time before the robust VMT reductions that have been so widely reported by the European car sharing organisations can be replicated in the United States.

Mindfulness of Transportation Costs

Earlier it was suggested that the apparent decline of service usage with increasing length of membership might be attributed to the member's increasing awareness of the true costs of their automobile trips. On the Year-End Survey they were asked about this matter directly. The evidence indicated that 75% of the survey respondents reported they had become more aware of travel costs since they had become CSP members. In turn, 62% said this influenced either somewhat (N = 24) or greatly (N = 16) the likelihood that they would use a CSP vehicle; and while a small minority reported their travel behaviour was not affected by this knowledge, the majority of members said it did influence their travel in other modes, as well.

Psychology of the Car Sharing Experience

In a provocative challenge to the introduction of car sharing in the United States, Bernard (1998) has suggested that car sharing starts out with at least six negatives:

- 1 a user has to plan their trips in advance. So in most cases spontaneity is lost;
- 2 the user has to remember and take the time to make a reservation;
- 3 the car is probably parked further from the user's residence than their personal car would be;
- 4 the user has to leave it clean, every time, even if they are in a hurry;
- 5 the user has to deal with some form of paper work, pin numbers, lock boxes, etc. every trip; and
- 6 the user has to worry about getting the car back on time – another loss of spontaneity.

Table 4: Member Attitudes about Car Sharing Requirements

Feature Importance	Extremely	Somewhat	Not
Travelling to the vehicle station	4	25	32
Planning a trip in advance	0	31	31
Spending time making a reservation	0	12	47
Obtaining a vehicle key	2	15	45
Filling out trip ticket	0	17	45
Ensuring the vehicle is clean when done	0	7	53
Returning car on time for next user	1	36	25

With such a set of hurdles to overcome, it is hard to imagine that car sharing would ever appeal to very many people. Yet, these 'negatives' did not deter the members of CSP from joining the organisation. Nor did they find them terribly burdensome after experiencing the service. Their responses to a set of questions on the Year-End Survey about shared fleet requirements are shown in Table 4.

Table 4 indicates that the majority of CSP members did not report being distressed by the requirements of booking and using a car in the fleet. While two of them, trip planning and returning the car in time for next user, were felt to be 'somewhat inconvenient' in both cases, almost as many members said they were not inconvenienced by having to perform them. Whatever concerns they might have had about these 'negatives' before joining, never developed into serious problems after they had been members for awhile. To be sure, in the beginning, a number of new tasks had to be learned, but the learning process appears to have been rapid so that the majority of the members adapted quickly to these requirements. Furthermore, however burdensome they may have felt them, most did not let that interfere with the satisfaction they derived from the car sharing experience.

Conclusion

While the members of CarSharing Portland did not drive fewer miles after they joined the organisation, they did exhibit a number of notable changes in their mobility behaviour.

Seventeen members sold a personal vehicle, while 34 more avoided purchasing one. Members also became more aware of their transportation costs and began

changing their customary mobility habits by planning vehicle usage more carefully and bundling together trips that might have formerly been taken separately. Car sharing also led to significant changes in the use of alternative transportation. After joining CSP, individuals took the bus more often, rode their bicycle more and did more walking than they had before. However, it must be acknowledged that these changes may have been in addition to vehicle trips, not in replacement of them.

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Pedestrian flow characteristics at an intermodal transfer terminal in Calcutta

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Abstract

In recent years, walking as a transportation mode has gained recognition as a basic building block in urban design. It is highly suitable for a certain kinds of journeys. To encourage walking and to make it more safe, convenient and attractive, the physical facilities must be available to support the physiological and social needs of pedestrians. It is important, therefore, that the flow characteristics of pedestrians be understood properly to aid the planning and design of facilities. Keeping in view the above facts, a study has been conducted at an inter-modal transfer terminal in the Calcutta Metropolitan District, and relationships of speed, density, flow and space have been developed. The paper also discusses the problems of pedestrian movement in Calcutta and suggests a few policy decisions for providing safe, convenient and pleasant movement.

