Treatment of Walking as a Mode of Transportation

MARCUS WIGAN

Walking is viewed from many different perspectives, but it lacks informed advocacy groups and a unified policy treatment. Walking is treated here as a full transportation mode that both genders use. Significant gender differences are disguised by combining cycling and walking into a single nonmotorized transportation mode. New data derived from Australian travel surveys are presented, and the relative importance of walking to other transport modes is illustrated in terms of the fractions of trips and of travel time.

Walking is the most widespread mode of movement, but it is not always treated as a full mode of transportation. "Pedestrian" is the term used for the mode of transport. Pedestrians are rarely treated on the same level as vehicle-based modes. ["Nonmotorized transportation" (NMT) is now used to lump walking and cycling together, although they have very different usage and network profiles.] Major factors that influence the treatment of travel modes are strong advocacy groups, information about the mode, its performance and impacts, and the people and groups affected.

Many groups represent the handicapped and mobility constrained; few represent pedestrians as a whole. Information about walking and pedestrians therefore is largely limited to areas in which government bodies have been required to take an interest or commercial investments rely on passing pedestrians. Only injury data are collected and made available on a regular basis. As a result, most pedestrian policies focus on reducing reported injuries rather than integrating walking into the treatment of mobility.

Walking is an essential component of almost all trips and determines physical access to facilities of all kinds. Public transportation such as trains and buses requires walking both for access and for movement within the vehicles themselves. Private transportation also includes a walking component—from house to vehicle and parking place to destination.

What does a pedestrian trip comprise? To whom is walking most important? How does pedestrian activity compare with other modes of transport? How does one evaluate travel and access by foot in specific locations and for the walking stages of complex journeys? Walking provides the initial access (and egress) to trips by other transport modes. People both walk and cycle as ends in themselves for exercise and sightseeing, and the ability to use off-road rights of way as alternatives to the normal transportation network is shared.

A trip is a movement between locations; 400 m is a sensible distance to quality as a transport journey—but only if the access and egress stages of vehicular journeys are assumed to have no impact on the vehicular travel. (In fact, the 1991 Greater Sydney House- hold Interview Survey used a definition that required walking trips to be recorded by the surveyed person only if they exceeded 100 m, or 110 yd, in public areas.) People make real efforts to park less than 400 m (440 yd) from their destination, yet the disutility of that final 100 to 399 m (100 to 440 yd) is frequently ignored as a "trip" for transport measurement purposes.

Distance is not always a good measure for transport comparisons. A typical walking speed is 4 to 5 km/hr (2.5 to 3 mph), so 400 m (440 yd) translates to a 5-min trip, which would be 1 to 3 km (0.6 to 2 mi) by car in an uncongested area.

Pedestrian is used to describe someone who is walking, usually in public places, and particularly on or adjacent to public rights of way for vehicles.

A person observed "during the walking stages of a trip" appears to be somehow different from a "pedestrian." Dealing with walking as a transportation mode is made more difficult by confusion between the concepts:

- Mode = person (in walking), and
- Round trip = use of multiple modes by the same person.

Cambridge Systematics, 68 Castle Street, Eaglemont, Victoria 3084, Australia.

Definitions

Walking is applied to travel by foot for exercise or enjoyment or for reaching a specific location for some purpose. Power walkers on the footpath, trail hikers, and pedestrians moving inside and outside transport interchanges are all walking. People both walk and cycle as ends in themselves for exercise and sightseeing, and the ability to use off-road rights of way as alternatives to the normal transportation network is shared.
CONTEXT

Walking and pedestrians are considered important by a wide range of groups in different contexts, so walking provisions are considered piecemeal and not as part of a transport and trip end access system. These provisions include:

- Very high costs and vulnerability in road accidents;
- Pedestrian phases and road crossings for traffic lights;
- Access by the aged, disabled, and children;
- People flows on footpaths and in malls and transport interchanges;
- Predictions of passing trade by foot for retail siting and valuation;
- Health, recreation, and exercise;
- Valuation of waiting and walking times;
- Segregated NMT movement networks;
- Parking location, pricing, and choice; and
- Provision of activity in public areas as a security measure.

Planners and environmental designers are concerned with the social and commercial success of space dedicated for pedestrians, and the factors that make it attractive often are measured by shop rentals and the levels of pedestrian activity over time.

