Integration of walking and cycling into strategic transport models

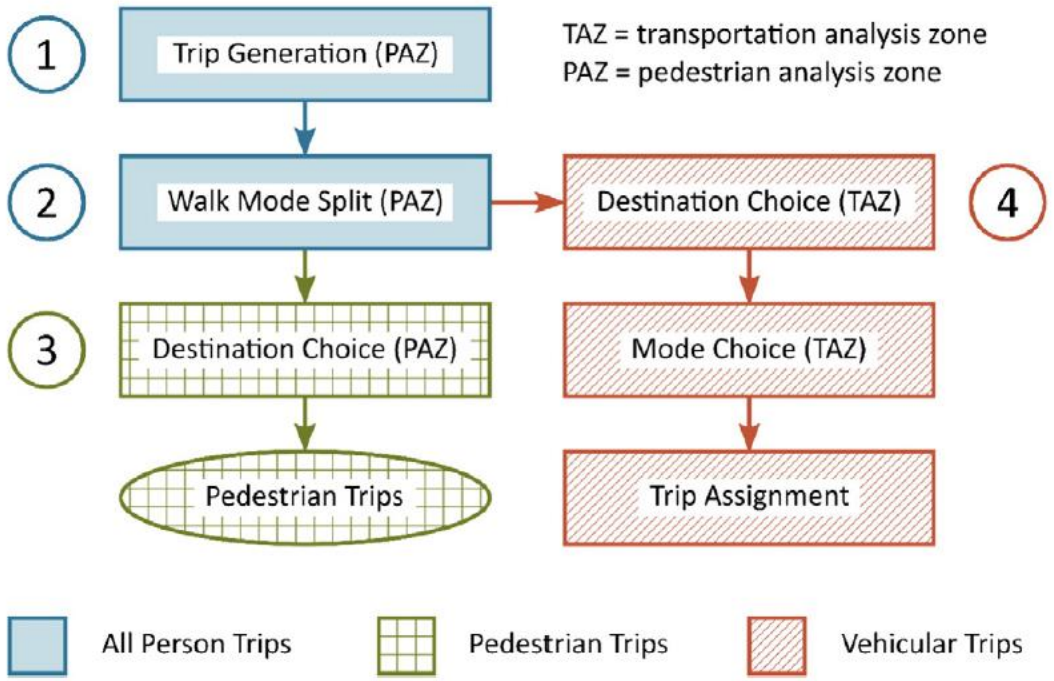
Meead Saberi
Research Centre for Integrated Transport Innovation (rCITI)
University of New South Wales (UNSW) Sydney

From left to right: Rastin Saberi, Meead Saberi, Yuexuan Shen, Yining Hu, Fatemeh Nourmohammadi, Moloud Damande, Ahmad Emami, and Tanapon Lilasathapornkit

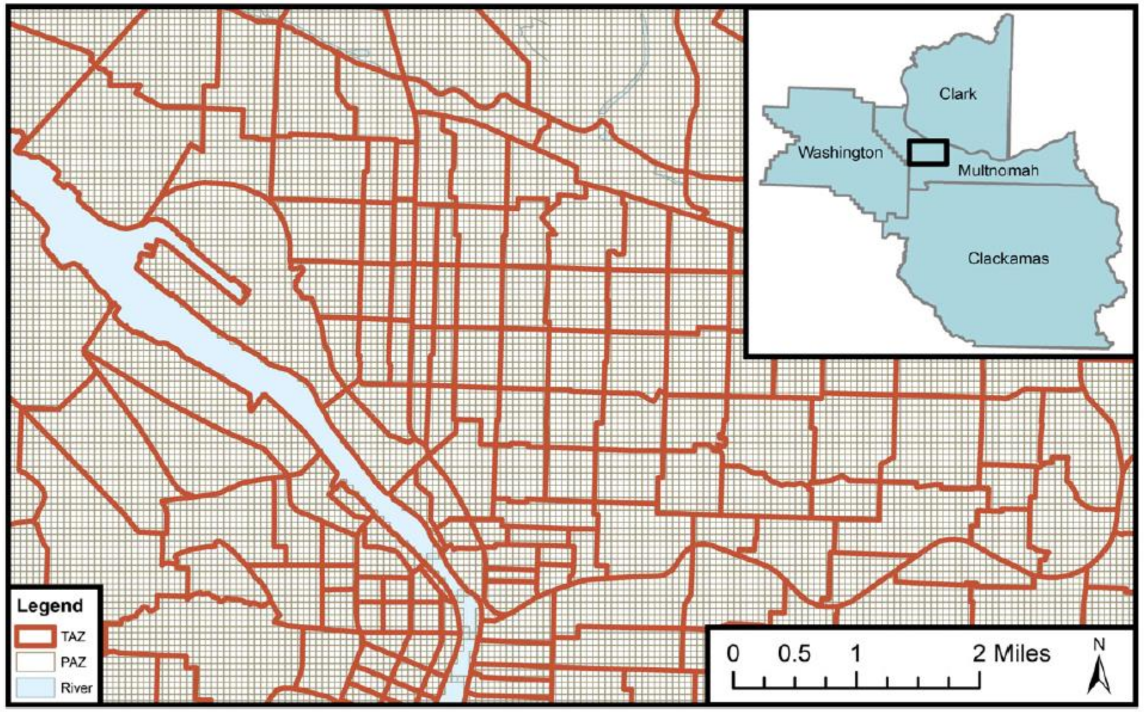
Three key considerations

- Walking and cycling Infrastructure network
- Walking and cycling demand estimation/projections
- Walking and cycling route and destination choice approaches and assumptions

Conceptual diagram of strategic pedestrian modeling framework

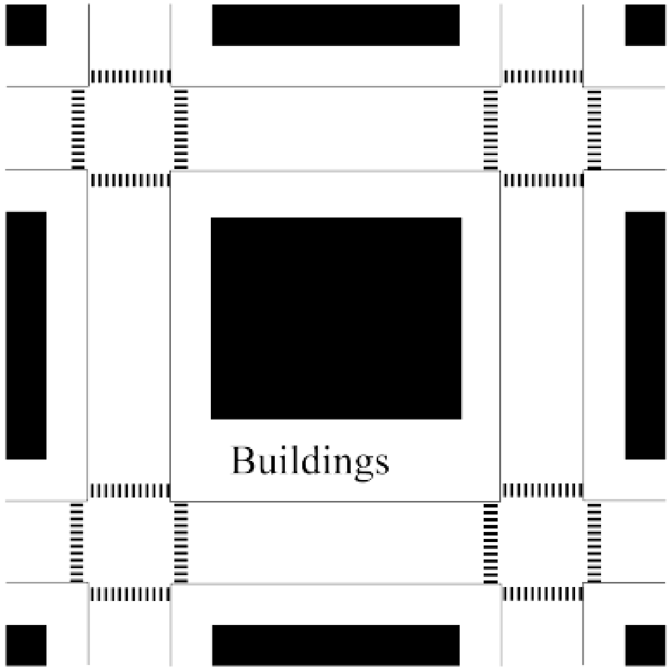


PAZs and TAZs in Part of the Portland, Oregon, Region

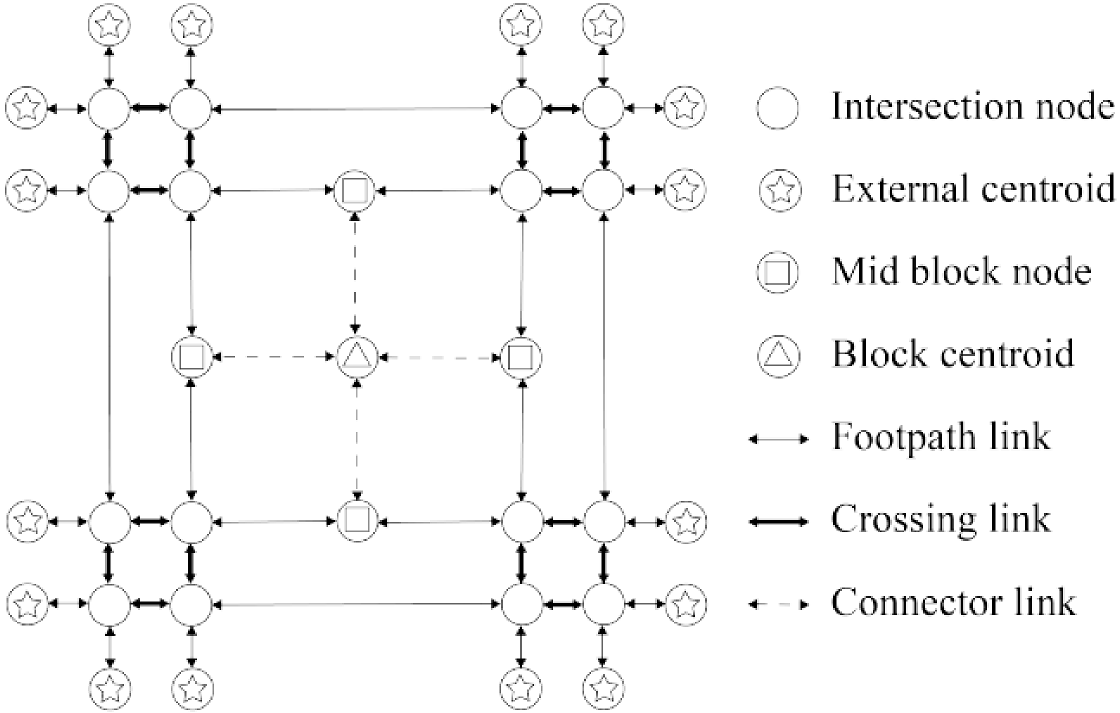


Kelly J. Clifton, Patrick A. Singleton, Christopher D. Muhs, Robert J. Schneider, Representing pedestrian activity in travel demand models: Framework and application, Journal of Transport Geography, Volume 52, 2016, Pages 111-122, ISSN 0966-6923, https://doi.org/10.1016/j.jtrangeo.2016.03.009.