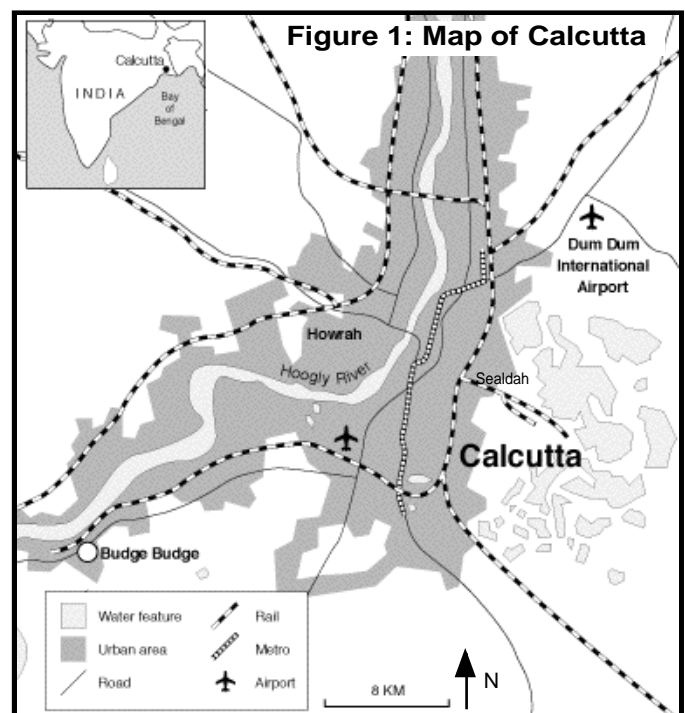
Keywords

Calcutta, density, flow, pedestrians, space, speed, walking

Introduction

Walking is widely used as a travel mode in the cities of Less Developed Countries. Data available in Advanced Capitalist Countries also suggest that pedestrian journeys account for a significant portion of the total urban travel (Koushki, 1988). Walking is used mainly for short trips and it plays a vital role in sustaining the social and economic relationships essential to city life. In Less Developed Countries, very often pedestrians are forced to walk long distances in the absence of alternatives. When modes are available, the fares are too high for a large proportion of the population. Moreover, the shape and population distribution of the cities in most cases is not ideally suited to the provision of efficient transit networks. This often results in commuters having to walk long distances at the origin and destination of their journeys. Walking also provides a versatile link between transportation modes, mainly at inter-modal transfer points, which is almost impossible by other modes.

Keeping in view the large pedestrian traffic on roads, especially in the cities of Less Developed Countries, there is a need to provide adequate physical facilities to make walking safe and convenient, if not pleasant. Planning and design of such facilities require an understanding of the characteristics of pedestrian flow and human behavioural factors. Pedestrian behaviour can be very complex and unpredictable as it depends on a number of physiological and psychological factors. It is thus imperative that at least the flow characteristics of pedestrians should be understood to aid in the planning and design of pedestrian facilities. The speed–density, speed–flow and flow–density relationships have been studied by Older (1964), Navin & Wheeler (1969), Furin (1971), Sleight (1972), Polus *et al.* (1983), Tanaboriboon *et al.* (1986), and Veeraghavan (1991) in different countries. All of them suggest a linear relationship between speed and density. However, they obtained different rates of variation of speed with density. Parabolic relationships have been established between speed–flow and flow–density.



The objective of the present study has been set to come up with the relationships between the speed–density, flow–density, speed–flow, flow–space and speed–space of pedestrian traffic. As a case study, the travel characteristics of pedestrians at the intermodal transfer terminal at Howrah Railway Station in the Calcutta Metropolitan District was considered.

Data Collection:

To carry out a meaningful study so that the relationships between speed, density, flow and space of pedestrian traffic are established, the following requirements were set for selecting the test stretches:

- The width of the walkway be constant throughout the test stretch length for a set of data;
- The pedestrian flow be in one direction only;
- Pedestrian traffic of varying ranges be available (i.e. from low flow rate to high flow rate); and
- Flows not being affected by features immediately outside the test stretch.

Howrah is one of the major railway terminals in India. More than 1 million passengers use the railway station every day. It is one of the two major gateways to the city of Calcutta. Besides serving long distance passengers, the station also facilitates local passengers, who come to the city everyday from surrounding areas for work and other purposes. The station is located on the western bank of the river Hoogly with the city of Calcutta proper on the other side. There is only one bridge close to the station connecting Howrah and Calcutta and thus most of the time it remains highly congested with traffic. A large number of passengers prefer to use water transport to cross the river to Calcutta. For the benefit of these passengers a few subways have been constructed connecting the railway station with the river bank. The floating ferry terminals are connected to the river bank with a few pedestrian bridges. The density and flow of pedestrians in the subway and on the bridges vary appreciably depending on arrival of trains and departure of ferries. Also, it was observed that during the morning peak hours, the flow was mainly unidirectional, i.e. passengers were travelling from the railway station towards the ferry terminals.

Selected stretches of the subway at Howrah

Railway Station towards the Ferry Ghat and two pedestrian bridges connecting the river bank with the floating ferry terminals were selected to study the pedestrian flow characteristics. The details of the stretches are given in Table 1. Data was collected on ordinary working days during morning peak hours.

Procedure of Data Collection

Video recording was used to collect pedestrian flow data in most of the recent studies. In the selected test stretches for the present study, fixing video camera without disturbing the pedestrian flow characteristics was not possible. So, relevant data was collected manually.

Test stretches were selected in accordance with the physical conditions of the locations. Flow was measured by counting the number of persons crossing the centre line of the trap length in a certain time interval. The time intervals were chosen according to the type of flow. The speed was measured by noting down the time taken by randomly selected pedestrians to cross the test stretch length in each cycle in which flow was measured. On average, the speed of one-quarter of pedestrians crossing the line was measured in each cycle. The average of these speeds was taken as the speed corresponding to that flow.

