

Distances people walk for transport

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Abstract

We present detailed information on the distances people walk for transport purposes in Brisbane, Australia. The data is derived from the *South East Queensland Travel Survey 2003-04 – Brisbane Statistical Division*, a household travel survey providing information on the weekday travel of 10 931 respondents, weighted and expanded for a city population of 1 615 579 persons. The vast majority of non-motorised travel recorded was walking for transport, whether this comprised trips using the walking mode only, or whether it was walking made to and from public transport. We report the full distributions of the distances walked for transport from homes to other places, as well as the walk travel made between places other than homes. Single-mode walk trips are longer than the walk trip stages made to and from public transport, both in terms of distance and time. However, there are more than twice as many walk trip stages made to and from public transport. The median and 85th percentile distances people walk from home to all other places using the walk mode only are 780 m and 1.45 km respectively; from home to all public transport stops, 600 m and 1.30 km; and from public transport stops to end destinations, 470 m and 1.09 km.

Refereed Paper

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INTRODUCTION

How far do people walk for transport purposes in cities? We present, in this paper, detailed information on walking distances in Brisbane derived from household travel survey data. Given the general lack of attention to this form of urban travel, our interest is in providing quantitative information potentially of use for policy and planning in both transport and health fields.

Walking comprises the bulk of non-motorised travel in many cities (Pucher and Dijkstra 2003; Vivier 2001). Walking can be for transport purposes (so called *active transport*) made to access destinations or to access public transport en route to destinations. It is the distances travelled when walking for transport that is the focus of this paper. Walking may also be for exercise, sport or recreation – when accessing a destination is not the primary purpose of a trip (Litman 2003; Tudor-Locke et al. 2005). Walking is of increasing interest given the decline of physical activity observed in Western populations (Berrigan et al. 2006; Frank 2000).

There are considerable issues in measuring walk travel and in comparing it across cities. Household travel surveys (HTSs), the main method of data collection on travel behaviour, are primarily directed at modes other than walking, and methods used in these surveys differ across jurisdictions. As a result, there are a number of conceptual and definitional problems inherent in any analysis of HTS walking data, and comparisons across survey datasets are difficult. For example, trip distances may be estimated using respondent recall alone or may be derived using the city's street network recorded in geographical information systems (GIS). Varying definitions or survey methodologies used in different surveys can also lead to some forms of walking being excluded or under-reported – recreational walking or walking to and from motor vehicles, for example. The way multi-stage trips are handled also differs. In addition, there is no consistent approach to reporting the amount and characteristics of walking travel (other than perhaps a walking mode share). There is not always recognition that observed walk trip distances relate not just to traveller's preferences, but also to the distribution of available destinations within the city and the density of catchments. Finally, much of the available literature on this topic is from the US which, given the low mode shares for walking in US cities in comparison to European, Asian and Australasian

cities (see Vivier 2001), may have limited relevance to cities elsewhere.

There has been some attention in the literature to the influence of distance (or proximity) on trip generation rates and mode choices for walking (i.e. Krizek and Johnson 2006; Polzin and Maggio 2007) as well as to walk trip distances travelled to particular destinations. For instance, Hsiao et al. (1997:51) used 1990 Orange County Transportation Authority data to show that persons walked on average 0.29 miles (0.47 km) per trip to or from public transport. Plaut (2005:351) used data from the 2001 American Housing Survey to determine how far people walked from homes to workplaces as part of single-mode trips. These US travellers walked on average only 0.20 miles (0.32 km) with a standard deviation of 0.53 miles (0.85 km). For all trip purposes, Land Transport NZ (2004) found more than half of all walking trip stages made in New Zealand were less than 500 m.

In Australia attention has primarily been given to walking distances to and from public transport, in part to assist with public transport stop spacing and land use design. Ker and Ginn (2003:75-76,79) have reported on intercept surveys of commuters at five mostly outer-suburban rail stations in Perth to show that walking distances to rail services were much greater than the 400 m to 800 m 'rules of thumb' used by transport and land use planners. Wallace (2006) found similar results for walking distances to three busway stations in Brisbane. Using HTS data from the period 1997-2005, the NSW Transport and Population Data Centre (2006:3-4) found persons walked, on average, 700 m from homes to train services in Sydney, and those walking from trains to their end destinations walked 600 m.

While aware of the limitations of household travel survey (HTS) data analysis, this paper examines in detail the data on walking in Brisbane. We focus solely on walking and report the full distributions of walking trip distances to the most common destinations. Throughout the text we also refer to the median and 85th percentile trip distances. In this paper there is no disaggregation by demographic characteristics or by sub-regional variation of populations or available destinations.

METHOD

The most recent HTS data for Brisbane was used for this work – the *South East Queensland Travel Survey 2003-04 – Brisbane Statistical Division (SEQTS)*. The survey used a multi-stage, variable-proportion, clustered sampling of households within Census Collection Districts (CCDs) in 11 sub-regions. The SEQTS achieved a response rate of 60% and obtained information on the travel behaviour of 10 931 respondents living in 4057 households.

Diaries were completed by respondents aged 5 and over, with diaries reconstructed from other household diaries for children aged 0-4. The respondents completed single weekday travel diaries during the periods October-December 2003 and February-March 2004. All trips made by respondents were recorded, with each trip divided into trip stages (for example, a public transport trip from home to school may involve three stages: walk stage to the public transport stop, the public transport stage, and the final walk stage from the public transport to the school).

In total 41 110 trip stages were recorded for the survey sample in the 35 960 trips that they reported. The relatively low average of 1.14 trip stages per trip for the city relates to both the low mode share for public transport in the city, compared to European cities, and the definitions and methods used in the SEQTS. In particular, walking trip stages made to a motor vehicle were generally ignored, whilst those made from a motor vehicle were recorded separately and only in terms of their travel time, as is discussed further below. The SEQTS did not use trip-stage enrichment processes such as those developed by Chalasani (2005) that attempt to more fully impute missing walk trip stages.

The exact route travelled by respondents was not captured and trip distances were calculated using geographic information systems that determined the shortest path possible on the available street and path network. Motor vehicles were defined in the survey as either a car, 4WD, van, or truck (Queensland Transport et al. 2005:87-89,133-134).

To account for non-reporting, weightings for both non-response and selection bias (derived from

household characteristics and Australian Bureau of Statistics 2001 census data for the areas surveyed) were included within the SEQTS data set. It was found that people in rented, multi-unit dwellings were under-represented in the sample, as were males and people aged 15-29 or over 75. The weighting processes generally assumed that, for each demographic group, non-respondents to the survey travel in similar ways to respondents. The weightings were applied to the sample results to estimate the active travel parameters for the city population of 1 615 579 persons (Queensland Transport et al. 2005:73-82). It is population data that is reported in this paper.