Traffic policies emphasize segregating pedestrians from traffic as a measure to reduce injuries and value the benefits in these terms. Traffic design requires pedestrian crossings to be provided and used. Designers need to know how far people will divert to use a crossing or a bridge, what speed they normally walk, how long they will wait for a pedestrian light phase without jaywalking, and how quickly they will cross. Transportation planning often recognizes walking and waiting time as an element in mode choice but rarely looks closely at the walking trips themselves, except when they influence the "major" mode choice decision.

To what extent can walking substitute for motorized transportation? What are the effects on different groups of altering the relative attractiveness of motorized and nonmotorized modes? These questions require a "transport" view of walking.

The assumption that travel is undertaken simply to reach a destination is far less convincing for NMT than for motorized modes. Tourist and sightseeing travel occurs on motorized modes, but exercise, health, and recreation play an important part when bicycles and walking are involved. Environmental contributions, exercise, and health are all factors in NMT travel.

Austalian transportation surveys (1) show that both walking and bicycle participation rates tend to decrease with age for adults. However, if recreational and health participation are examined, U.S. evidence (2) shows that walking rises in importance relative to cycling as age increases (Figure 1).

The transportation aspects of walking and pedestrian movements can be examined using transportation survey data, and relevant results of such analyses are given in the following sections. Australian data for Canberra in 1975 and Launceston in 1976 (1) contained only 12 to 14 percent of nonmotorized trips undertaken solely for exercise or recreational purposes.

TABLE 1  Mean Speeds, Australia 1986

<table>
<thead>
<tr>
<th>Mode</th>
<th>Mean Speed km/h</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrians</td>
<td>5</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Bicycles</td>
<td>11</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Ferry</td>
<td>10</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Tram</td>
<td>13</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Bus</td>
<td>24</td>
<td></td>
<td>21</td>
</tr>
<tr>
<td>Taxi</td>
<td>28</td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>Train</td>
<td>30</td>
<td></td>
<td>29</td>
</tr>
<tr>
<td>Motorcycles</td>
<td>35</td>
<td></td>
<td>27</td>
</tr>
<tr>
<td>Car Driver</td>
<td>35</td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>Car Passengers</td>
<td>39</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>Truck</td>
<td>37</td>
<td></td>
<td>42</td>
</tr>
<tr>
<td>Overall</td>
<td>32</td>
<td></td>
<td>28</td>
</tr>
</tbody>
</table>
in the survey instrument, and the overall values of mean speed provide a broad indication of the relative use of time and distance covered by the two major NMT modes.

These figures are in surprisingly good agreement with detailed studies of pedestrian flows on footpaths: 4.7 km/hr (2.9 mph) is a commonly observed median value for movement in uncongested areas (4-8).

Figure 2 shows the effect of age. The elderly walk slowly, but mean walking speeds are surprisingly stable by age. Women walk slower than men at all ages.

People living in larger cities tend to walk faster than those living in small cities (9). This study also confirmed that age, gender, and weather conditions affected walking speeds in Australia and the United Kingdom.

SAFETY, SECURITY, AND CHOICE

Analysis distinguishing between walking trips and the waiting time for other transport modes is often done, and results show different values of time for these two activities of pedestrians. However, motor vehicle-pedestrian crashes are both severe and costly. Records of such incidents are perhaps the most reliable and widely available information on pedestrian activity made regularly available. In a transport sense, the determinants of walking as a travel mode include personal security and perceptions of risk rather than the vulnerability to traffic. The time and effort required to walk also is a significant part of any personal travel time budget. A sense of personal security is a major factor in streetscape design and activity levels in pedestrian areas, especially for children, women, and the elderly. Walking at night is a specific concern of the elderly, one that has been shown to be much greater in the United States among urban than rural dwellers (10).

Pedestrian activity in mall areas is undertaken for a number of reasons, including shopping, exercise, and social purposes. However, the feeling of personal security is an important element in this process (11). A rising number of studies of the sociology of pedestrians and pedestrian behavior are pertinent to predicting pedestrian behavior, location choice, and the characteristics of successful design of pedestrian areas (12).