Pedestrian network representation



Physical infrastructure



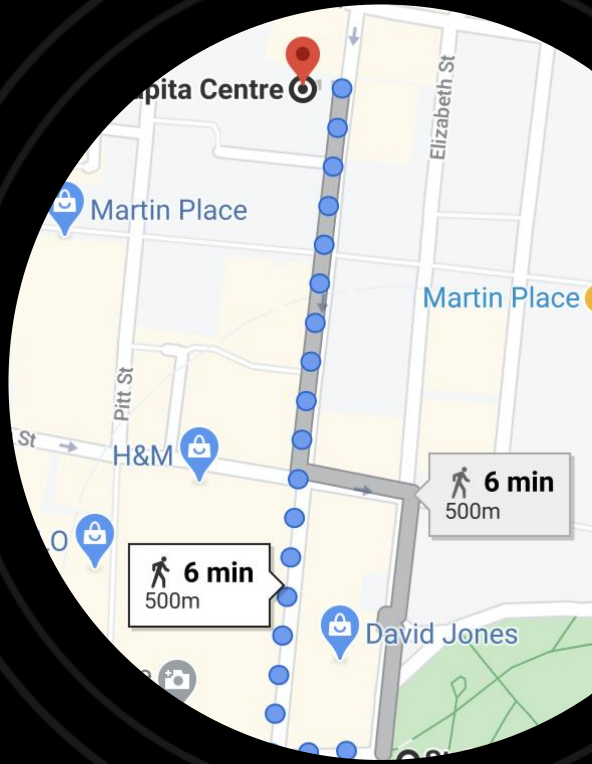
Network representation

A Routable and Connected Walking Network

Walking route choice

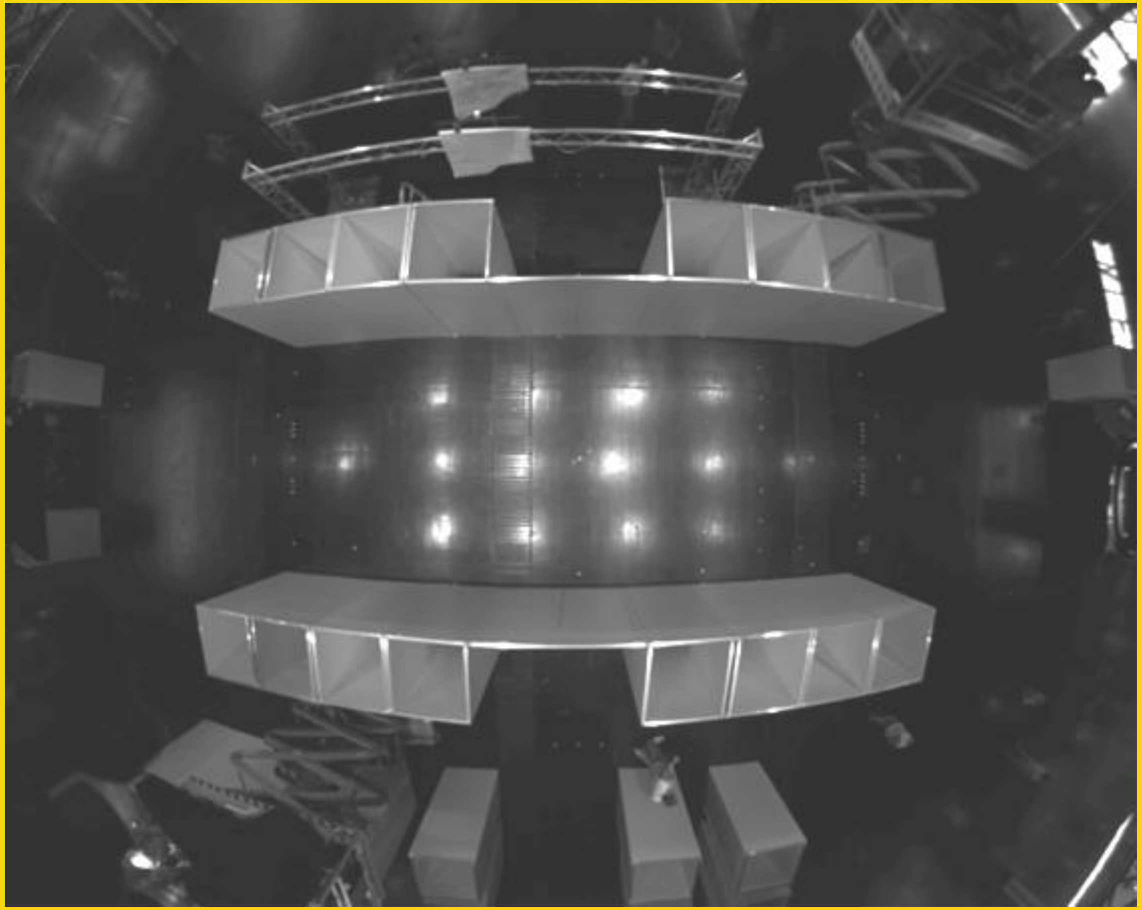
We have developed new modelling techniques for pedestrian traffic assignment problem (pTAP)

- Equilibrium seeking with
  - Stochastic vs. deterministic volume delay function
  - Symmetric vs. asymmetric volume delay function
- Non-equilibrium seeking logit-based route choice (a.k.a. zero-shot route choice)



Bidirectional Pedestrian Volume Delay Function

Flow ratio matters.



Source: Data archive of studies about pedestrian dynamics
https://ped.fz-juelich.de/da/doku.php

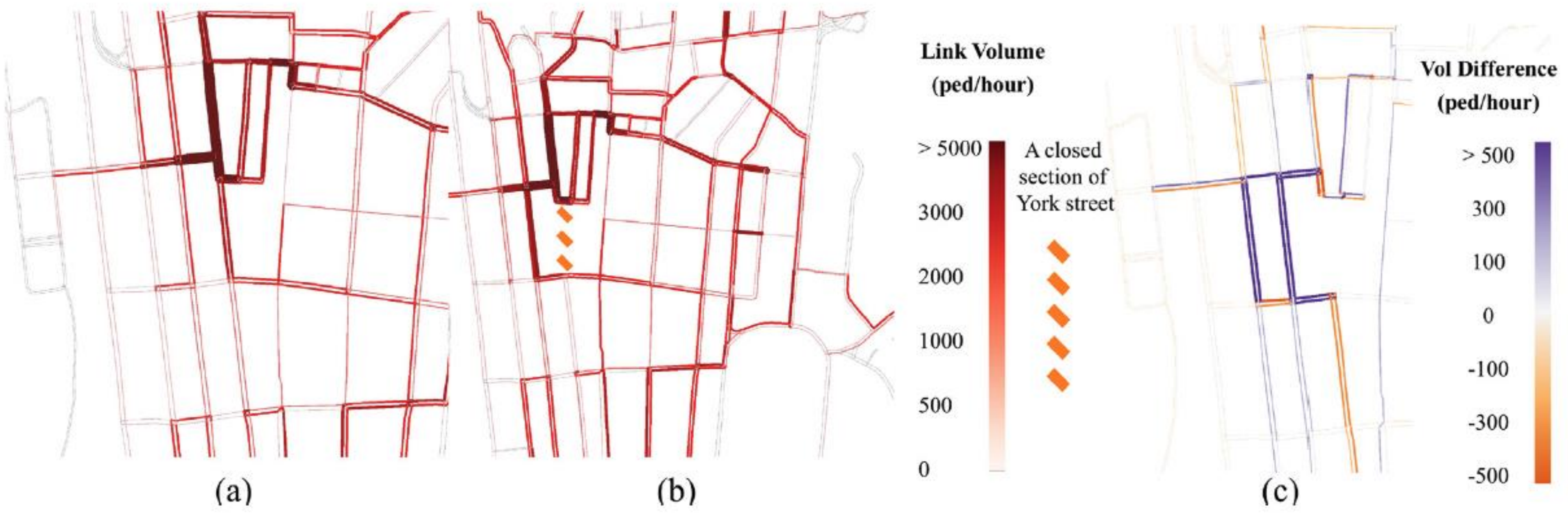
Application to City of Sydney Walking Network:

213,094 pedestrians
1 hour morning peak

Static model

A network operations example

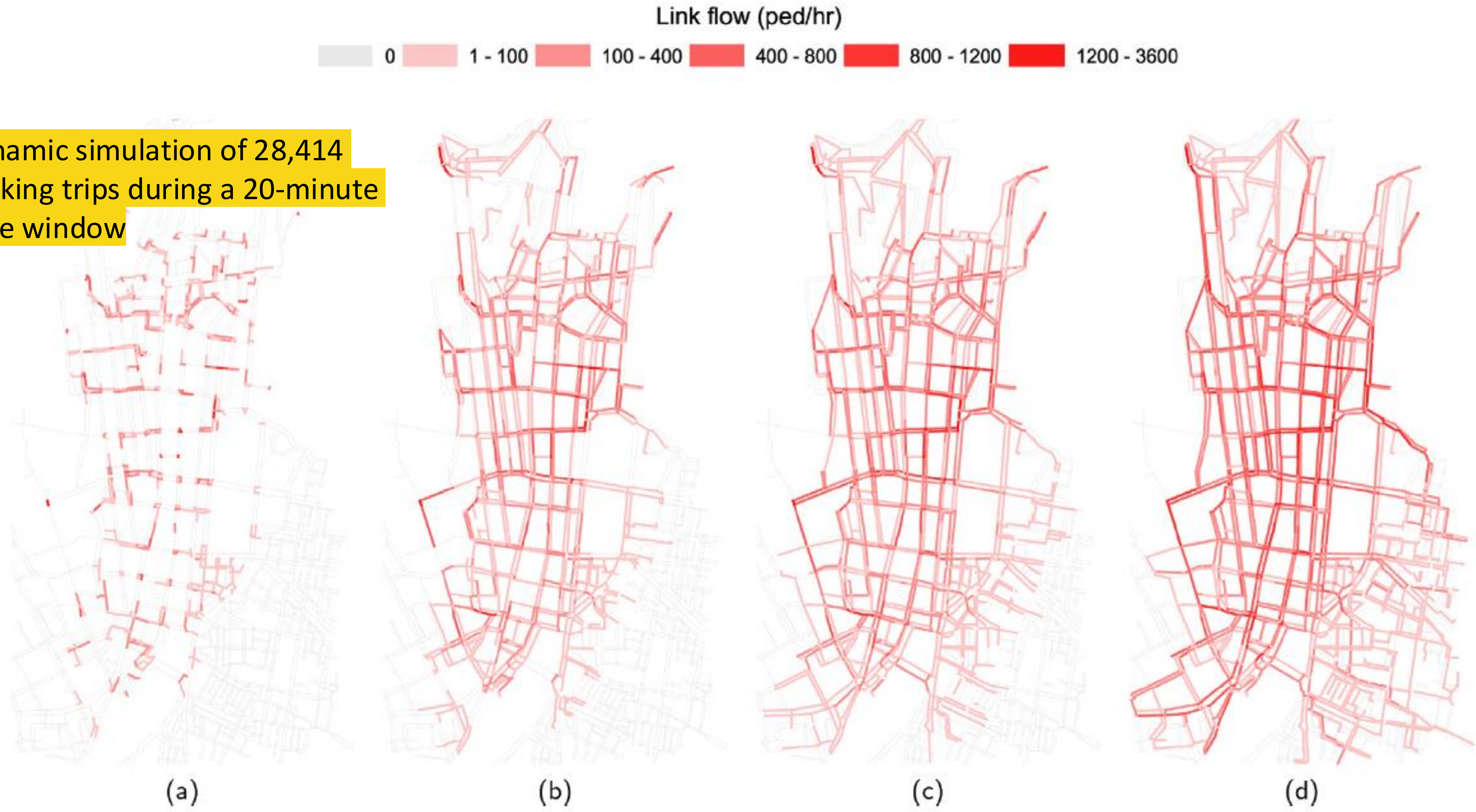
What if the sidewalks on a section of York Street are closed?
How would pedestrians re-route? What are the new pedestrian volumes?



Normal operations

Sidewalk closure

Dynamic simulation of 28,414 walking trips during a 20-minute time window



t=1 min t=3 min t=5 min t=14 min

Transportation Research Part C 144 (2022) 103905

Contents lists available at ScienceDirect

Transportation Research Part C

journal homepage: www.elsevier.com/locate/trc

Traffic assignment problem for footpath networks with bidirectional links

Tanapon Lilasathapornkit [a], David Rey [a,b], Wei Liu [a,c,d], Meead Saberi [a,*]

[a] Research Centre for Integrated Transport Innovation (rCITI), School of Civil and Environmental Engineering, University of New South Wales, Sydney, NSW, Australia
[b] SKEMA Business School, Université Côte d'Azur, Sophia Antipolis, France
[c] School of Computer Science and Engineering, University of New South Wales, Sydney, NSW, Australia
[d] Department of Aeronautical and Aviation Engineering, The Hong Kong Polytechnic University, Hong Kong

ARTICLE INFO

Keywords:
Pedestrian flow
Volume delay function
Traffic assignment problem
Macroscopic model
Stochastic model

ABSTRACT

The estimation of pedestrian traffic in urban areas is often performed with computationally intensive microscopic models that usually suffer from scalability issues in large-scale footpath networks. In this study, we present a new macroscopic user equilibrium traffic assignment problem (UE-pTAP) framework for pedestrian networks while taking into account fundamental microscopic properties such as self-organization in bidirectional streams and stochastic walking travel times. We propose four different types of pedestrian volume-delay functions (pVDFs), calibrate them with empirical data, and discuss their implications on the existence and uniqueness of the traffic assignment solution. We demonstrate the applicability of the developed UE-pTAP framework in a small network as well as a large scale network of Sydney footpaths.

1. Introduction

Rapid urban population growth in the past few decades has made understanding and predicting pedestrian traffic an increasing challenge in major city centers across the world with overcrowded footpaths. The growing interest in improving walkability and the need for more comprehensive appraisal of walking infrastructure in cities require reasonably accurate estimates of pedestrian traffic volumes. However, the modeling methodologies and tools to estimate foot traffic have been an overlooked area of research in the literature. To the best of our knowledge, no study has explicitly extended the traffic assignment problem to pedestrian networks in the urban context taking into account the walking route choice and microscopic behavior of pedestrian crowds such as self-organization and formation of lanes.

The traffic assignment problem (TAP) has been subject to intense research since the 1950's building upon seminal studies of Wardrop (1952), Beckmann et al. (1956), and Smith (1984). However, almost all studies on TAP have focused on car traffic in which vehicle flow on a link is associated with travel time on the same link known as the link performance function or volume-delay function (VDF) (Bureau of Public Roads, 1964). A common assumption in the TAP is that the link performance functions are independent of each other, making the travel time on a given link depend only on the flow through that link and not on the flow through any other link in the network. Link flows interaction was first introduced in the TAP for heavy traffic on two-way streets, signalized intersections, merging sections, left-turning movements in unsignalized intersections, and multi-modal traffic using a pairwise symmetric link interaction function (Sheffi, 1985; Abdulaal and LeBlanc, 1979; Dafermos, 1971; Chevallier and Leclercq, 2007). Beckmann et al. (1956) showed that the TAP has a unique User Equilibrium (UE) solution if the link travel time function is

* Corresponding author.
E-mail address: meead.saberi@unsw.edu.au (M. Saberi).

https://doi.org/10.1016/j.trc.2022.103905
Received 26 July 2021; Received in revised form 20 September 2022; Accepted 22 September 2022
Available online 10 October 2022

Lilasathapornkit, T., Rey, D., Liu, W., Saberi, M. (2022) Traffic assignment problem for footpath networks with bidirectional links. *Transportation Research Part C*, 144, 103905.
https://doi.org/10.1016/j.trc.2022.103905

Lilasathapornkit, T., Saberi, M. (2022) Dynamic pedestrian traffic assignment with link transmission model for bidirectional sidewalk networks. *Transportation Research Part C*, 145, 103930.
https://doi.org/10.1016/j.trc.2022.103930

Transportation Research Part C 145 (2022) 103930

Contents lists available at ScienceDirect

Transportation Research Part C

journal homepage: www.elsevier.com/locate/trc

Dynamic pedestrian traffic assignment with link transmission model for bidirectional sidewalk networks

Tanapon Lilasathapornkit, Meead Saberi *

Research Centre for Integrated Transport Innovation (rCITI), School of Civil and Environmental Engineering, University of New South Wales, Sydney, NSW, Australia

ARTICLE INFO

Keywords:
Bidirectional pedestrian flow
Dynamic network loading
Link transmission model
Dynamic user equilibrium

ABSTRACT

Planning assessment of urban walking infrastructure requires appropriate modeling methodologies that capture the time-dependent and unique microscopic characteristics of bidirectional pedestrian streams. In this paper, we develop a simulation-based dynamic pedestrian traffic assignment (DPTA) model specifically formulated for walking networks (e.g. sidewalks) with bidirectional links. The model consists of a dynamic user equilibrium (DUE) based walking route choice and a link transmission model (LTM) for network loading. The formulated DUE adopts a pedestrian volume delay function (pVDF) taking into account the properties of bidirectional pedestrian streams such as self-organization. The adopted LTM uses a three-dimensional triangular bidirectional fundamental diagram as well as a generalized first-order node model. The applicability and validity of the model is demonstrated in hypothetical small networks as well as a real-world large-scale network of sidewalks in Sydney. The model successfully replicates formation and propagation of shockwaves in walking corridors and networks due to bidirectional effects.

1. Introduction

Potential health and societal benefits of active transportation are becoming more acknowledged. Many cities around the world are increasing their investment in walking infrastructure. However, overcrowded footpaths in some cities during peak hours create potential safety risks and increase delays for pedestrians. Investment in walking infrastructure is often made on an adhoc manner rarely supported by strategic large-scale pedestrian network models similar to what is commonly used for analysis of vehicular traffic systems.