RESULTS

Mode Share

Mode share is most often reported from HTS data based on the mode of the *trip* – with multi-stage trips ascribed a mode according to the following hierarchy: public transport modes first, the motor vehicle next, then the bicycle, with walking the lowest in the hierarchy (Queensland Transport et al. 2005:85-86). In such reporting, trips that are undertaken solely by walking are the only walking trips identified in the mode share results. Mode share for Brisbane from the SEQTS, estimated in this manner, is shown in *Figure 1a* – walking represents just over 10% of all trips. An alternative way of looking at mode share is the proportion of all *trip stages* undertaken using each mode, and Brisbane results for trip stages are shown in *Figure 1b*. Over 20% of all trip stages are walked. This different way of looking at the same travel data highlights the importance of walking within the city, whether as walking only trips or walking as part of trips that include other modes.

Further, the walking reported in the SEQTS is largely walking for transport (travel to destinations) rather than walking primarily for exercise, sport and recreation purposes (the latter walking is coded in the SEQTS as being for walking the dog, or for exercise, sport and recreation and not having a destination where such activities occur). In the SEQTS data set, 97% of the walking trip stages were walking for transport. In terms of distance, this represented 96% of the total kilometres walked in Brisbane, with only 4% for exercise, sport and recreation purposes.¹

¹ Comparison with data obtained on walking for transport vs. walking for exercise, sport and recreation in NSW by Cole et al. (2006) suggests that the walking for exercise, sport and recreation is significantly under-reported in the SEQTS (Burke and Brown 2007) – and this is an issue likely to be found in all HTS data sets.

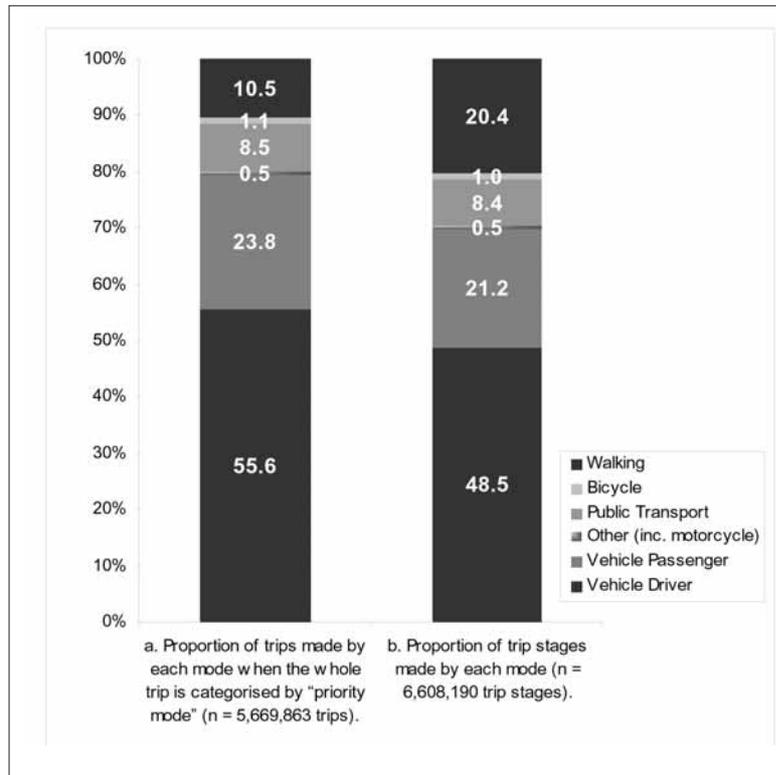


Figure 1
Mode shares for trips vs. mode shares for trip stages

Walking for transport

Walking for transport was disaggregated according to the origins and destinations of each trip, not trip stage, ensuring it is categorised by the place the traveller eventually reached at the end of a trip. This travel was categorised as being from a person's home to other places, from other places to the person's home, or travel between other places. Of the total kilometres walked for transport purposes in the city, around 36% was made from respondent's homes to other places, 25% was made from other places to homes, and 38% was travel between other places. The difference between the travel from homes and the travel to homes was partly due to differences in the rates at which people walk to public transport. A higher proportion of persons walked *from* public transport to their home than walked *to* public transport from their home, with persons often riding as passengers in motorcars to access public transport. However, on the basis that travel *from homes* by walking, and travel *to homes* by walking is largely similar but in the reverse direction, we report home-based data only in terms of the travel from homes to other places. Walking trips not associated with the home, solely between other places, are considered separately, below.

For travel from homes to other places, walking is found in one of three types of trip:

Single-stage, single-mode:

- Walk trips made directly to destinations (single-mode walk trips).

Multi-stage, multi-mode:

- Walk trip stages made to and from public transport stop as part of public transport trips.
- Walk trip stages made to or from a motor vehicle as part of vehicular trips.

The last of these, to and from a motor vehicle, is considered separately below.

Table 1 shows a summary of the trip stages made for persons walking from homes to other places. Single-stage walk trips are longer than the walk trip stages made to and from public transport, both in distance (mean = 940 m vs. 640 m) and time (mean = 12.9 mins vs. 7.9 mins). However, there are more than twice as many walk trip stages made to and from public transport, such that around 60% of both the total distance and time walked is associated with making a public transport trip, with only some 40% as single-stage, single-mode, walk trips.

Burke and Brown (2007) have analysed the destination of trips made from home to other places in the SEQTS,

Table 1
Mean travel times and distances for walking trip stages made from home to other places.

	No. of trip stages	% of trip stages	% of kilometres walked	% of minutes walked	Mean distance per trip stage (km)	Std. deviation	Mean time per trip stage (min)	Std. deviation
Single stage walk trips	154 809	31%	38%	41%	0.94	0.79	12.9	9.48
Walk trip stages to/from public transport	349 982	69%	62%	59%	0.67	0.58	8.23	6.71
Total	504 791	100%	100%	100%	0.75	0.66	9.66	7.96

Table 2
Destinations of trips made from home that include walking for some or all of the trip

Destinations	No. of single-stage trips to this destination (per 1000 persons) by walking	No. of multi-stage trips to this destination (per 1000 persons) that include walking
Primary school	26.0	4.8
Shop	22.7	11.8
Other ¹	15.7	11.7
Workplaces	9.2	51.6
Someone else's home	8.2	2.2
Secondary school	6.3	17.9
Pre-schools & childcare	3.8	0.1
Restaurants & cafes	2.1	2.2
Universities & TAFEs	1.8	13.6
Total	95.8	116.1

¹ Includes all destinations not otherwise referred to in the table (e.g. health services, other personal services, places for exercise, sport or recreation, places for entertainment, libraries, airports and petrol stations)

and a summary of these destinations is shown in *Table 2*. Primary schools and shops are the predominant destinations for walk-only trips and, to a lesser extent, workplaces and someone else's home. For multi-stage multi-modal trips that include walking, the predominant destinations are workplaces, secondary schools, universities and TAFEs², and shops.