Initially a 2 metre trap length was chosen for the study in the subway. However, it was found to be difficult to measure accurately the time taken by the pedestrians to cross such a small distance. Also, it did not represent the journey speed but only the spot speed of the pedestrians. It was found that speed could be measured fairly accurately when the trap length was about 10 m.

For the measurement of flow a 30 second time interval was chosen for the subway, but it was found to be difficult to observe the speed of sufficient number of pedestrians in that short interval. Finally, a 2 minute time interval was found to be satisfactory. In the Ferry Ghat Bridges, during off-peak periods only 90–120 passengers were arriving in each ferry launch and 40–50 seconds was sufficient for all of them to clear the bridges. So a 30 second interval was chosen. At some instances when numbers of passengers were large, a 45 second time interval was found suitable.

Table 1: Details of Test Stretches

Name of Test Stretch	Howrah Station Subway	Howrah Ferry Ghat Bridge 1	Howrah Ferry Ghat Bridge 2
Width (m)	5.4	1.8	2
Trap Length (m)	10	9	10
Surface condition	Concrete	Wooden	Wooden
Nature of Sides	Wall with Glazed Tiles	Railing	Railing

Analysis and Results

Calculation of flow, speed & density

With the observed number of pedestrians crossing the centre line of the test stretch in each cycle time, the flow was calculated from Equation 1:

$$q = N/T \tag{1}$$

where

q = flow of pedestrians (pedestrians/metre/minute)

N = number of pedestrians crossed the centre line of test stretch

T = time interval considered

The speed of pedestrians against each time interval in which the flow was observed was calculated by dividing the length of stretch by the time taken for pedestrians to cross the test stretch. The speed of as many pedestrians as possible were observed and the average was taken as the representative speed of pedestrians at that time.

The density was calculated using the following equation:

$$\text{Flow} = \text{Speed} \times \text{Density} \tag{2}$$

The flow and the corresponding speed were obtained from the observed data.

Results of the speed & density study

Based on the data collected in this study, the characteristics of speed such as mean, maximum, minimum and standard deviation were calculated for each test location and the results are summarised in Table 2. Different ranges of densities were obtained in each location.

The mean speed of pedestrians at the subway (87.51 m/minute) is higher than all other locations because of low densities observed on the site. This also resulted in a higher minimum speed relative to other stretches. From the standard deviation it can also be observed that there is wide variation of speeds at low densities. In the subway, where the densities reach a maximum of 0.6 pedestrians per metre, the standard deviation of speed is the highest. At low densities, pedestrians can choose their own speed as their

movements are hardly affected by the presence of others. At higher densities the speed gets restricted due to the presence of other pedestrians and, thus, average speed goes down. In the absence of the choice of individual speeds, the standard deviation is also low.

Determination of speed, flow & density relationships

Data collected at different stretches produced densities of varying degrees. Thus, it was decided to combine them together to come up with meaningful relationships between speed, flow, density and space.

Speed–Density relationship

The relationship can be expressed in terms of a linear equation (Figure 2) considering the entire range of data. Using least square analysis the following equation was arrived at:

$$u = 87.59 - 20.86k \quad (r^2 = 0.82) \tag{3}$$

where

u = average pedestrian speed (metres/minute)

k = pedestrian density (pedestrians/square metre)

The free walking speed is obtained as 87.59 metres per minute. The jam density i.e. the density at which

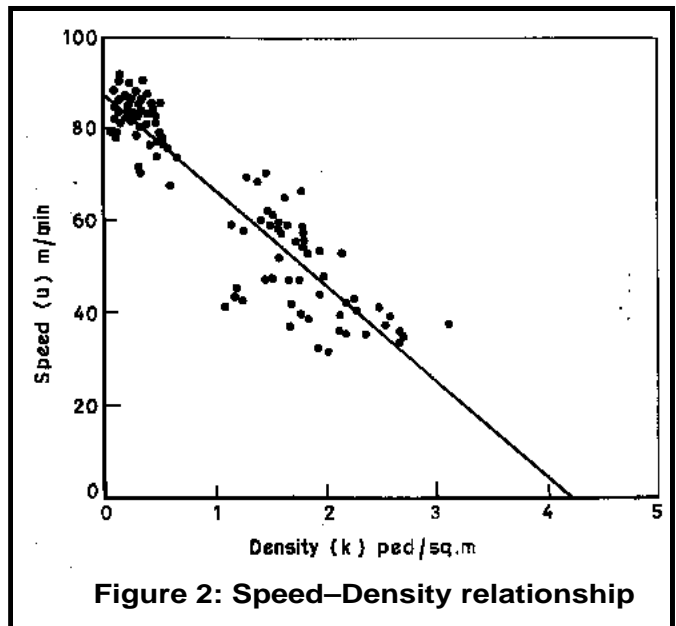


Figure 2: Speed–Density relationship

Table 2: Results of Speed & Density Study

Location	Howrah Station Subway	Howrah Ferry Ghat Bridge 1	Howrah Ferry Ghat Bridge 2
Mean Walking Speed (m/min)	87.51	50.55	74.46
Minimum Walking Speed (m/min)	60	26.05	34.33
Maximum Walking Speed (m/min)	138	104.65	112.78
Standard Deviation of Speed	37.8	15.24	14.73
Sample Size	1372	483	279
Range of Densities	0.06 to 0.51	1.08 to 3.10	0.30 to 0.65

the average speed becomes zero is obtained as 4.2 persons per square metre from the above equation.