Pedestrians' perceptions of safety have a strong gender element. Women have valid concerns about walking unaccompanied in urban centers and parks (13) (an active walking issue) and about being unaccompanied in transportation terminals in the evening and at night (in addition to pedestrian/waiting time issues). Personal security is an issue in the use of public transport—more in terms of rail than bus travel, but significant in both cases.

Walking as a social, recreational, or health occupation is not universally popular: many of those who walk most like it least, generally as a function of constrained resources and a means of mobility for the elderly (14,15).

Such customer perspectives of personal safety and security as mobility constraints are common to several countries, and they contrast with the road safety, crash-oriented view of pedestrian-vehicle conflicts and accidents as the issue requiring most attention. Both safety issues need attention, but the injury area refers mainly to costs and actions familiar to traffic engineering, whereas personal concerns relate to travel demand estimation and time, mode, route, and location choice decisions by individuals in various categories and to a different group of policy makers.

Several studies of walking and cycling on road footpaths have yielded travel exposure values for walking on footpaths and cycling for children (13). This type of study does not affect the significance or level of walking in overall transportation terms, and it collects no information on the travel choices available.

WALKING IN AUSTRALIA

Treating walking as just another mode of transportation requires some care. The discussion of walking speeds suggests that travel time rather than distance or trip frequency should be considered. The 1986 ORS study (3) contains information only on people 9 years old and older. This has a greater effect on walking than on any other mode, as walking is of great importance to young people. Only walking trips of at least 400 m (440 yd) are reported.

Figure 3 shows the trip rates per day (the full weekday plus weekend period) by gender and status. Women report more walking than men in every category but part-time work and unemployed. Students display the highest levels of walking, and retired people the lowest.

The trip rates are standard population trip rates (SPTR). SPTR is defined as the number of trips by a group divided by the number in that group. Consequently, SPTR does not show the levels of walking activity undertaken by people who actually do walk, and the values are diluted by the numbers of people who do not. This distinction between participation (i.e., at least one walk trip) and activity rate (i.e., the number of trips per day made by those reporting at least one trip) has been shown to be important in person travel analysis (7). Expressing walking time as a percentage of total daily travel time goes some way to correct this effect and give a clearer view of the importance of walking to people of each gender and in each age group.

Figure 4 shows that women spend much more time walking than men at all ages. Walking time is 10 to 20 percent of all travel for women of all ages, with a mean value of about 15 percent. Men do less walking, at about 10 percent. The omission of people below 9 years old and the open-ended definition of a walking trip ensure that these are conservative values.

Figure 5 shows the numbers of walking trips in Australia during 1985-1986 as a function of age and gender for people 9 years old and over. Women still walk more than men, but walking is a substantial fraction of all trips made across the whole range of age and for both genders.

The combination of walking and cycling (Figure 6) shows a closer match between the genders, as cycling is more popular with
men. This might appear to favor treating NMT as a mode, but the strong gender differences are disguised by such aggregation.

Walking appears to be more important in Sydney (the largest and densest metropolitan area) than in Australia as a whole. Figure 7 shows the differences between weekday and weekend travel as a percentage of all trips reported. It is difficult to ignore the high percentage of walking trips in both periods. Even if the lowest values are used, walking accounts for 20 percent of all reported trips. The percentages of travel time in Sydney spent walking in 1981 are shown in Figure 8 and may be compared with the 1986 nationwide figures in Figure 4. The importance of walking time in Sydney on weekdays is greater than for the nationwide figures, which are more comparable to the weekend Sydney ratios.

SHOPPING

One area where walking is crucial is in shopping trips, which are increasingly made within major enclosed centers and pedestrian-only malls.

The length of walking trips made in the course of shopping trips is affected strongly by any omission of pedestrian travel within such enclosed areas—and such movements are not sought in transport surveys, only in activity surveys. Most transportation and traffic analyses concentrate on peak-hour, work-related travel, and it is necessary to shift this emphasis in order to understand pedestrian travel better.

The 1986 ORS study (3) showed shopping second only to work commuting in importance in terms of the numbers of trips made. Shopping was 57 percent of the number of trips to work for men and 157 percent for women. The work force participation rates for women were considerably lower than those for men, but the relative importance of the contribution of shopping trips to overall travel by gender was certainly considerably higher for women than men in 1986.