When considering all travel (travel to/from homes and travel made solely between other places) public transport-related walking represents 51% of the total

kilometres walked, whereas single-mode walk trips represent 49%.

Distances walked for single-stage walk trips

The distances travelled for all single-stage walking trips made from home to other places are shown in *Figure 2a*. The most common destinations for these trips were primary schools (27% of the kilometres walked to all destinations in single-stage trips), shops

² Technical and Further Education colleges (TAFEs) are higher education providers in Australia.

(21%) and workplaces (11%). No other destinations represented more than 10% of the total distance people walked for these types of trips. The distributions of the distances walked to these destinations are shown in *Figure 2b*.

The median distance walked from home to all other places was 780 m (85th percentile = 1.45 km). Distances walked to shops (median = 680 m; 85th percentile = 1.24 km) and primary schools (median = 790 m; 85th

percentile = 1.34 km) are less than to workplaces (median = 1.04 km; 85th percentile = 1.85 km).

Distances walked at either end of the public transport trip

The most common destinations for public transport trips made from home were to workplaces (representing 46% of the kilometres walked for these trips to all destinations), secondary schools (16%), universities and TAFEs (12%) and shops (11%). No other destinations represented more than 10% of the kilometres walked for these trips.

Distances walked from homes to any public transport node (bus stops, train stations and ferry terminals) for all public transport trips to all destinations, are shown in *Figure 3a*. This is disaggregated by public transport stop type in *Figure 3b*. The median distance walked from home to all public transport stops is 600 m (85th percentile = 1.30 km), though persons travel much less distance to bus stops (median = 440 m; 85th percentile = 1.07 km) than they do to train stations (median = 890 m; 85th percentile = 1.57 km) or ferry terminals (median = 890m; 85th percentile = 1.54km). The difference in the median walking distances to bus stops and train stations, more than 400 m, is statistically significant (Mann Whitney U = 969 086 782; p < 0.001). There is also significant difference in the variances of the travel distance distributions for bus stops and train stations (F = 1530; p < 0.001). A greater proportion of travellers walk very short distances (<500 m) to bus stops than to

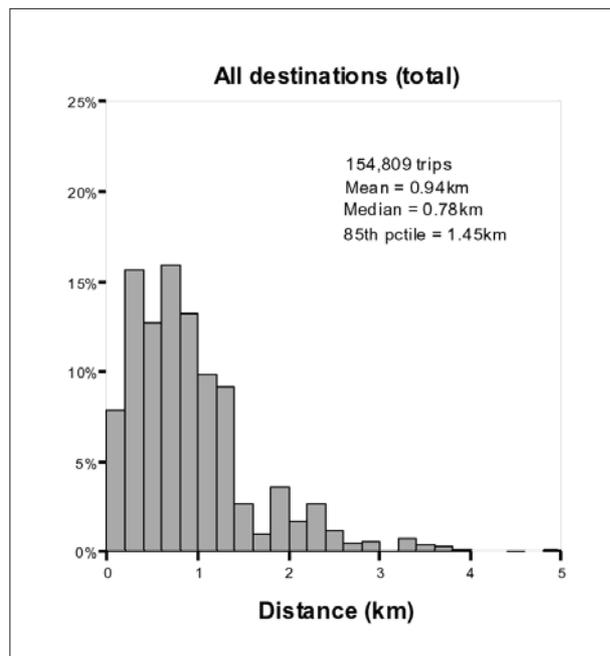


Figure 2a
Distances walked for single-stage trips from home to all other places

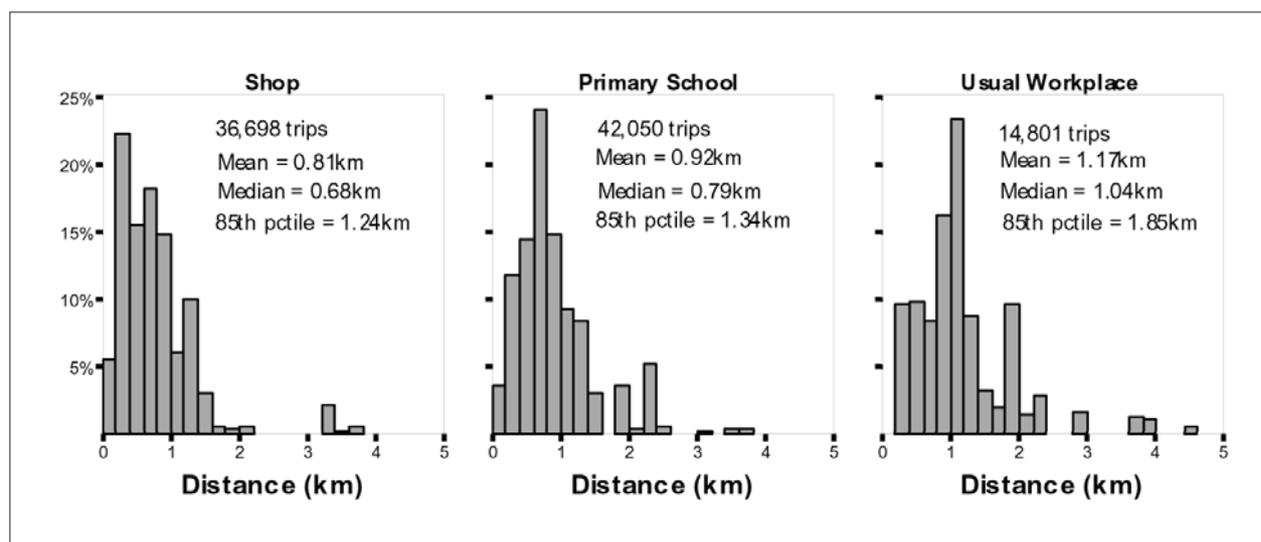


Figure 2b
Distances walked for single-stage trips from home to shops, primary schools and workplaces

train stations—an outcome of the greater number and availability of bus stops compared to train stations within Brisbane.