Density–Flow relationship

A parabolic relationship between flow and density was found suitable (Figure 3) and the equation obtained as:

$$q = 87.59k - 20.86k^2 \tag{4}$$

where

q = pedestrian flow (pedestrians/metre/minute)

k = pedestrian density (pedestrians/square metre)

From the figure it can be observed that flow increases as density increases up to a certain point. Beyond that the flow decreases even with increase in density. This is because the density is so high that it becomes almost impossible for the pedestrians to move. The maximum flow of 92 pedestrians per metre per minute is obtained when the density is 2.1 pedestrians per square metre. The corresponding average speed is 44.5 metres per minute as observed from Figure 2.

Speed–Flow relationship

The relationship between speed and flow can be suitably represented by a parabolic relationship (Figure 4) and the equation obtained was:

$$q = 4.198u - 0.0479u^2 \tag{5}$$

where

q = pedestrian flow (pedestrians/metre/minute)

u = average pedestrian speed (metres/minute)

As flow increases the physical contacts among pedestrians become more and speed decreases. This trend continues until the maximum flow is obtained. Beyond that point the density becomes so high that the movements of the pedestrians become highly restricted and both flow and speed begin to decrease.

Flow–Space relationship

This relationship best defines the level of service offered by the facility. Space for each pedestrian indicates the comfort experienced by the pedestrian. In the present study a non-linear relationship has been obtained as shown in Figure 5 and the equation is given as:

$$q = 87.59/m - 20.86/m^2 \tag{6}$$

where

q = pedestrian flow (pedestrians/minute/metre)

m = average space per pedestrian (square metres/pedestrian)