Urban footpaths or sidewalks can be viewed as a network of bidirectional pedestrian links. Several studies in the past have already investigated the bidirectional crowd dynamics using the fundamental relationship between flow and density (Seyfried et al., 2005; Zhang et al., 2012; Hänseler et al., 2014; Cao et al., 2017; Hänseler et al., 2017; Saberi and Mahmassani, 2014; Saberi et al., 2015). Despite its significance and practical relevance, very little effort has been put into understanding and modeling the network-wide impact of pedestrian traffic in the urban context for planning applications. This study aims to develop a simulation-based dynamic pedestrian traffic assignment (DPTA) framework to model large-scale footpath or sidewalk networks.

Research on pedestrian flow modeling and dynamics has grown in several directions in the past few decades including development of novel approaches in microscopic modeling (Løvås, 1994; Helbing and Molnar, 1995; Blue and Adler, 2001; Moussaïd et al., 2010; Huang et al., 2017; Tao and Dong, 2017; Shahhoseini et al., 2018), mesoscopic modeling (Xiong et al., 2010; Cristiani et al., 2011; Tordeux et al., 2018), and macroscopic simulation (Hughes, 2002; Colombo et al., 2011; Schwandt et al., 2013;

* Corresponding author.
E-mail address: mead.saberi@unsw.edu.au (M. Saberi).

https://doi.org/10.1016/j.trc.2022.103930
Received 20 December 2021; Received in revised form 16 August 2022; Accepted 15 October 2022
Available online 2 November 2022

Modelling cycling route choice

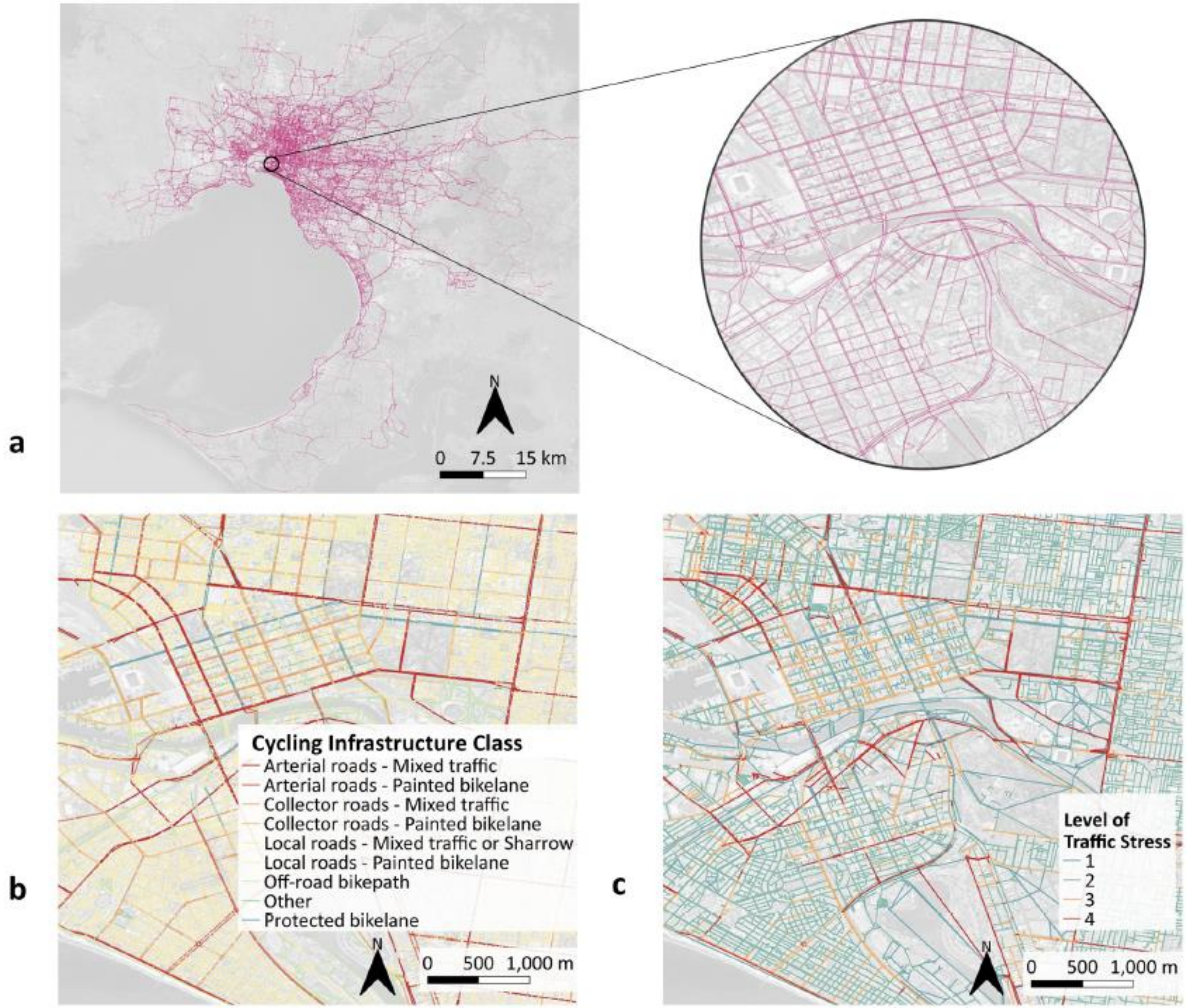


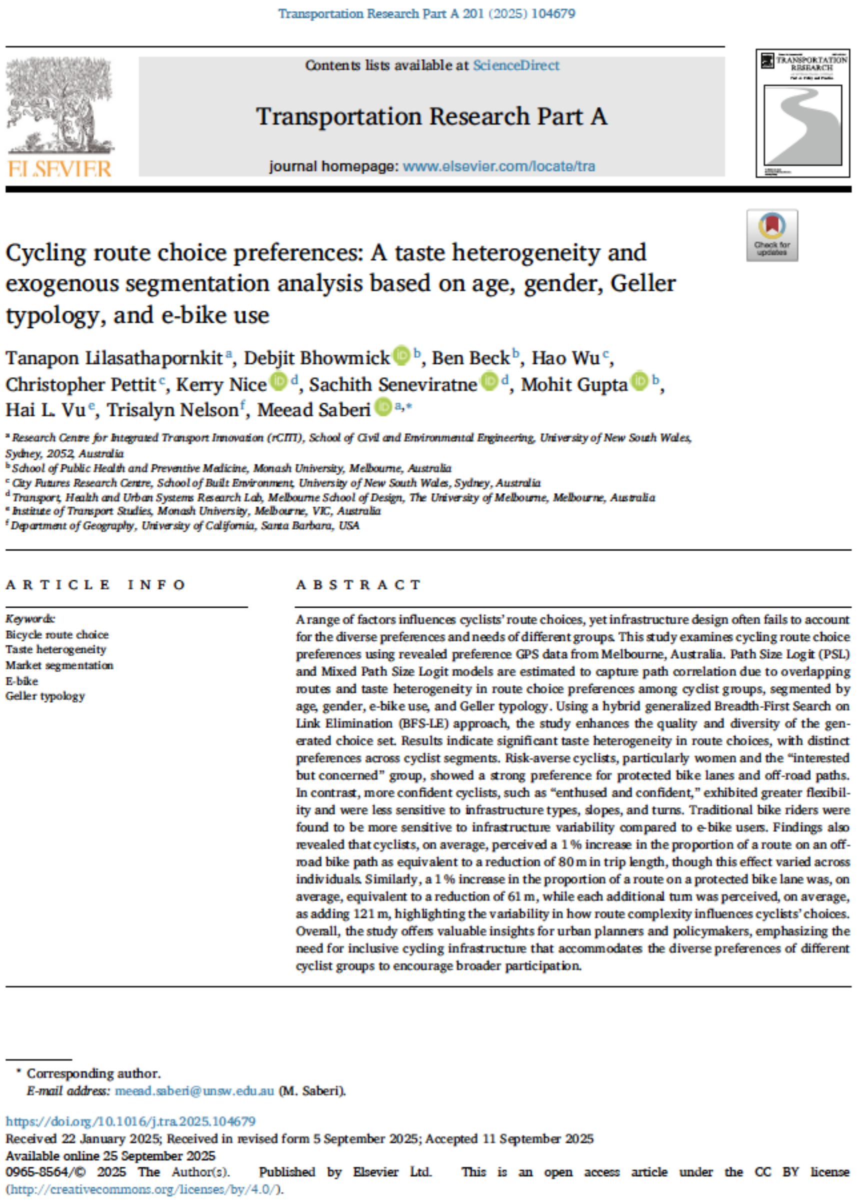
Fig. 1. An overview of the input data used in this study: (a) observed cycling trajectories with a zoomed-in view, (b) cycling infrastructure classes at the link level, and (c) the level of traffic stress (LTS) at the link level, ranging from LTS 1 (low stress) to LTS 4 (high stress), used to represent the comfort and safety of cycling conditions across the network..

Modelling cycling route choice

Cycling route choice model estimation results (N = 11,001): General PSL and Mixed PSL models.