Distances walked at the end of these trips, *from* public transport nodes to all destinations, are shown in *Figure 4a*, and disaggregated by public transport stop type in *Figure 4b*, and for particular destination types in *Figure 4c*. The median distance travelled from public transport *to* end destinations was slightly less

(470 m) than the median distance travelled *from* homes to public transport (600 m), a difference that is statistically significant (Mann Whitney U = 12 209 166 116; $p < 0.001$). Persons walking from bus stops to end destinations (median = 330 m; 85th percentile = 850 m) travelled lesser distances than those walking from train stations (median = 620 m; 85th percentile = 1.32 km), which is also statistically significant (Mann Whitney U = 3 431 321 892; $p < 0.001$), and again there is a difference in the variances of the walking distances for the two modes ($F = 3996$; $p < 0.001$). Around 40% of persons walking from bus stops to end destinations travel less than 400 m, compared to only 15% walking less than 400 m from train stations.

Persons also walk, on average, further from public transport stops to secondary schools (median = 570 m; 85th percentile = 1.38 km), universities and TAFEs (median = 590 m; 85th percentile = 1.53 km) and workplaces (median = 490 m; 85th percentile = 990 m) than they do to shops (median = 310 m; 85th percentile = 760 m) – see *Figure 4c*. This in part relates to the greater use of buses than trains for shopping trips.

Distances walked between destinations other than homes

Travel made by persons solely between other places (not to or from their homes) comprised around 25% of the total walking kilometres for transport purposes. Some 72% of the kilometres walked between other places was undertaken by single-stage walking trips, and only 28% was made by multi-stage trips involving

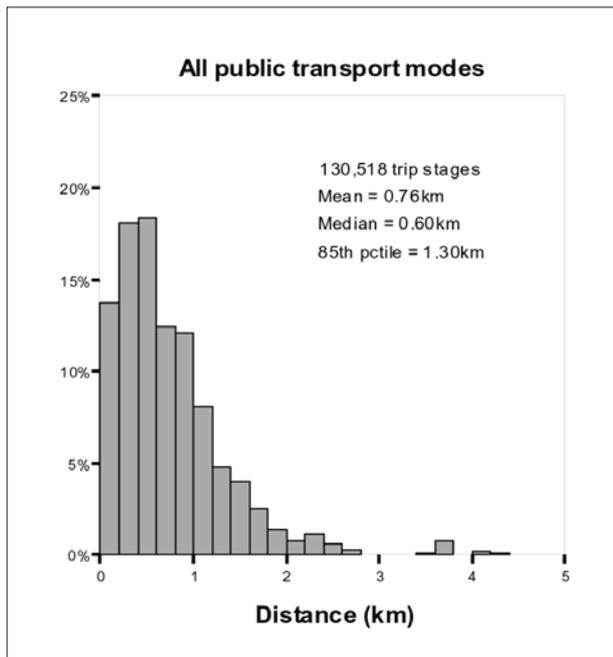


Figure 3a
Distances walked *from* home to all public transport nodes as part of trips to all other places

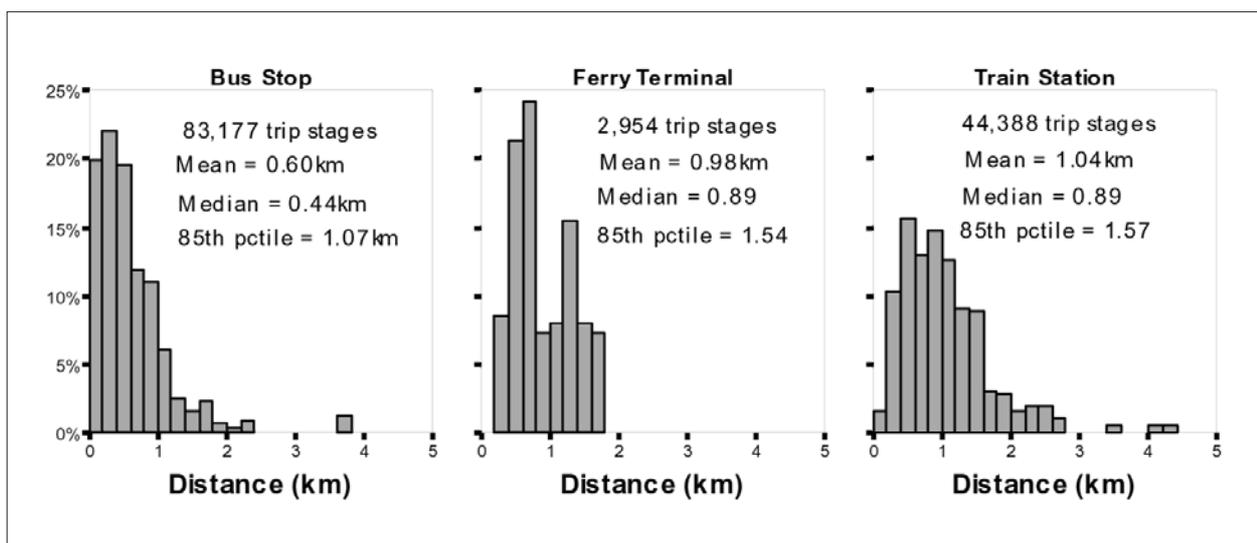


Figure 3b
Distances walked *from* home to bus stops, ferry terminals and train stations as part of trips to other places

public transport. Closer investigation revealed that much of the public transport related travel was part of longer trip chains involving travel to or from homes.

Much of the single-stage walking travel was made between specific origins and destinations, namely, between workplaces and shops (12.3% of the kilometres walked for all origin and destination pairs), from one shop to another shop (12.1%) and between

workplaces and restaurants or cafes (11.9%). No other origin and destination pairs were responsible for more than 10% of the kilometres walked for this travel. Distances walked for all single-stage walk trips made between other places are shown in *Figure 5a*, and disaggregated for the most important origin and destination pairs in *Figure 5b*.

The median distance walked for single-stage walking trips between other places was 430 m (85th percentile = 1.09 km). On average, people walked slightly further from shop to shop (median = 410 m; 85th percentile = 1.18 km) than they did when travelling between workplaces and shops (median = 390 m; 85th percentile = 910 m) and between workplaces and restaurants or cafes (median = 330 m; 85th percentile = 870 m). Note that the distance walked between shops is influenced by the means by which this travel was recorded in the SEQTS. The travel diaries used emphasise travel between buildings, not between individual shops—such that travel within shopping malls from shop to shop is generally not reported.