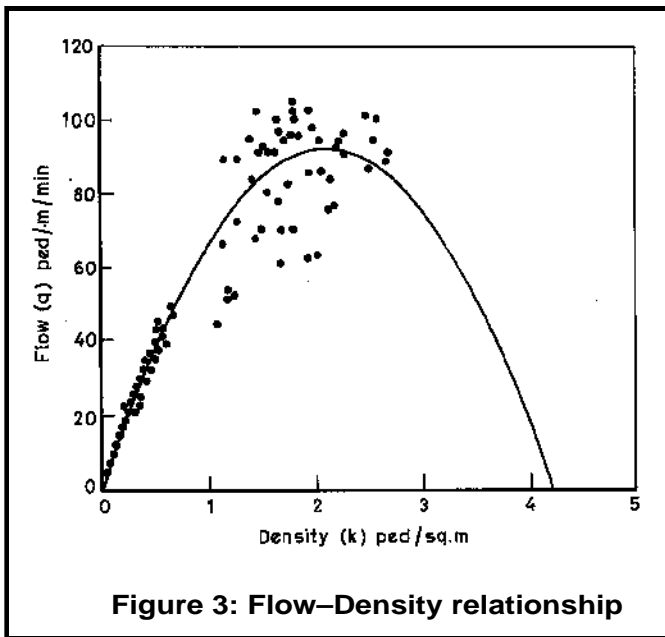


Figure 3: Flow–Density relationship

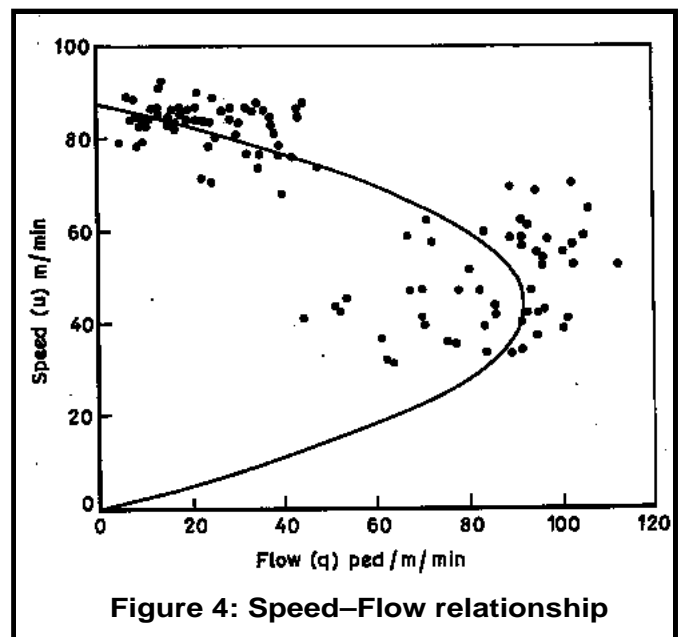


Figure 4: Speed–Flow relationship

Table 3: A comparison of pedestrian speeds

Author	Pedestrian speed (metres/ minute)	Maximum flow (pedestrians/ metre/ minute)	Space required at maximum flow (square metres/ pedestrian)
Sarkar & Janardhan	87.59	92	0.48
Tanaboriboom et al. (1986)	73.9	89	
Older (1964)	78.6	78	
Furin (1971)	81.4	81	
Hoel (1968)			0.5

From the figure it can be seen that a minimum space (0.24 m² per pedestrian) is required before a person can move and flow can occur. After that the flow increases sharply with a slight increase in space to a peak. Beyond that point, the flow decreases with increase of space. Corresponding to the maximum flow of 92 pedestrians per metre per minute, the space requirement is obtained as 0.48 m² per pedestrian.

Speed–Space relationship

This is similar to the speed–density relationship, but it is a better measure because space indicates the convenience experienced by the pedestrian. The relationship between speed and space can be expressed as:

$$u = 87.59 - 20.86/m^2 \quad (7)$$

where

u = average pedestrian speed (metres/minute)

m = average space per pedestrian (square metres/pedestrian)

The relationship is shown graphically in Figure 6. It is observed that a minimum space of 0.24 m² per pedestrian is necessary before a pedestrian can move. Once that space is available the speed increases almost linearly up to a space of 1 m² per pedestrian. In this range pedestrians walk in a stream and there is no scope for individual choice of speed. With further increase in space up to 3.5 m² per pedestrian, the speed increases gradually. In this range there is some scope to change speed according to individual choice as some space is available to manoeuvre. Beyond this enough space is available for the pedestrian to choose their own speed and further increase of space does not affect the speed.

Comparison of present study with earlier studies

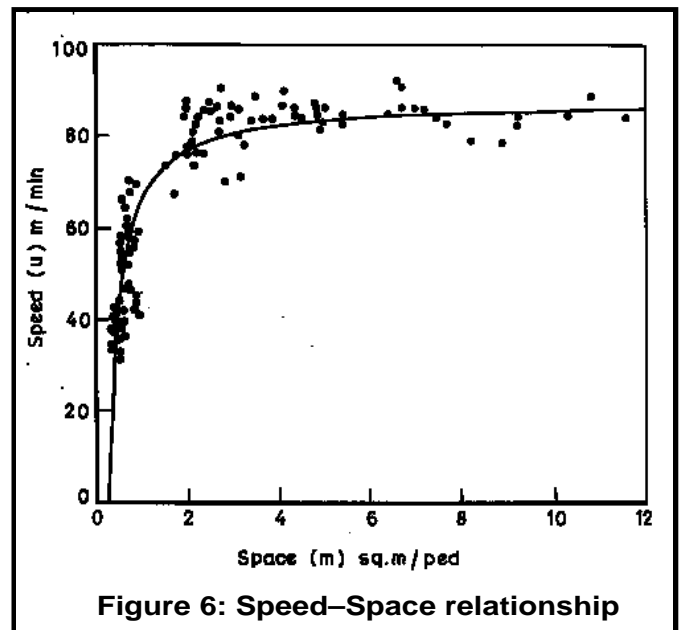
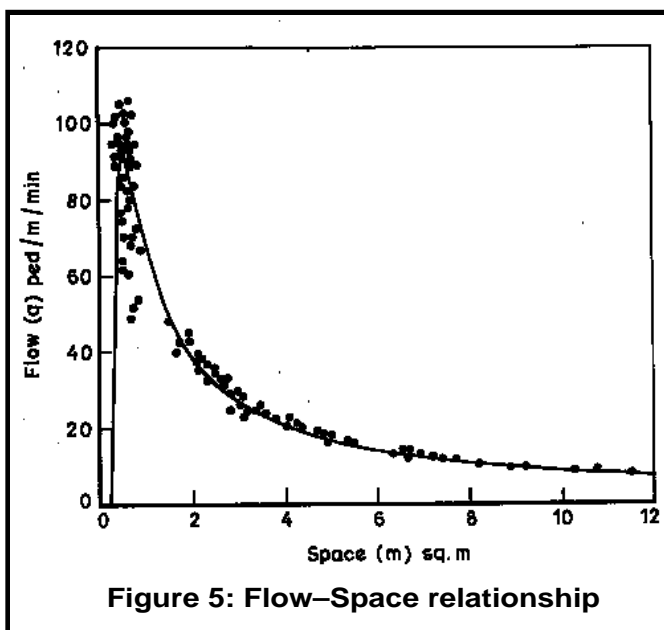
The free speed as obtained in this study