Attribute	Multinomial Logit		Path Size Logit (PSL)		Mixed PSL	
	β	t-value	β	t-value	β	t-value
Distance (km)	−0.16	−20.70**	▼ −1.67	−4.53**	0.15	−2.50*
Distance stdv (km)					−0.12	−1.95*
Prop. of Arterial roads– Painted bikelane			▼ −2.77	−8.54**	1.54	14.75**
Prop. of Arterial roads– Mixed traffic			▲ 2.07	8.73**	−6.38	−9.25**
Prop. of Local roads– Mixed traffic or sharrow			▲ 3.83	22.50**	1.21	17.90**
Prop. of Collector roads – Mixed traffic			▲ 6.03	26.90**	1.35	17.93**
Prop. of Protected bikelane			▲ 2.35	3.60**	0.90	5.98**
Prop. of Off-road bike path			▲ 5.04	22.19**	1.18	12.91**
Infrastructure stdv					1.46	18.39**
Distance on LTS1 (km)			▲ 1.83	4.94**	0.42	141.96**
Distance on LTS2 (km)			▲ 1.94	5.32**	0.39	161.18**
Distance on LTS3 (km)			▲ 1.51	4.12**	0.01	94.31**
Distance on LTS4 (km)			8e-4	2.08*	−16.05	−26.31**
LTS stdv (km)					0.01	0.23
Max Slope (%)			▼ −1.66	−12.92**	1.32	151.35**
Max Slope stdv (%)					2.21	30.92**
POI (1000s)			▼ −6.83	−15.22**	1.83	13.37**
POI stdv (1000s)					1.07	9.19**
Turns (100s)			▼ −7.76	−34.54**	2.33	53.33**
Turns stdv (100s)					−0.80	−14.29**
Path Size			−1.65	−15.19**	3.89	20.91**
Rho-squared-bar	0.007		0.23		0.31	
Final log-likelihood	−25,429		−19,658		−17,698	
Akaike Information Criterion	50,859		39,345		35,437	

Note: ** indicates significant values at the 1 % level (** $p < 0.01$). * indicates significant values at the 10 % level (* $p < 0.1$).



Transportation Research Part A 201 (2025) 104679

Contents lists available at ScienceDirect

Transportation Research Part A

journal homepage: www.elsevier.com/locate/tra

Cycling route choice preferences: A taste heterogeneity and exogenous segmentation analysis based on age, gender, Geller typology, and e-bike use

Tanapon Lilasathapornkit[a], Debjit Bhowmick[b], Ben Beck[b], Hao Wu[c], Christopher Pettit[c], Kerry Nice[d], Sachith Seneviratne[d], Mohit Gupta[b], Hai L. Vu[e], Trisalyn Nelson[f], Meead Saberi[a,*]

[a] Research Centre for Integrated Transport Innovation (rCITI), School of Civil and Environmental Engineering, University of New South Wales, Sydney, 2052, Australia
[b] School of Public Health and Preventive Medicine, Monash University, Melbourne, Australia
[c] City Futures Research Centre, School of Built Environment, University of New South Wales, Sydney, Australia
[d] Transport, Health and Urban Systems Research Lab, Melbourne School of Design, The University of Melbourne, Melbourne, Australia
[e] Institute of Transport Studies, Monash University, Melbourne, VIC, Australia
[f] Department of Geography, University of California, Santa Barbara, USA

ARTICLE INFO

Keywords:
Bicycle route choice
Taste heterogeneity
Market segmentation
E-bike
Geller typology

ABSTRACT

A range of factors influences cyclists' route choices, yet infrastructure design often fails to account for the diverse preferences and needs of different groups. This study examines cycling route choice preferences using revealed preference GPS data from Melbourne, Australia. Path Size Logit (PSL) and Mixed Path Size Logit models are estimated to capture path correlation due to overlapping routes and taste heterogeneity in route choice preferences among cyclist groups, segmented by age, gender, e-bike use, and Geller typology. Using a hybrid generalized Breadth-First Search on Link Elimination (BFS-LE) approach, the study enhances the quality and diversity of the generated choice set. Results indicate significant taste heterogeneity in route choices, with distinct preferences across cyclist segments. Risk-averse cyclists, particularly women and the "interested but concerned" group, showed a strong preference for protected bike lanes and off-road paths. In contrast, more confident cyclists, such as "enthused and confident," exhibited greater flexibility and were less sensitive to infrastructure types, slopes, and turns. Traditional bike riders were found to be more sensitive to infrastructure variability compared to e-bike users. Findings also revealed that cyclists, on average, perceived a 1 % increase in the proportion of a route on an off-road bike path as equivalent to a reduction of 80 m in trip length, though this effect varied across individuals. Similarly, a 1 % increase in the proportion of a route on a protected bike lane was, on average, equivalent to a reduction of 61 m, while each additional turn was perceived, on average, as adding 121 m, highlighting the variability in how route complexity influences cyclists' choices. Overall, the study offers valuable insights for urban planners and policymakers, emphasizing the need for inclusive cycling infrastructure that accommodates the diverse preferences of different cyclist groups to encourage broader participation.

* Corresponding author.
E-mail address: meead.saberi@unsw.edu.au (M. Saberi).

https://doi.org/10.1016/j.tra.2025.104679
Received 22 January 2025; Received in revised form 5 September 2025; Accepted 11 September 2025
Available online 25 September 2025

Tanapon Lilasathapornkit, Debjit Bhowmick, Ben Beck, Hao Wu, Christopher Pettit, Kerry Nice, Sachith Seneviratne, Mohit Gupta, Hai L. Vu, Trisalyn Nelson, Meead Saberi, Cycling route choice preferences: A taste heterogeneity and exogenous segmentation analysis based on age, gender, Geller typology, and e-bike use, Transportation Research Part A: Policy and Practice, Volume 201, 2025, 104679, https://doi.org/10.1016/j.tra.2025.104679.

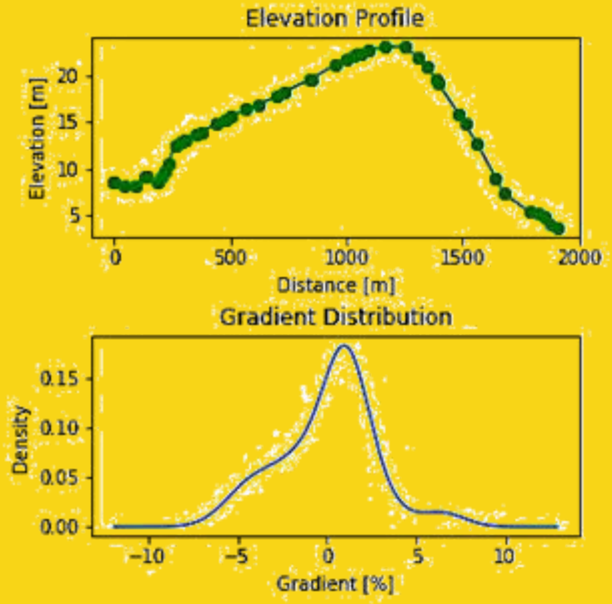
Smart phone-based RP survey

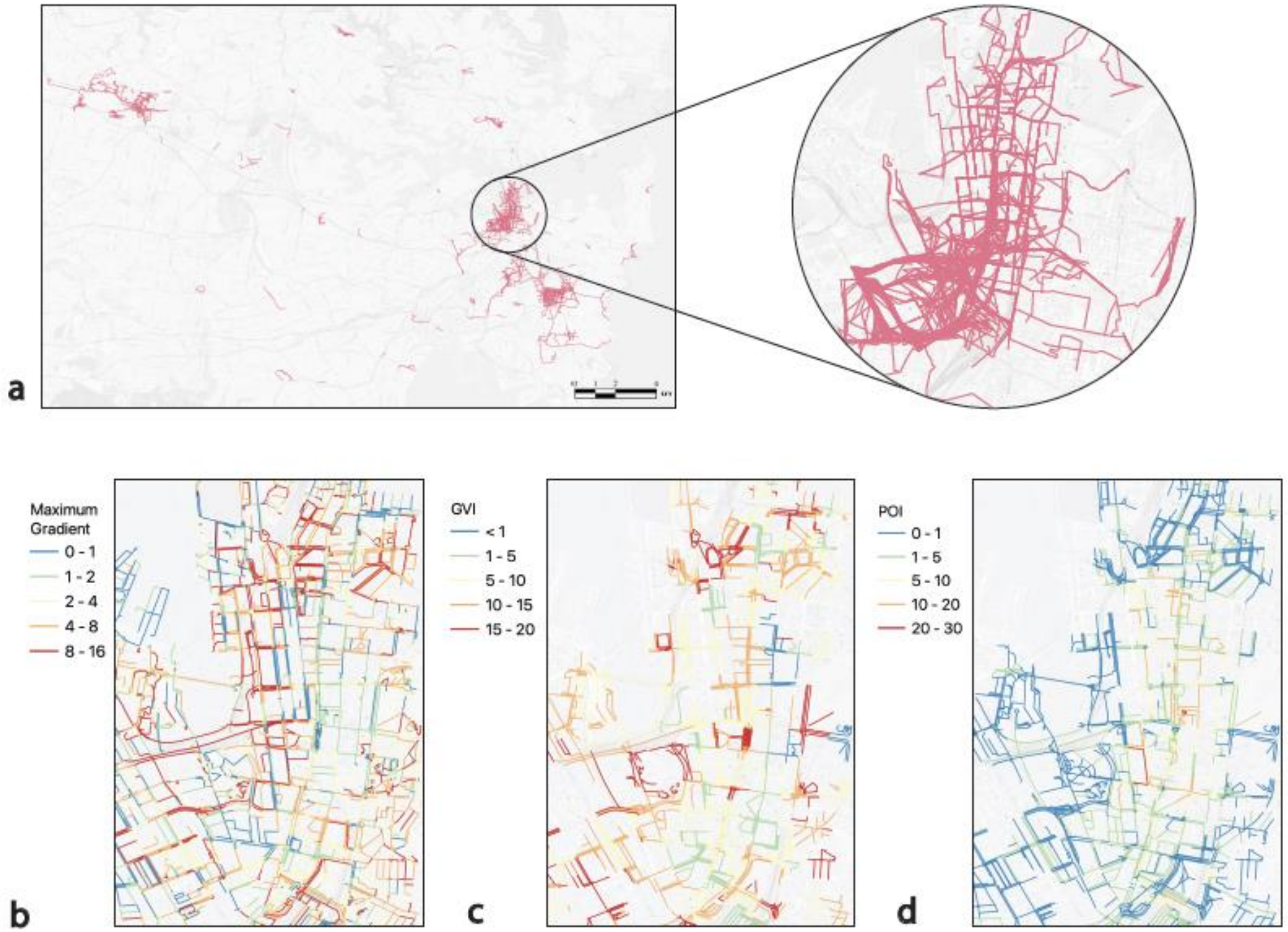
Collected from February to April 2019
Sample size: 1,250 walking trips