Distances walked from motor vehicles to destinations

The walk to access motor vehicles is trivial. Information on the walk from where motor vehicles were parked to destinations was collected in the SEQTS, from drivers and passengers, but only in terms of estimated minutes of walking *from* where the motor vehicle was parked to the end destination. This data suffers from the 'lumpiness' of all such time estimates (whereby

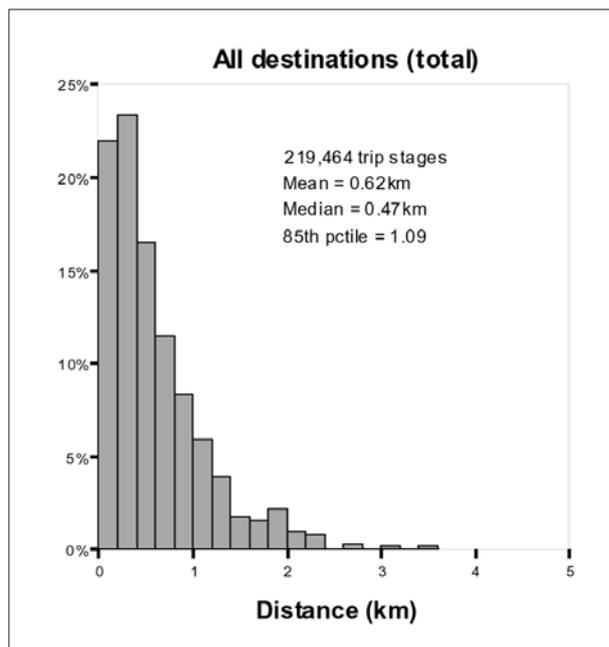


Figure 4a
 Distances walked from public transport nodes to end destinations as part of trips from home to other places

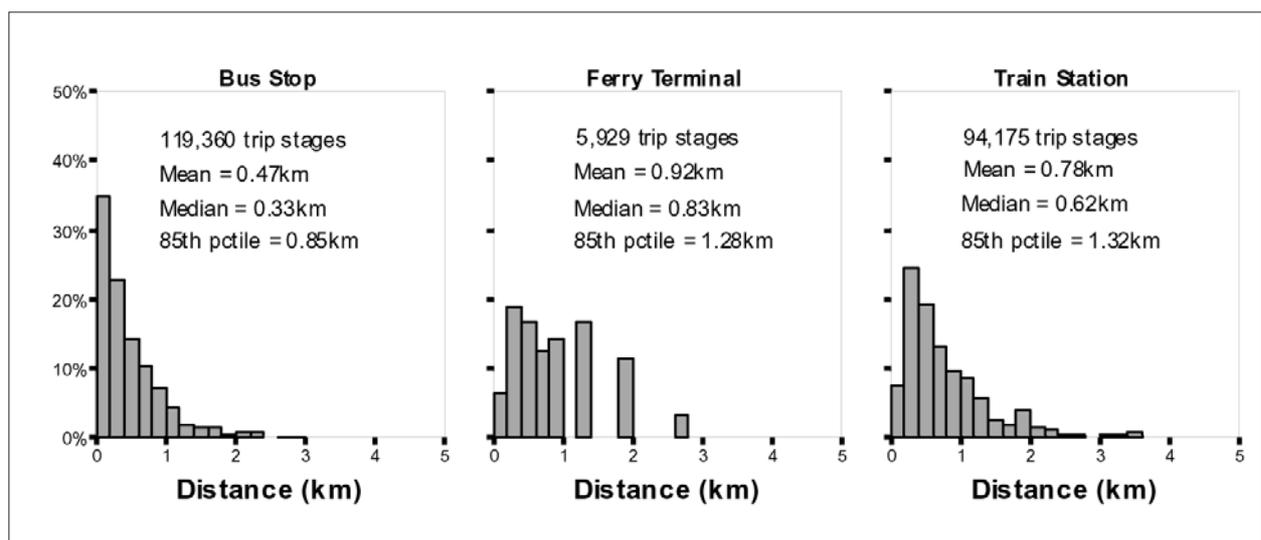


Figure 4b
 Distances walked from bus stops, ferry terminals and train stations to end destinations as part of trips from home to other places