(87.59 metres per minute) is higher than earlier studies by Tanaboriboom *et al.* (1986); Older (1964); and Furin (1971). The maximum flow for the present study is 92 pedestrians per metre per minute which is higher than in the earlier studies (see Table 3). The reason for higher values may be contributed to the fact that the study was conducted at an inter-modal transfer terminal during morning peak hours. The passengers were mainly daily commuters and were in a hurry to reach their respective destinations on time. After alighting from the train they went to catch a ferry which had scheduled departure times. Thus, very often they had to walk at a very high speed and some times a few of them were seen to run. This resulted in high speed and flow values in this study. The space required for pedestrians at maximum flow is 0.48 m² which is almost equal to the value, 0.5 m², obtained by Hoel (1968). The rate of decrease of speed with density for the present study is 20.86, which is very close to the values obtained by Older 1964 (20.2) and Furin 1971 (20.4).

Policy Decisions on Pedestrian Planning

The study conducted on pedestrian movement in Calcutta helps us not only to understand the speed–density, flow–density, speed–flow, flow–space and speed–space relationships, but also to determine the levels of service provided to pedestrians. This in turn helps us to take measures to make the movement of pedestrians smooth, pleasant and safe.

The Calcutta Metropolitan District spreads over 1350 km² and has a population of more than 12 million people. It is the most important business and commercial centre in eastern India. Thus a large number of people from the Calcutta Metropolitan District and beyond travel to central Calcutta on a daily basis. The major offices, businesses, commercial establishments



and educational institutions are located in this area. Buses and local trains are the main modes used by commuters to reach the city centre. Trams have limited routes and do not extend much beyond the 104 km² Calcutta Municipality. Furthermore, the tram system is disliked by some commuters because of its relatively slow speed. The metro rail system, 16.4 km long, provides a fast and reliable service and is preferred by a large number of commuters. However, keeping in view the total area of the Calcutta Metropolitan District, its service length is highly limited.

The local railway network helps commuters to come to the city centre from far off places. There are 87 suburban railway stations within the Calcutta Metropolitan District. A large number of suburban commuter traffic is oriented towards central Calcutta and practically all this traffic is funnelled through the terminal stations either at Howrah and Sealdah. While Howrah is across the river Hoogly from Calcutta, Sealdah is within the Municipality. Two kinds of pedestrian traffic are generally observed in these two stations: persons walking within and around the railway terminal area towards bus, minibus and ferry (water transport) terminals; and pedestrians going to their destinations by walking through the city streets and footpaths. The second group is more predominant in Sealdah. Howrah is quite a distance from Calcutta and commuters alighting from trains rush to take bus, minibus, tram or ferry to reach journey's end. Only those with destinations close to the railway station walk. Thus the main pedestrian traffic is within and around the station area. There are a few subways for the convenience of the pedestrians connecting the railway terminal area with the transit and ferry terminals. The scenario is different in Sealdah. The terminal area is small in comparison to Howrah and bus, minibus and tram stops are located just outside it. In spite of this, a large number of passengers prefer to walk to reach their destinations.

It is to be noted that the pedestrians in a developing country are not just tourists or shoppers, but mostly pedestrians out of compulsion, since they have no choice but to travel by mass transport and on foot. A large number of the commuters travel a few hours in heavily crowded trains to reach Howrah and Sealdah stations. These trains sometimes do not reach the destinations on time. The physical and mental tensions tend to make the commuters impatient and in their eagerness to reach their destinations on time, walk very fast and do not follow the designated paths. This results in pedestrians almost running in all possible directions within the terminal area. While walking on roads, sometimes they take erratic crossings causing direct conflict with vehicles, thus exposing themselves to potential mishap. This problem is aggravated by

the absence of properly designed wide footpaths or encroachment of footpaths by street vendors.

The socio-economic problems in a developing country lead to ribbon development for want of adequate space in a metropolis which has limited infrastructural facilities and job opportunities. The ribbon development may include the stall vendors and hawkers who like to sell their consumer goods at a place where pedestrian traffic is at its maximum. Again, most of the essential services such as telephones, electricity supply, the drainage systems and water supply are laid underground, mostly along or under footpaths. Repairs to any of these services leads to further encroachment due to excavation, dumping of materials and garbage. The forced co-existence of pedestrians with hawkers and with street furniture like letter boxes, bus stops, milk booths, electricity and telephone poles, trees and tree-guards, etc. compel pedestrians to walk in a zig-zag manner most of the time. Sometimes they are even forced to use the carriageway exposing themselves to risk of collision.