Going beyond travel distance

Slope, number of turns, number of crossings, vegetation (shade), POI, etc.

id	2726
originalId	6383
student zid	z5147478
start time	2019-03-04 05:49:36
end time	2019-03-04 06:53:48
purpose	Recreation/Excercise
noise	4.0
vegetation	3.0
Gradient average	0.0786
Gradient standarad dev	2.5926
Gradient max	6.7079





An overview of the input data:

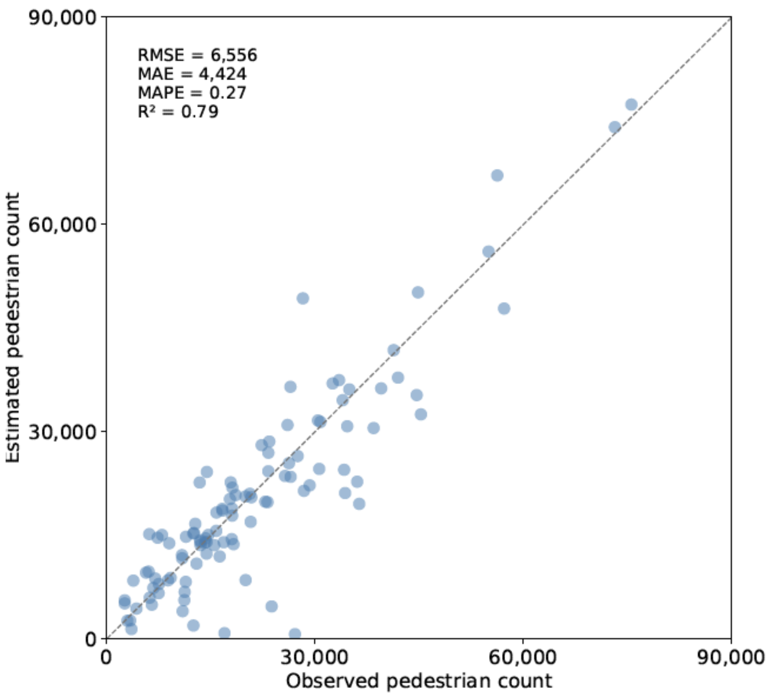
a) Passively observed walking trajectories in Sydney with a zoomed-in view of Sydney CBD;
b) Maximum gradient percentage at the link level;
c) Average Green View Index (GVI) at the link level; and
d) Number of POIs at the link level.

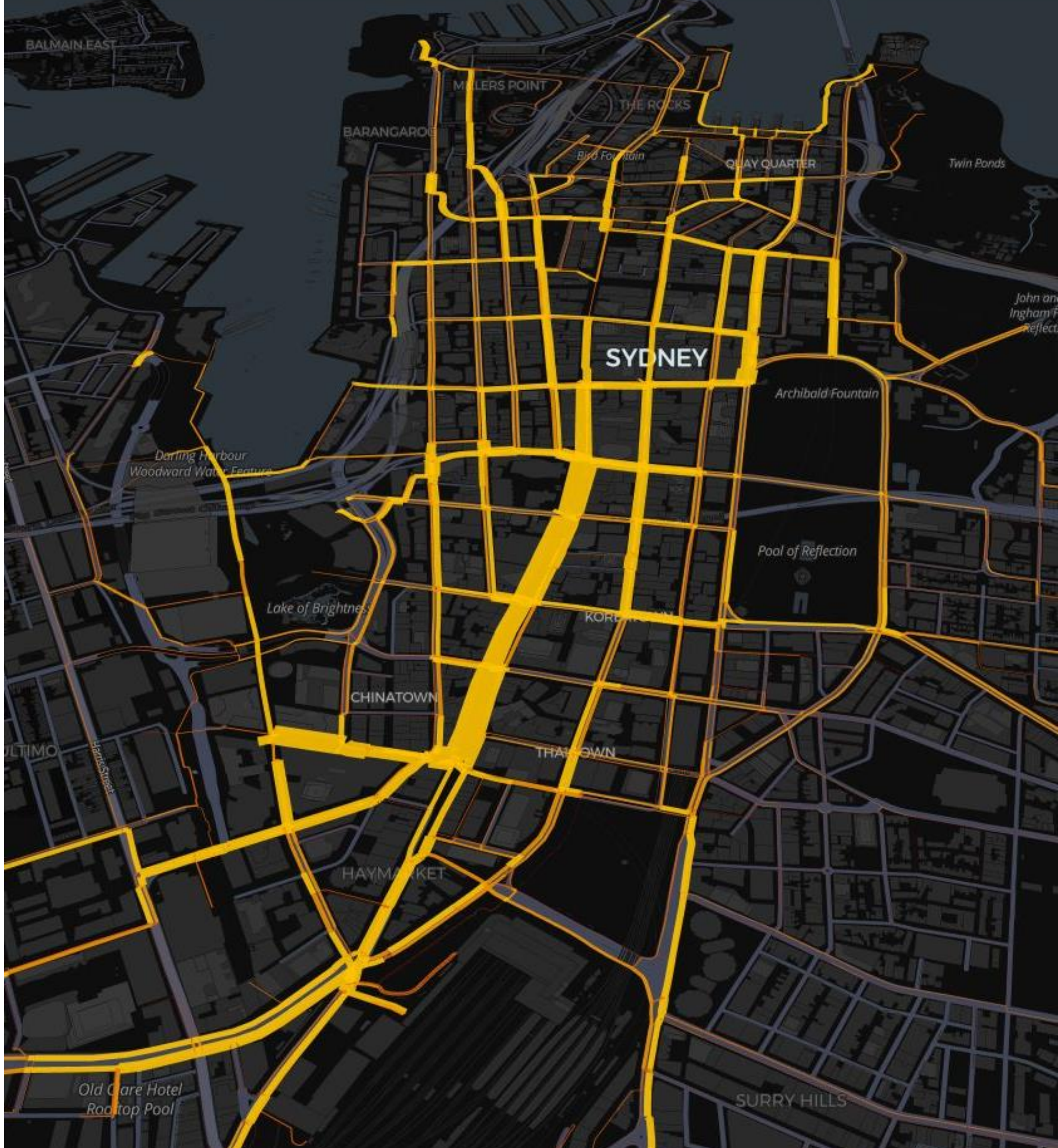
Logit-based route choice model

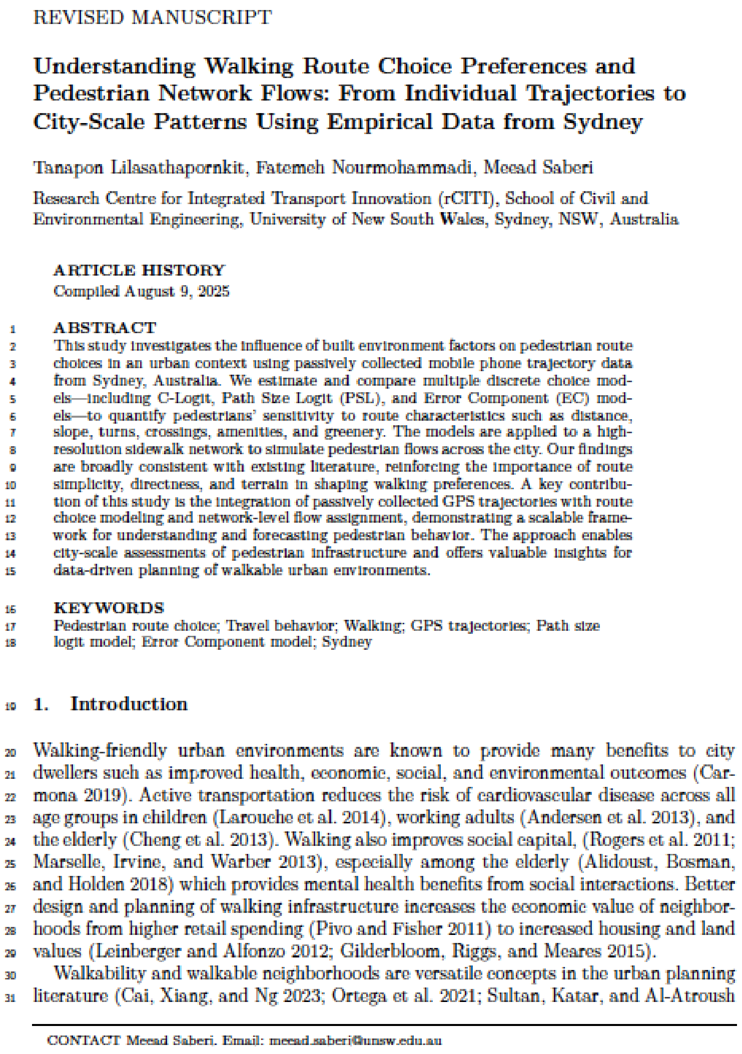
Variable (Unit)	C - Logit		Path Size Logit		EC Logit without Path Size		EC Logit with Path Size	
	β	t-value	β	t-value	β	t-value	β	t-value
Length (per 1 km)	-0.50	-2.28**	▼ -0.49	-2.22**	-0.39	-1.89*	-0.49	-2.22**
Number of turns	-0.11	-9.69***	▼ -0.11	-9.27***	-0.11	-9.39***	-0.11	-9.27***
Number of crossings (per 100 crossings)	-0.01	-2.15**	▼ -0.01	-2.02**	-0.01	-2.22**	-0.01	-2.01**
Maximum Gradient (percentage along the route)	-0.16	-7.63***	▼ -0.16	-7.42***	-0.16	-7.63***	-0.16	-7.42***
Number of POIs (per 10 points along the route)	0.01	1.38	▲ 0.01	1.06	0.01	1.14	0.01	1.06
Green View Index (average percentage)	0.29	0.31	▲ 0.03	0.04	0.05	0.06	0.03	0.04
Commonality Factor	0.65	4.60***						
Path Size			▼ -1.81	-7.27***			-1.82	-7.27***
σ_1 (per 1 km)					0.11	6.53***	-0.26	-0.14
σ_2 (per 1 km)					0.09	6.65***	0.20	0.29
σ_3 (per 1 km)					0.27	1.15	-0.20	-0.49
σ_4 (per 1 km)					-0.12	-1.45	0.00	0.34
σ_5 (per 1 km)					-0.02	-1.50	0.00	0.41
σ_6 (per 1 km)					0.07	5.01***	0.00	0.32
Final Log Likelihood	-1647.10		-1632.26		-1657.19		-1632.26	
Akaike Information Criterion	3308.21		3278.52		3338.38		3290.52	