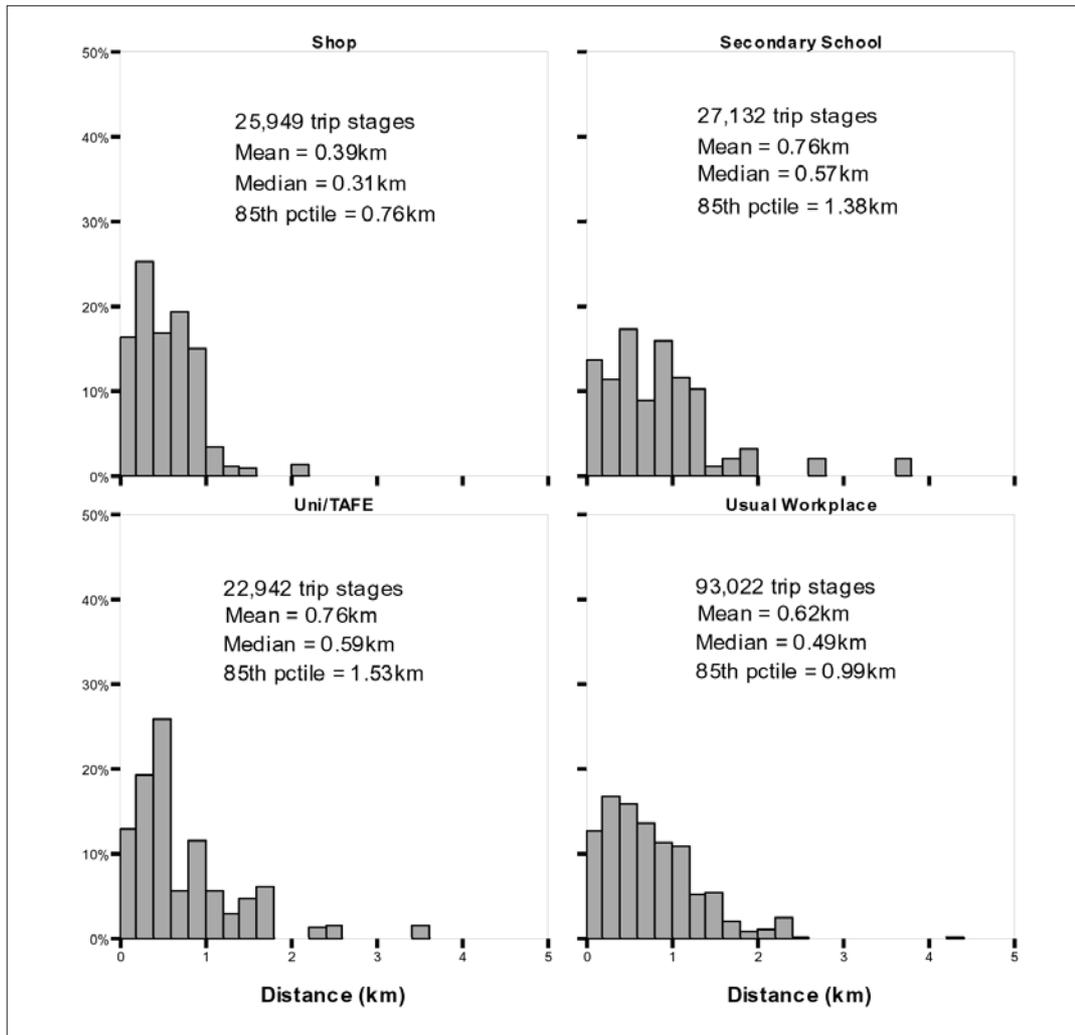


Figure 4c
Distances walked from public transport nodes to shops, secondary schools, universities/TAFEs and workplaces, as part of trips from home to other places

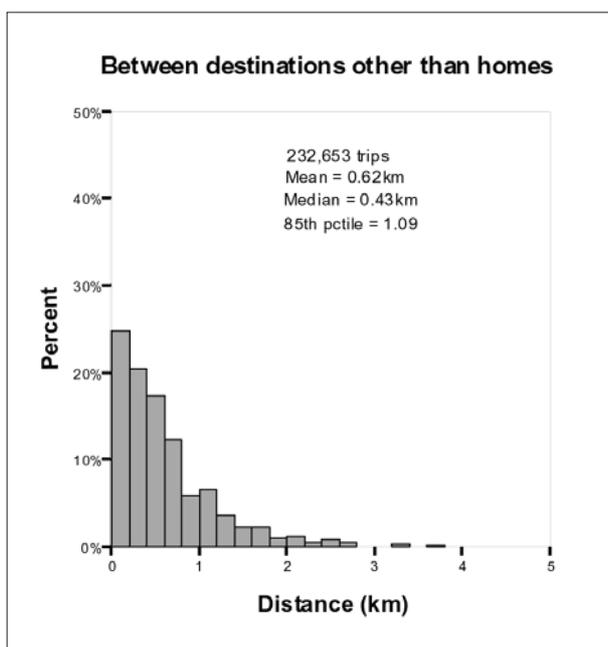


Figure 5a
Distances walked for single-stage trips made between destinations other than homes

respondents tend to indicate they walked either one minute, two minutes or in multiples of five minutes). While recognising such weaknesses, these times have been converted to approximate distance travelled, using a walking speed of 1.26 m/s (75 m/min) calculated as the average speed of all other walking for transport made within the SEQTS. The distribution of these walking distances is shown in Figure 6.

Persons walking at least one minute travelled a median distance of 75 metres (1 min) from their vehicles to destinations (mean = 150 m or 2 min; 85th percentile = 225 m or 3 min). The number of walk trip stages made on exiting a motor vehicle is large—not surprising given motor vehicles account for 79% of all trips, and 70% of all trip stages, made in Brisbane, but these walk trip stages are very much shorter than those made either to or from public transport, or as part of single-mode walk trips.

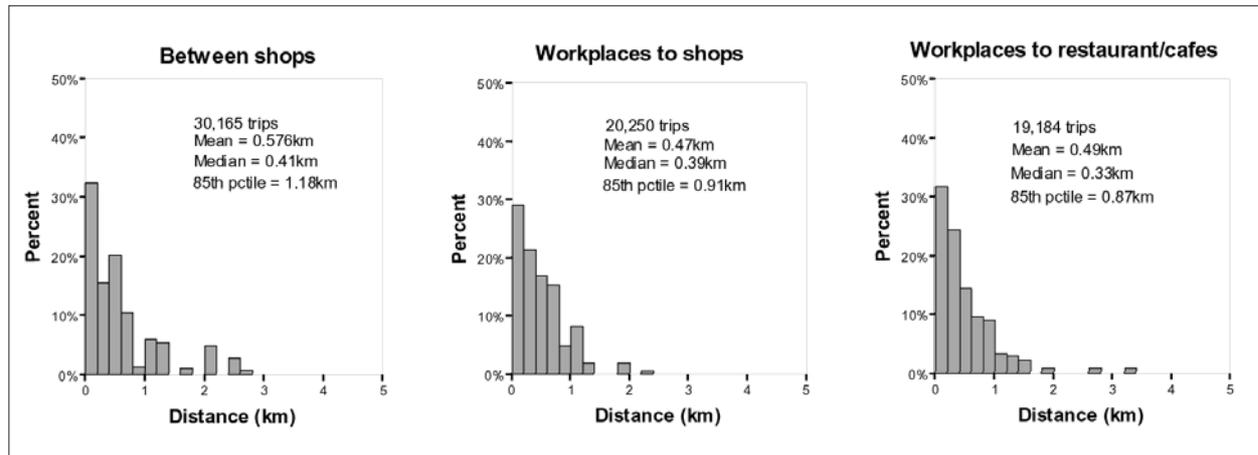


Figure 5b

Distances walked for single-stage trips made between shops, between workplaces and shops, and between workplaces and restaurants/cafes

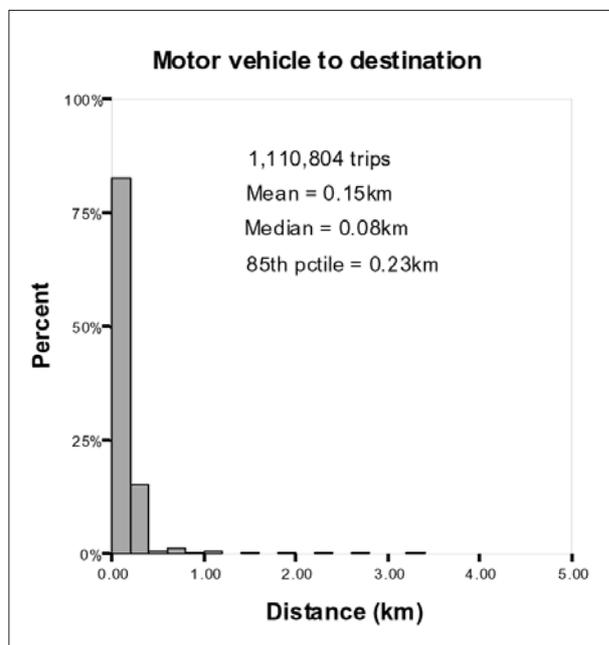


Figure 6

Distances walked when exiting a motor vehicle and walking to an end destination, for trips made from home to other places

FUNCTIONS FITTED TO THE DISTRIBUTIONS

The walking distance distributions were fitted with various functions using *EasyFit* software, which tests goodness-of-fit of a number of distribution functions. It was found that these distributions were consistently best fitted by the gamma distribution. Taylor and Young (1988:73-74) note that the gamma distribution is useful in describing transport data which cannot be readily characterised by either a negative exponential

distribution or a gaussian distribution. The fitting of gamma functions to the walking-distance distributions is not intended to suggest additional insight into walking behaviour is provided by the gamma functions – the purpose has to been to efficiently mathematically describe the distributions. The gamma function features two parameters – a scale parameter (\pm) and a shape parameter (2). Methods to calculate parameter values and a full explanation of the gamma distribution are found in Johnson et al. (1994: 337-414).

