# Rail station access by bicycle: a case study in Melbourne Victoria

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## Abstract

Public transport patronage levels are increasing worldwide, driven by a multitude of factors. In Melbourne, Australia a similar story is playing out with 235 million passenger trips serviced by the rail network in the 2016 financial year. This represents an annual growth of 1.6%. With increasing demand for public transport services an issue that will have to be addressed is the feasibility of providing adequate infrastructure capacity for station access modes, particularly by car. A cost effective solution is to encourage the use of the bicycle for the 'first mile' link. However, to promote cycling as a station access mode, a better understanding of the current bike and ride 'ecosystem' is needed. This research[1] aims to address this knowledge gap by exploring the demographic, built environment and station characteristics in Melbourne and how they play a role in the rates of bicycle access to stations. Findings show that a lack of cycling infrastructure leading to the station, connectivity issues with existing cycling infrastructure and adverse terrain may make it difficult for commuters to cycle to the station. However, the provision of secure bicycle parking facilities and underlying demographics characteristics of the residents around stations is an encouraging sign in promoting mode shift to the bicycle.

## 1. Introduction

Urban densification is a global change, 66 per cent of the world's population is expected to live in urban areas by 2050 (United Nations 2015). Concentrating growth in cities while aiming to cater for the mobility options will place increasing demands on existing networks, including public transport. To deal with increasing mobility demands in Australian cities, particularly Melbourne, a focus has been on increasing the public transport network capacity. Yet, how people access public transport is an important aspect of use that is often neglected.

The two most common station access modes in Melbourne is walking (56%) and then by car (18%) (Public Transport Victoria 2015). With rail patronage levels forecast to rise, the demand for vehicular based station access will also increase, adding to the strain on existing car parking facilities. Most urban stations are landlocked with limited land for car parking infrastructure. Existing car parks at stations reach capacity well before the AM peak period and overflow parking occurs in neighbouring streets impacting local residents.

Parking facilities for bicycles are much more cost effective. Catering for cyclists accessing the station requires a significantly smaller parking footprint while also providing economic,

[1] This is an abridged version of the paper originally submitted for ATRF 2018. For further information about this research please contact the authors.

environmental and health advantages. Given evidence that cycling rates and bicycle sales are increasing in Australia (Bauman et al. 2008, Australian Bicycle Council 2015) there is potential for the bicycle to cater for a higher proportion of station access trips.

At present there is a lack of understanding of the current context in which a cyclist has to ride to the station. This research aims to enhance the understanding of the bicycle as an access mode to railway stations.

# 2. Research context

This research is focused on Melbourne, Australia. With a current population of 4.8 million, Melbourne is expected to grow to 8 million by 2050, the size of London and New York (ABS 2018). Partly due to population growth, demand for public transport is projected to increase by 89 per cent by 2031 (Infrastructure Australia 2015). Melbourne is currently serviced by an extensive public transport network of heavy and light rail and, buses. This study focused on the radial rail network, which is 400 kilometres in length with a total of 219 metropolitan stations. At 73 stations there are dedicated secure bicycle parking facilities (a locked bicycle parking cage capable of holding 26 bikes), some stations provide bicycle parking hoops and cyclists could find somewhere to lock a bike at all stations (e.g. fence or post). Across the network there is substantial variation in the extent to which cycling is used as an access mode.

# 3. Research method

To explore the current context in which people ride to metropolitan stations in Melbourne, a range of data were compiled and analysed. Secondary sources of data, classified as demographic data, built/natural environment data and station attribute data were compiled from multiple sources (see table 1). GIS was used to capture, manipulate and extract spatial data relating to demographics and the built/natural environment at a station catchment level. The catchments were circular in nature, non-overlapping and represented a cycling distance of 4.5 km.

## 3.3 Demographic, built/natural environment and station characteristic variables

Demographic characteristics of the population living in each of the station catchment areas were obtained from the 2011 Australian census (Australian Bureau of Statistics 2011) and included: population density, median age and population attending educational institutes.

The built/natural environment is known to influence travel behaviour ( Vandenbulcke et al. 2011, Mertens et al. 2017). Factors considered for this category include municipal/principal bicycle network which considers the dedicated bicycle infrastructure such as on-road bicycle facilities, off road paths and local streets which form common bicycle routes along each of the station cycling catchment areas. Also considered were bicycle network connectivity, traffic volumes along major arterial roads and land use mix. The natural topography was also of interest as slopes greater than 3 to 5 percent have been reported to reduce rates of general cycling ( Heinen et al. 2010). As most cyclists are riding to the station to travel for employment and education (Rose et al. 2016) it was hypothesised that commuters would prefer a less physically taxing trip and a slope of 2 degrees was selected to define an adverse grade.

Aspects of the station such as the number of car parking spaces and the availability of secure bicycle parking facilities were also of interest. Secure bicycle parking facilities, defined as

enclosed parking facilities accessible only via a registered swipe card, were available at 73 railway stations.