Keeping in view the large pedestrian traffic in Calcutta, there is a need to consider pedestrians as the most important traffic unit and start planning to provide them with better facilities and surroundings for walking. While planning transportation systems in the city area and formulating various transport schemes, the priorities must be pedestrians, buses, taxis and private cars... in that order. A noticeable change in the minds of the decision makers have been observed regarding this in recent times. A few footpaths in Calcutta have been cleared of hawkers in spite of tremendous opposition. Keeping in view the socio-economic necessities, the hawkers have been provided with alternative locations to sell their goods. A number of pedestrian underpasses have been constructed near the metro stations to assist commuters in crossing the highly trafficked roads. There is also a proposal by the Government of West Bengal to construct a 2.2 km travelator from the Sealdah station area to BBD Bag to meet the need of pedestrian traffic. It has been estimated recently that some 250,000 pedestrian journeys occur during the morning peak hours from Sealdah to the BBD Bag area in central Calcutta from this station. Construction work, in collaboration with the private sector, is scheduled to start in October 2001.

Even though some steps have already been initiated to plan for pedestrian movements within the city, little attention has been given to smooth pedestrian movement within and around Howrah railway station. A large area within the terminal area gradually has been redeveloped to provide more waiting areas for long distance passengers. This has hindered pedestrian movement. Moreover, the bridge connecting the bank of the river with the ferry jetty is

only 1.2 m wide. During peak hours, it is very difficult to walk as passengers rushing to board are confronted by alighting passengers creating a pedestrian traffic jam.

It must be acknowledged that there has been a change in the thinking of the decision makers in recent times and pedestrians are gradually getting due recognition in the transportation planning and management processes. However, only a beginning has been made and there is tremendous scope to improve pedestrian movement in Calcutta. Any future plan for pedestrians must include the following points:

- **Safety**

Pedestrians should be completely segregated from vehicular traffic, especially in the busy areas around shopping and commercial centres and important railway terminals. This can be achieved by grade separation where the track used by pedestrians should be exclusive to them.

- **Convenience**

The track used by pedestrians should be comfortable and effortless to use. The route should not involve steep grades and stairways, and should be sufficiently wide for smooth and easy two-way flow without jostling or shuffling. In some cases it may be necessary to separate two-way traffic. It should be free of encroachments and other hazards to walking. Wherever possible, subways or footbridges with escalators should be provided if pedestrian traffic is very heavy.

Planning of pedestrian movements within terminal areas is still neglected; this needs careful attention.

- **Pleasant environment**

Pedestrian plazas which are clean, well-surfaced and landscaped should be specially designed. Certain streets or lanes should be either fully reserved for pedestrians for the whole day or during the hours of maximum pedestrian traffic.

Conclusion

The study carried out in the Calcutta Metropolitan District at Howrah Railway Station shows similar pedestrian flow characteristics as obtained in previous

studies. However, higher free speed and maximum flow values were observed. The reason for higher values can be attributed to the fact that the study was conducted at an inter-modal transfer point during morning peak hours. In such cases pedestrians are usually in a hurry to catch a mode with a schedule departure time, after alighting from another mode.

The study also concludes that a change in the thinking of the decision makers in Calcutta regarding pedestrian movement has taken place in recent times and, accordingly, some steps have been taken in the right direction. However, there is a need to provide special attention to pedestrian movement within and around major rail terminals.

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A very public solution: transport in the dispersed city

by Paul Mees,

Melbourne University Press, PO Box 278, Carlton South, Victoria 3053, Australia, (April 2000)

Available from The Eurospan Group, 3 Henrietta St, Covent Garden, London. WC2E 8LU

ISBN 0 522 84867 2 A\$ 29.95

This is the best book on public transport to be published in English in the last 25 years. There is obviously something very special about the Australian experience of running public transport in Sydney and Melbourne that has triggered such a stimulating, incisive, scientifically-rigorous and policy rich book.

Mees ranges widely over the condition of developed cities. He knows the situation in Australian, Canadian, US and European cities intimately and he brings the incisiveness of an outsider to bear on the poor quality analysis we have seen in the past. The book is not just about buses, trains and trams. It is about the way that land use patterns influence transport demand and the way that the quality of public transport in a planned system fundamentally determines the amount of use of that system. Mees is scathing and unassailable in his analysis of privatised, liberalised, free market public transport systems. They just don't work and they fail fundamentally to deliver the kind of integrated, well-planned, quality services that attract passengers. This is why Toronto is so successful as a public transport best practice example and why land use patterns (dispersal), whilst important, are less important than quality. In a memorable phrase Mees coins the expression 'New York run by the Swiss? The Toronto model'.

The Toronto model has its antecedents in Zurich. Here the 'clock-face pulse timetabling' ensures that passengers have a high degree of certainty about interchange between modes and a high enough service frequency to make the psychological leap into public transport. The Melbourne approach based on infrequent services and poor quality interchange is exactly the kind of policy that deters use of public transport.

Mees shows beyond reasonable doubt that planning has succeeded in Toronto and the market has failed in Melbourne. It is possible to provide excellent public transport in car-dependent societies and cope with dispersal and edge-city developments.