Probability density functions for the gamma distributions that approximate the measured travel distributions were calculated. *Figure 7a* shows the gamma function fitted to the walking distance distribution previously identified for all single-stage walking trips made from home to other places (*Figure 2a*). *Figure 7b* shows the same for walking trips made from train stations to all other destinations (*Figure 4b*).

Anderson-Darling (A-D) tests examine how well the observed walking distance data are estimated by gamma functions. The A-D test is a robust non-parametric test based on the maximum distance between the observed and hypothesised curves and is a modification of the Kolmogorov-Smirnov (K-S) test. The A-D test gives more weight to the tails of the distributions than the K-S test and may be considered as conservative in situations where the function parameters are estimated from the data (see Stephens (1974) or NIST and SEMATECH (2004)). *Table 3* shows the parameters for the different gamma functions that have been fitted to each of the measured walking distance distributions reported in the paper, and the

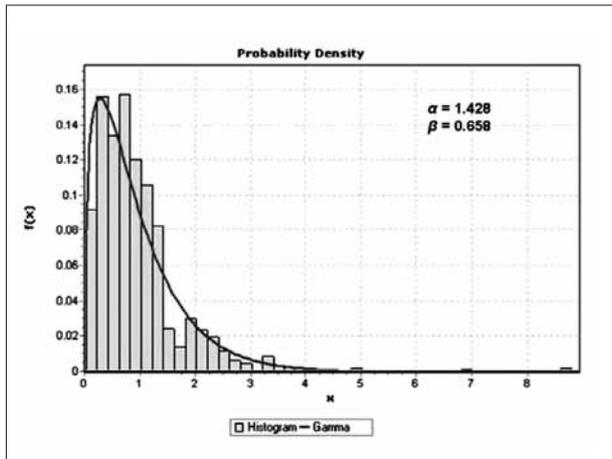


Figure 7a
Gamma function fitted to the distribution of walking trip distances for single-stage trips from home to all other places

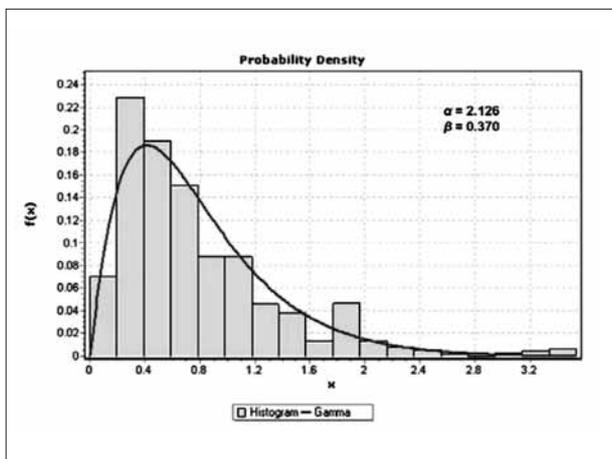


Figure 7b
Gamma function fitted to the distribution of walking trip distances from train stations to end destinations as part of trips from home to other places

A-D test statistic for whether that measured sample of walking distances could have come from a population of distances with that gamma distribution. Despite the conservative nature of the test, the gamma functions fit the distributions well in most cases, though trip types with smaller numbers of observations were less likely to have walking distance distributions that closely follow the gamma function.

DISCUSSION AND CONCLUSIONS

Walking for transport is shown to be an important component of travel in Brisbane. As one in five trip stages in Brisbane involves walking, then more analysis of walking, more understanding of its

parameters, and more planning and design to encourage it, is warranted.

For trips using the walk mode only, people are willing to walk sizeable distances. The median and 85th percentile distances people walk from home to all other places using the walk mode only are 780 m and 1.45k m respectively. However, distances for walk trip stages made to and from public transport are also substantial. Median and 85th percentile walk distances from home to all public transport stops are 600 m and 1.30 km; and from public transport stops to end destinations, 470 m and 1.09 km. There are also more than twice as many walk trip stages made to or from public transport as there are single-mode walk trips. The result is that, in total, persons who are using public transport in Brisbane each weekday (206 000 persons, 12.8% of the population) are, on average, walking more than 2.3 km and over 28 minutes to and from public transport. While it could be argued that such walking may not be the same as deliberate exercise, any more than any other sort of 'incidental' walking is, it could be noted in passing that, for these travellers, public transport-related walking almost meets the Australian daily minimum physical activity recommendation of 30 minutes (Egger et al. 1999).

Though comparisons across datasets are problematic the results are in line with Ker and Ginn's (2003) and Wallace's (2006) findings regarding walking trip distances to public transport. Walking trip distances are much further than the 400 m to 800 m rule-of-thumb proximities (' $\frac{1}{4}$ to $\frac{1}{2}$ mile') for walking destinations promoted by New Urbanist designers (see Aurbach 2005:10-11; Dover Kohl & Partners and Chael Cooper & Associates P.A. 2005:6). Clearly, people in both Brisbane and Perth are willing to walk significant distances, especially to access rail (and busway) services. The results also suggest that the walk trip distances observed for certain trips in Brisbane may be larger than those observed in US cities. The mean walk distance from homes to workplaces as part of single-mode trips in Brisbane (1.17 km) is almost triple that observed by Plaut (2005) for the US (0.32 km). And the distances walked to and from public transport services in Brisbane were greater than those observed by Hsiao et al. (1997) in Orange County.