Model outcomes and validation

Non-equilibrium zero-shot application of the estimated path size logit







REVISED MANUSCRIPT

Understanding Walking Route Choice Preferences and Pedestrian Network Flows: From Individual Trajectories to City-Scale Patterns Using Empirical Data from Sydney

Tanapon Lilasathapornkit, Fatemeh Nourmohammadi, Meead Saberi

Research Centre for Integrated Transport Innovation (rCITI), School of Civil and Environmental Engineering, University of New South Wales, Sydney, NSW, Australia

ARTICLE HISTORY
Compiled August 9, 2025

ABSTRACT
This study investigates the influence of built environment factors on pedestrian route choices in an urban context using passively collected mobile phone trajectory data from Sydney, Australia. We estimate and compare multiple discrete choice models—including C-Logit, Path Size Logit (PSL), and Error Component (EC) models—to quantify pedestrians' sensitivity to route characteristics such as distance, slope, turns, crossings, amenities, and greenery. The models are applied to a high-resolution sidewalk network to simulate pedestrian flows across the city. Our findings are broadly consistent with existing literature, reinforcing the importance of route simplicity, directness, and terrain in shaping walking preferences. A key contribution of this study is the integration of passively collected GPS trajectories with route choice modeling and network-level flow assignment, demonstrating a scalable framework for understanding and forecasting pedestrian behavior. The approach enables city-scale assessments of pedestrian infrastructure and offers valuable insights for data-driven planning of walkable urban environments.

KEYWORDS
Pedestrian route choice; Travel behavior; Walking; GPS trajectories; Path size logit model; Error Component model; Sydney

1. Introduction

Walking-friendly urban environments are known to provide many benefits to city dwellers such as improved health, economic, social, and environmental outcomes (Carmona 2019). Active transportation reduces the risk of cardiovascular disease across all age groups in children (Larouche et al. 2014), working adults (Andersen et al. 2013), and the elderly (Cheng et al. 2013). Walking also improves social capital, (Rogers et al. 2011; Marselle, Irvine, and Warber 2013), especially among the elderly (Alidoust, Bosman, and Holden 2018) which provides mental health benefits from social interactions. Better design and planning of walking infrastructure increases the economic value of neighborhoods from higher retail spending (Pivo and Fisher 2011) to increased housing and land values (Leinberger and Alfonzo 2012; Gilderbloom, Riggs, and Meares 2015).

Walkability and walkable neighborhoods are versatile concepts in the urban planning literature (Cai, Xiang, and Ng 2023; Ortega et al. 2021; Sultan, Katar, and Al-Atroush

CONTACT Meead Saberi. Email: meead.saberi@unsw.edu.au

Lilasathapornkit, T., Nourmohammadi, F., Saberi, M. (2025) Understanding Walking Route Choice Preferences and Pedestrian Network Flows: From Individual Trajectories to City-Scale Patterns Using Empirical Data from Sydney (*Pre-Print)*

Modelling pedestrian destination choice

Aggregate or disaggregate?
How to form the choice set?
How to estimate and validate?
How transferable the models are?

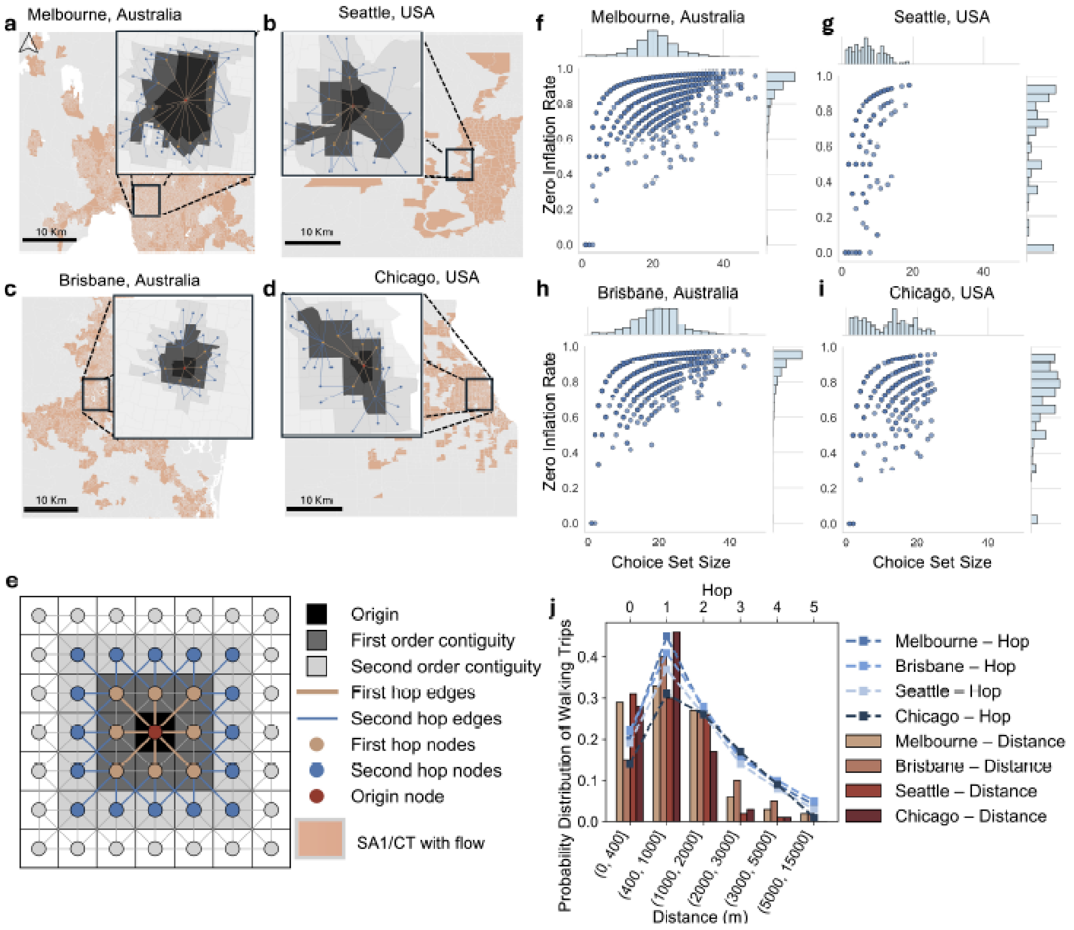


Figure 1. Study areas in (a) Melbourne, (b) Chicago, (c) Brisbane, and (d) Seattle. Each study area is divided into Statistical Area Level 1 (SA1) regions in Australia and Census Tracts in the United States. Light orange areas with grey borders indicate SA1s or Census Tracts where walking trips were observed as destinations, while grey areas with white borders indicate zones with no observed walking trips. The zoomed-in panels highlight a sample SA1 or Census Tract as the origin and its corresponding hybrid hop- and network-distance-based choice set. (e) A simplified 7×7 grid illustrating spatial Queen contiguity represented as a graph, centered on the origin. The black cell represents the origin unit. Dark grey and light grey cells show first- and second-order contiguity. Nodes correspond to spatial unit centroids: the red node marks the origin, while orange and blue nodes indicate first- and second-hop neighbors. Edge colors reflect hop distance from the origin. (f)–(i) Zero-inflation rates produced using the hop-distance-based choice set formulation. Scatter points (right y-axis) show the zero-inflation rate for each origin. Histograms (left y-axis) display the distribution of zero-inflation rates. The x-axis reports the size of the choice set, with accompanying x-axis histograms showing the distribution of choice set sizes.(j) Probability distribution of observed trips ending at hops 1–5, shown in shades of blue for each city. Probability distribution of observed travel distances across specified distance intervals, shown in corresponding color ranges for each city.