The pedestrian component of shopping trips is important for several reasons:

- Impacts on accessibility,
- Demands for car parking,
- Constraints on luggage carrying,
- Concentrations of pedestrian flows, and
- Vehicle-pedestrian conflicts.

The individual stages within a shopping trip often are lumped into a single trip and may contain personal business and service calls. The movements between retail outlets, personal business, and services within an area are usually by foot within a shopping area of reasonable scale. Models of such trips are rare (16).
Such complex trips are often non-home-based and underreported. They play a significant and increasing role in personal travel, and shopping and personal business travel have risen at several times the rate of travel-to-work trips in recent years in both France and the United States. As these travel purposes continue to grow in importance, the detailed structure of the shopping and personal business trips becomes more significant.

The high density of daytime pedestrian trips in city commercial centers offers an opportunity for estimating the concentrations of pedestrian journeys as a function of commercial and retail shopping space in the area, which was done in Milwaukee in the early 1970s (17). The resulting pedestrian flow equations for both non-daytime and overall daytime average pedestrian flows showed the highest weighting to retail commercial floor area, followed by office space, including banks and other personal business destinations.

Those who walked to the city centers of Calgary (a large city with only 2 percent walking to work) and the small city center ofHalifax (where about 10 percent walk to work) (18) then went on to walk a considerably greater distance (600 m, or 650 yd) within the center than did those arriving by other modes [225 m (250 yd) by bus and 325 m (360 yd) by car]. The influence of walking as a mode of choice is clearly significant.

**REFORMULATING MODELS OF PEDESTRIAN MOVEMENT**

The treatment of pedestrian travel as a variant of vehicle flow modeling is well established, and levels of service for sidewalks and pedestrian routes form a useful section of the standard transportation engineering handbooks (19). This aspect of pedestrian travel is the equivalent of highway capacity analysis and traffic management. The concentration on the interference between pedestrian movements and vehicle movements over shared space.
such as roads is treated again as a traffic management and safety problem.

Analysis of walking movements as pedestrian travel by a full travel mode requires a greater concentration on route and destination choice and on assessing the quality of pedestrian routes and the influence of factors such as environmental quality, visual design, and shopfront activity attractiveness to predict who will go where and how they will travel to and around the areas concerned.

This approach would bring the economic importance of access by foot into the transport analysis mode and destination choice approach and give a greater weight to the nonwork trips (shopping, in particular) that now comfortably exceed work trips in number.

Collection and analysis of large-scale pedestrian movements and route choice are beginning to occur. Such data should be extended to treat pedestrian stop frequency and destination choices using the stated and revealed preference analysis that is now proving so effective for other modes of transportation (20).

CONCLUSIONS

Pedestrian behavior, demand, and policy are integrated poorly. Social space design and pedestrian movements as a special form of traffic flow do not need to consider overall needs and determinants of personal travel. Traffic conflict issues are addressed consistently, but the impacts of pedestrian movements and constraints on specific groups are less well monitored or understood, and the effective tools of travel choice analysis are still applied only rarely.

Walking is a major transport mode, of crucial importance to several large groups in the community and a contributor to reducing motor vehicle emissions. It is not clear who is responsible for planning and providing services to these groups, and by default it is the road safety area that has paid most attention and produces most of the public information. The contribution of nonmotorized travel to fitness and the maintenance of mobility for the elderly should be added to mobility and accessibility to achieve balanced evaluations (21).

The numbers and proportions of trips to, from, and within retail and personal services areas are increasing around the world. Design within the retail and terminal areas is now likely to influence both mode and frequency of travel and activity in these growing areas of personal travel.

Walking and pedestrians need better understanding and information and more consistent policies if mobility and accessibility are to be maintained for the community as a whole. It is clear that a considerable amount of movement takes place that is not counted in the assessments of travel, and thorough understanding of these nonmotorized movements will permit more balanced allocations of resources and improvements to overall access and mobility. Such efforts have already occurred to some extent for the mobility handicapped, but the rest of the population makes up a much larger group whose interests should not be ignored.
ACKNOWLEDGMENTS

The work was part of a Joint ITS-RTA Study of Non-Motorized Transport funded by the Roads and Traffic Authority of New South Wales. The Federal Office of Road Safety provided access to the 1986 Survey of Day-to-Day Travel.

REFERENCES