These distributions of walking distances for transport in Brisbane are current actual travel behaviour for a weekday. Of course, they do not necessarily represent

Table 3
Parameters of gamma functions fitted to the distributions of walking trip distances

Distribution	Gamma parameters		Anderson-Darling
	α	β	
Single-stage trips from home to all other places (Figure 2a)	1.428	0.658	4.88**
- to shops (Figure 2b)	1.332	0.608	4.42**
- to primary schools (Figure 2b)	2.468	0.372	0.59
- to workplaces (Figure 2b)	2.626	0.447	0.60
From home to all public transport nodes (Figure 3a)	1.459	0.523	1.49
- to bus stops (Figure 3b)	1.390	0.436	2.83*
- to train stations (Figure 3b)	2.312	0.449	0.98
From all public transport nodes to destinations (Figure 4a)	1.375	0.454	10.93**
- from bus stops (Figure 4b)	1.183	0.407	8.38**
- from train stations (Figure 4b)	2.126	0.370	5.30**
From any public transport node for journey to:			
- to shops (Figure 4c)	1.172	0.334	2.53*
- to secondary schools (Figure 4c)	1.659	0.468	2.71*
- to universities/TAFEs (Figure 4c)	1.533	0.497	0.77
- to workplaces (Figure 4c)	1.584	0.391	3.64*
Single-stage trips between destinations other than homes (Figure 5a)	1.286	0.521	5.01**
- between shops (Figure 5b)	1.253	0.558	2.96*
- between workplaces and shops (Figure 5b)	1.592	0.330	2.33
- between workplaces and restaurants/cafes (Figure 5b)	1.099	0.468	2.76*
From motor vehicle to an end destination for trips between homes and other places (Figure 6)	0.368	6.147	52.59**

* p<0.05

** p<0.01

preference. Some of the distances walked, or even the fact that a particular person walked at all, may result from that person's travel options being constrained by the non-availability of other travel modes. Equally, many persons may not be undertaking walk travel due to a paucity of appropriate destinations within walkable distances from home, or of public transport stops that would take them to appropriate destinations. The distributions are also silent with respect to the quality, convenience and perceived safety of the walk route, and the effectiveness of any walk/public transport interchange, and, of course, the demographic characteristics of the walkers at a

disaggregate level. These are topics for further research.

REFERENCES

- AURBACH, L (2005). *TND Design Rating Standards: version 2.2*, Hyattsville, Maryland, USA.
- BERRIGAN, D, TROIANO, RP, MCNEEL, T, DISOGR, C, and BALLARD-BARBASH, R (2006). Active transportation increases adherence to activity recommendations, *American Journal of Preventive Medicine* 31(3):210-216.
- BURKE, M, and BROWN, AL (2007). *How much household travel is 'active transport'*? Unpublished manuscript.

- CHALASANI, V (2005). Enriching Household Travel Survey Data: experiences from the Microcensus 2000. Presented at the 5th Swiss Transport Research Conference, 9-11 March 2005, Monte-Verita, Ascona, Switzerland. www.strc.ch/pdf_2005/STRC05_A2_Chalasani.pdf
- COLE, R, LESLIE, E, BAUMAN, A, DONALD, M and OWEN, N (2006). Socio-demographic variations in walking for transport for recreation or exercise among adult Australians, *Journal of Physical Activity and Health*, Vol 3:164-178.
- DOVER KOHL & PARTNERS and CHAEL COOPER & ASSOCIATES (2005). *Design Guidelines for Pedestrian-Friendly Neighbourhood Schools*, City of Raleigh, North Carolina.
- EGGER, G, DONOVAN, R, SWINBURN, B, GILES-CORTI, B, and BULL, F (1999). *Physical Activity Guidelines for Australians – Summary and Appendices*, The University of Western Australia and the Centre for Health Promotion and Research, Sydney.
- FRANK, LD (2000). Land Use and Transportation Interaction: Implications on public health and quality of life, *Journal of Planning Education and Research* 20(1):6-22.
- HSIAO, S, LU, J, STERLING, J, and WEATHERFORD, M (1997). Use of Geographic Information System for analysis of transit pedestrian access, *Transportation Research Record* 1604:50-59.
- JOHNSON, N, KOTZ, S and BALAKRISHNAN, N (1994). *Continuous Univariate Distributions – Volume 1 (Second Edition)*, Wiley-Interscience, New York.
- KER, I, and GINN, S (2003). Myths and realities in walkable catchments: the case of walking and transit, *Road and Transport Research* 12(2):69-80.
- KRIZEK, KJ and JOHNSON, PJ (2006). Proximity to trails and retail: effects on urban cycling and walking, *Journal of the American Planning Association* 72(1):33-42.
- LAND TRANSPORT NZ (2004). *Draft Pedestrian Network Planning and Facilities Design Guide*, Wellington, New Zealand; Land Transport NZ.
- LITMAN, T (2003). Active transportation policy issues, Presented at *National Roundtable on Active Transportation*, 9-10 April 2003, Victoria, BC, Canada.
- NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST) and SEMATECH (2004). *e-Handbook of Statistical Methods*. <http://www.itl.nist.gov/div898/handbook/index.htm>
- PLAUT, P (2005). Non-motorized commuting in the US, *Transportation Research Part D: Transport and Environment* 10(5):347-356.
- POLZIN, S and MAGGIO, E (2007). *Public Transit in America: analysis of access using the 2001 National Household Travel Survey*, Tampa, Florida: Center for Urban Transportation Research, University of South Florida.
- PUCHER, J and DIJKSTRA, L (2003). Promoting safe walking and cycling to improve public health: lessons from The Netherlands and Germany, *American Journal of Public Health* 93(9):1509.
- QUEENSLAND TRANSPORT et al. (2005). *South-East Queensland Travel Survey 2003-2004: survey procedures and documentation – Brisbane survey*, report prepared by Queensland Transport, The Urban Transport Institute, I-View, and Data Analysis Australia, Brisbane: Queensland Transport.
- STEPHENS, M (1974). EDF statistics for goodness of fit and some comparisons, *Journal of the American Statistical Association* 69(347):730-737.
- TAYLOR, M, and YOUNG, W (1988). *Traffic Analysis: new technology & new solutions*, Hargreen Publishing Company, North Melbourne, Vic., Australia.
- TRANSPORT AND POPULATION DATA CENTRE (2006). *Transfigures: train access and egress modes*, Transport and Population Data Centre, Sydney.
- TUDOR-LOCKE, C, BITTMAN, M, MEROM, D, and BAUMAN, A (2005). Patterns of walking for transport and exercise: a novel application of time use data, *International Journal of Behavioral Nutrition and Physical Activity* 2(1):5-14.
- VIVIER, J (2001). *Millenium Cities Database for Sustainable Mobility: analyses and recommendations*, UITP, Brussels.
- WALLACE, C (2006). *The 400 metre myth – how far do people walk to busway stations?* Masters thesis submitted to School of Built Environment, Queensland University of Technology.



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