Are pedestrian demand models transferable? And to what extent?

Contents lists available at ScienceDirect

Transportation Research Part A

journal homepage: www.elsevier.com/locate/tra

Spatial transferability of pedestrian trip generation models

Fatemeh Nourmohammadi, Taha H. Rashidi, Meead Saberi *

Research Center for Integrated Transport Innovation (rCITI) School of Civil and Environmental Engineering, Sydney, 2052, Australia

ARTICLE INFO

Keywords:
Pedestrian trip generation
Spatial transferability
Machine learning
Statistical approach

ABSTRACT

The availability and consistency of pedestrian travel data vary across different locations, often requiring the transfer of estimated models in the absence of comprehensive local data. However, the extent to which pedestrian demand models are spatially transferable is not well understood. This study explores the spatial transferability of both aggregate and disaggregate pedestrian trip generation models using data from the Household Travel Surveys of Sydney, Melbourne, and Brisbane, Australia and two cities in the United States, Seattle and Chicago. We estimate Negative Binomial regression, Bayesian regression, and Random Forest models as aggregate approaches, while for disaggregate individual walking trip generation, we estimate a Poisson zero-inflated model, a two-step Logit-Bayesian approach, and a two-step Random Forest model. Results suggest that aggregate models exhibit reasonable transferability under certain conditions, while disaggregate models show greater limitations. The study demonstrates that while Random Forest generally outperforms other models in estimating the number of walking trips and shows strong transferability between cities, Negative Binomial Regression is effective at handling data with high variability, often surpassing machine learning models. The results highlight that both traditional and machine learning approaches have distinct advantages depending on data characteristics and under some data conditions such as sample size, the distribution of variables, and the heterogeneity of input variables. The combined use of these models can effectively capture the behavior of walking trip generation at different scales and provide valuable insights for policymakers and urban planners at both city-wide and localized levels, especially in areas where data might be lacking.

1. Introduction

Walking offers significant societal, public health, and environmental benefits. In response, cities worldwide are enhancing the appeal and convenience of walking by prioritizing pedestrian-friendly environments. This focus has spurred increased research into walking behaviors and dynamics (Zhang, 2023; Clifton et al., 2016a; Nourmohammadi et al., 2024). However, planners and policymakers often lack the tools needed to address pedestrian planning challenges and evaluate the impact of their investments. Historically, early transportation models combined walking and cycling into a single category known as the non-motorized mode (Waddell, 2002). Developing a model that reliably estimates walking trips and ensures its transferability is a challenge (Kuzmyak et al., 2014; Liu et al., 2012; Singleton and Clifton, 2013).

There is a growing need for more effective planning of active transportation infrastructure, which has led to initiatives that create stand-alone pedestrian planning tools or improve pedestrian representation within traditional urban travel demand models.

Spatial transferability in pedestrian demand models has received relatively little attention; however, high data collection costs and limited availability in some regions remain persistent challenges in demand modeling (Malokin et al., 2019; Nieland et al.,

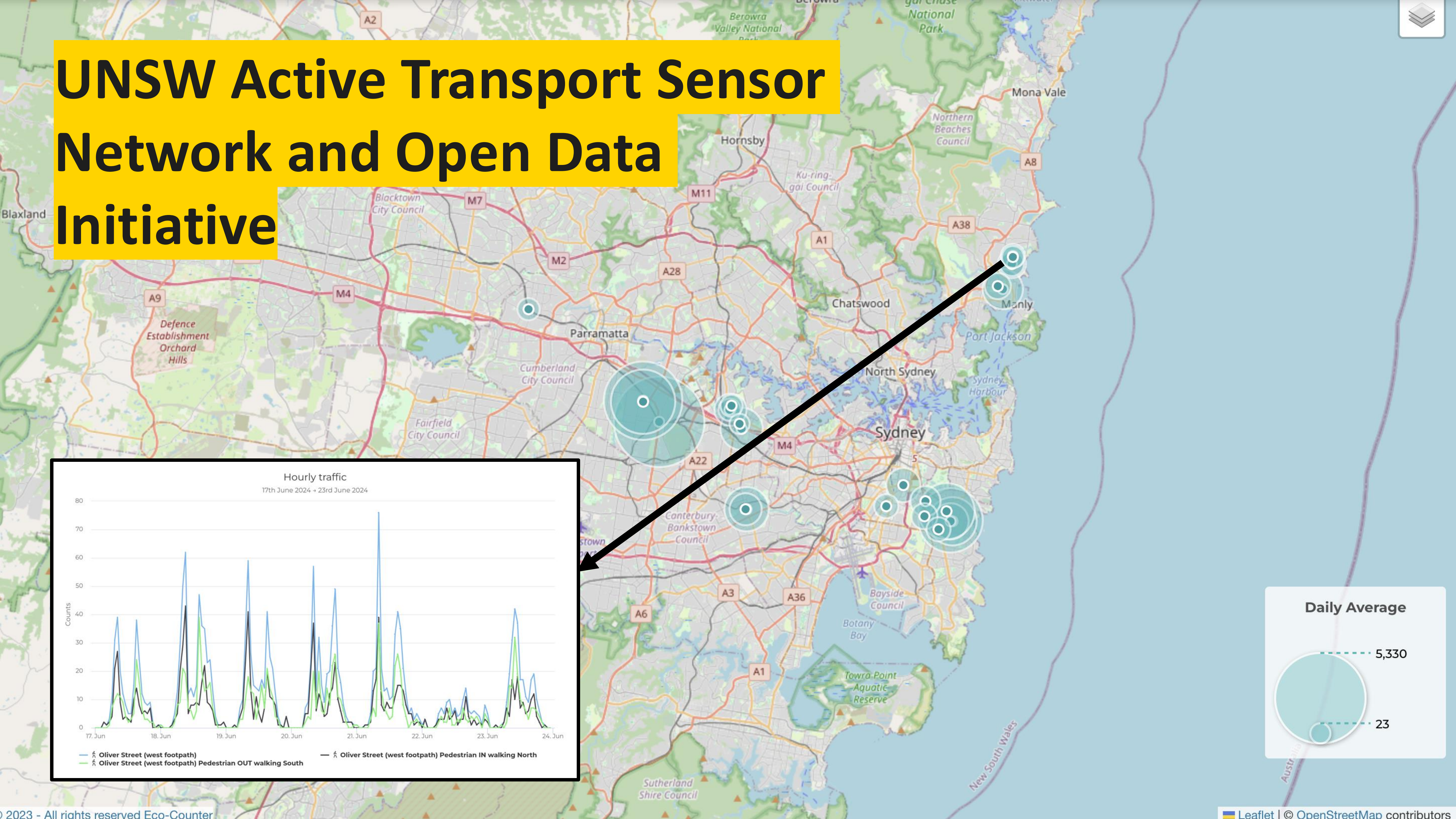
* Corresponding author.
E-mail address: meead.saberi@unsw.edu.au (M. Saberi).

https://doi.org/10.1016/j.tra.2025.104618
Received 20 January 2025; Received in revised form 28 May 2025; Accepted 18 July 2025
Available online 25 August 2025
0965-8564/©

Nourmohammadi, F., Rashidi, T.H., Saberi, M. (2025) Spatial transferability of pedestrian trip generation models. *Transportation Research Part A*, 199, 104618. https://doi.org/10.1016/j.tra.2025.104618

Building an open & independent network of pedestrian count sensors across Sydney

UNSW Active Transport Sensor Network and Open Data Initiative



One last reading recommendation

Zhang, Q., Moeckel, R. & Clifton, K.J. MoPeD meets MITO: a hybrid modeling framework for pedestrian travel demand. Transportation 51, 1327–1347 (2024). https://doi.org/10.1007/s11116-022-10365-x

Transportation (2024) 51:1327–1347
https://doi.org/10.1007/s11116-022-10365-x

MoPeD meets MITO: a hybrid modeling framework for pedestrian travel demand

Qin Zhang[1] · Rolf Moeckel[1,2] · Kelly J. Clifton[3]

Accepted: 22 November 2022 / Published online: 1 February 2023

Abstract
Transport demand models were initially designed for simulating car trips. Nowadays researchers and planners are considering pedestrian travel and its health and safety impacts in the regional transport models. However, the existing transport models lack the knowledge and experience in pedestrian modeling for health assessment. This paper contributes to the modeling practice by developing an integrated model called the MITO/MoPeD. The model builds upon previous model development and integrates the fine-grained pedestrian modeling tool into the agent-based transport model. The MITO/MoPeD model is applied to the Munich metropolitan area. Model performances are analyzed based on travel measures (e.g., walk share, trip length distribution, and pedestrian flow) and physical activity volumes. Results show that the MITO/MoPeD model can better represent pedestrian travel behavior than the existing Munich Model. It performed better in simulating the spatial distribution of walk shares and the distribution of walk trip lengths. Moreover, it overcomes the issue of overestimating physical activity volumes. These findings suggest that the MITO/MoPeD model can deliver more precise travel outcomes. More importantly, it is valuable for addressing pedestrian planning issues such as transportation infrastructure investments, land use planning, assessment of safety and health outcomes, and evaluation of environmental impacts.

Keywords Pedestrian modeling · Agent-based transport model · Travel outcomes · Physical activity volumes

Get in touch

meead.saberi@unsw.edu.au