The Toronto-Melbourne comparison is very important for understanding global issues. In the past few years most urban and transport planners have fallen into a particular kind of explanation. This explanation is dominated by land use/density arguments. A high density city with strict land use controls will produce the sustainable/livable city that we all desire. This leads to the next argument which is that public transport can only work in a high density

city. Mees shows that this is incorrect. Density and land use is still important if we wish to avoid the Los Angeles vision of the future, but high quality public transport based on total integration and highly effective planning is the answer.

This revelation could not be more relevant to the UK which, in spite of a great deal of promise from the Labour government, has abandoned the public transport plot completely. Rail and bus in the UK (outside London) are privatised and deregulated. There is no co-ordination or integration and as a result the public transport experience is very poor indeed. The UK public transport system has more in common with the chaotic free-for-all in Bangkok than with Toronto or Zurich. The 'race to the bottom' in transport planning reached a new low in April 2001 when the UK transport minister (Lord MacDonald) announced that there was nothing the government could do to sort out the poor rail services and he would encourage travellers to travel by car or air instead. Is this what integration, social exclusion and greenhouse gas reduction policies really mean? Clearly we need Paul Mees in the UK.

Chapter 8 is the jewel in the crown of this exceptional book. 'Waiting for a bus called Godot: public transport service quality' sets out an analysis of what is wrong with many public transport systems (e.g. Melbourne) and shows what needs to be done to put it right. It is remarkable that so few texts by transport professionals have strayed into this important area before but Mees does it with rigour and style. All that remains to be done is to persuade market-based systems to adopt real quality rather than corporate profitability as the central goal of the operation.

I do have one significant difference of opinion with Mees. Very early in the book he dismisses walking and cycling. He acknowledges their importance but claims that distances are against them achieving a great deal. This is the downside of an Australian perspective but even within an Australian perspective there is an urgent need to sort out the quality of the walking trip to the bus/train/tram stop. This is very poor in Melbourne and Sydney and whoever designs streets (are they designed?) doesn't know much about a quality pedestrian environment. The same point can be made for cycling. I don't expect Australians or Canadians to cycle 30 miles to work but I do expect children to cycle to their local schools (under 5 miles) and I do expect others to cycle to a bus/tram/train stop and put their bikes on the public transport vehicle. Mees misses this extra dimension of real life for the user of public transport and this is a shame.

*Professor John Whitelegg
Liverpool John Moores University*

Contributions to *World Transport Policy & Practice* are welcome. Whether you are a novice author or an experienced one, the Editor would like to invite you to consider sharing your thoughts and experiences with others like yourself. We can promise a considered and constructive review of your article and, for contributions deemed suitable, publication in *World Transport Policy & Practice*.

Read through the following guidelines and feel free to contact John Whitelegg, the Editor, who will be pleased to offer comments on drafts, work in progress, or ideas which could be made into an article.

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The journal aims to provide validated information about the latest developments in transport policy to enable local authorities, governments, consultancies, NGOs and supra-national organisations to speed up their policy development and implement new ideas from around the world. It will:

- cover all passenger and freight transport
- 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.

Article composition

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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1. By e-mail

Articles for publication may be submitted by e-mail attachment to Pascal Desmond. It is useful if authors indicate what software is required to read any attachments and if they include the letter combination 'zq' in the title. Please DO NOT name articles 'whitelegg', 'wtp' or variations of these. Authors are advised that they may need to provide a version on paper and/or on 3.5" disk prepared on an Apple Macintosh or PC system.

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Headings and subheadings should be used at approximately 500–750 word intervals. Ensure that headings and subheadings are clearly identified.

Charts, diagrams and figures

These should be called 'Figures' and numbered consecutively (e.g. Figure 1, Figure 2, etc.). Make sure they are clear and can be reproduced easily. In addition, provide the raw data so that we can redraw them, if necessary.

Indicate where in the text they should appear ('Figure 1 about here'). Each figure should have a brief title (e.g. 'Figure 1. Schematic of the Programme').

Tables

Tables should be numbered consecutively, independently of figures. Indicate in the text where they should appear. Give them a brief title. Ensure that they are clear and legible.

Authors should not use many tabs or spaces between columns of data – normally, one tab is sufficient.

Maps

Maps are especially welcome as 'tiff', 'pict' or 'jpeg'. They should be numbered consecutively, independently of figures and tables and their location in the text should be indicated.

Ensure that they are clear, uncluttered and legible. They should have a title.

Measurements

SI units should be used throughout.

Abstracts & Keywords

Write an abstract of 75 words or so which summarises the main points of the article. It should be sufficient for a reader to decide whether or not they want to read the whole article. Also note up to six keywords which describe the content of the article. These could include geographical area, if specific, industry, functions, managerial activity and process.

References

Authors should keep references to a minimum, ideally no more than ten to fifteen. References should be confined to essential items only and those that are necessary to establish key steps in an argument or key areas of support for a particular proposition.

Reference citations within the text should be by the author's last name, followed by a comma and year of publication enclosed in parentheses. A reference list should follow the article, with references listed in alphabetical order in the following form:

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