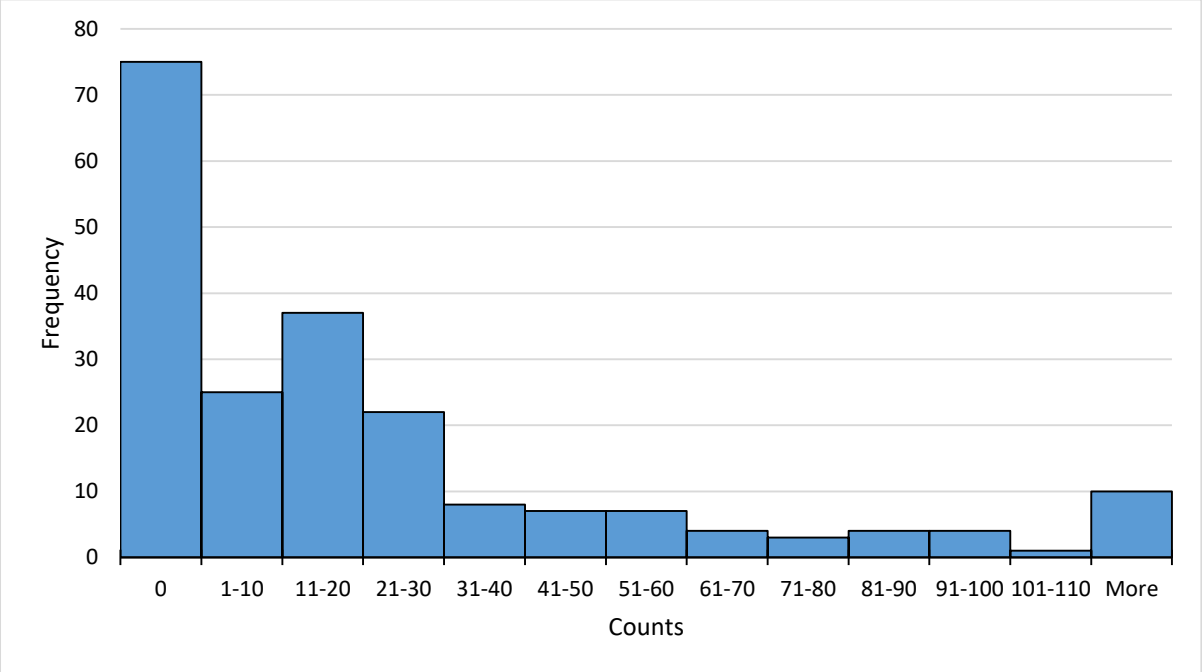
### 3.4 Station bicycle counts

Public Transport Victoria, the state's public transport authority provided counts of the number of cyclists riding to each of the metropolitan stations. This data represents the weekday daily entries by bicycle for the 2013/14 financial year across the 207 stations and was sourced from a 2012 Origin Destination Survey. The data from this intercept survey, which took place at each station for a single day, involved a systematic sampling approach. The survey period went for most of the year, excluding school holidays, public holidays and weekends. As this was a sampling survey, responses were weighted by patronage and factored up to represent total patronage.

## 4. Results

During the 2013/14 financial year, 5,139 daily weekday entries by bicycle to railway stations were recorded. On average, 24.83 cyclists access each of the 207 stations daily on a weekday. However, as seen from figure 1 below, at most stations the level of bicycle ridership is zero.

**Figure 1: Distribution of bicycle counts**




Variables considered as part of this research are presented in Table 1. Across the catchment areas, on average, the bicycle network density is 0.19 (out of 1), this indicates that comparatively to road infrastructure, provision of cycling infrastructure is limited. Compounding to this issue, the current cycling infrastructure that is provided is not well connected indicated by an average bicycle connectivity index of 0.26 out of 1. The average land use mix index is 0.51 indicating relative mixed land uses exist within a given station catchment area. At each station, on average, 186 car parking spaces are provided with a majority of roads within each catchment area being local streets (74.28%).

**Table 1: Descriptive statistics**

| Variable | Mean | Variance |
|---|---|---|
| Bicycle access counts[1] | 24.83 | 1607.82 |
| Population density (ppl/km)[2] | 2341 | 1834392 |
| Population attending educational institute (%)[2] | 14.46 | 14.20 |
| Median age[2] | 37.09 | 11.05 |
| Municipal/Principal bicycle network density[3] | 0.19 | <0.01 |
| Bicycle network connectivity[4] | 0.26 | <0.01 |
| Terrain (% area with slope greater than 2 per cent)[4] | 23.86 | 564.13 |
| Traffic volumes[3] | 8345.28 | 1807195.55 |
| Patronage (x10^6)[1] | 1.04 | 6.97 |
| Train frequency[1] | 19.44 | 74.00 |
| Number of car parking spaces[1] | 185.91 | 40158.19 |

**Data Sources:**
[1] Public Transport Victoria 2015, [2] 2011 Australian Census, [3] VicRoads 2017, [4] Department of Environment, Land, Water and Planning

Multivariate models were estimated to identify the effects of the explanatory variables on the extent to which bicycles were used as a station access mode. Across all models the directionality of the significant variables were the same, therefore discussion of the results will focus on the Negative Binomial forward selection sub model. The largest positive effect on the rates of cycling to a station was the level of rail patronage (total passenger entries). Frequency of departing trains during the morning peak period also has a positive relationship with the rates of cycling to the station. Availability of secure caged bicycle parking facilities at stations is also correlated with a larger number of cyclists riding to the station. The terrain, in terms of the percentage of the catchment area with a slope of 2 degrees or more, had the largest negative effect on the rates of cycling.

# 5. Conclusion

The bicycle as a station access mode offers a convenient urban mobility option. Encouraging station access by bicycle should be seen as part of a solution in managing access mode capacity pressures as demand for public transport increases. This study examined the current context in which cyclists are required to ride to the station in Melbourne, Australia. Station catchment demographics, the built/natural environment and station characteristics were considered. A lack of cycling infrastructure leading to the station and connectivity issues with existing cycling infrastructure where seen to be common across metropolitan Melbourne. Relatively high traffic volumes were also noted along arterial roads immediately surrounding the station catchment areas. Demographic variables including median age and percentage of population attending educational institutes show there maybe latent demand for commuters to cycle to the station as an access mode. Systematically lowering the barriers which prevent people from cycling to the station could help to unlock the potential of the bicycle as a station access mode.

# 6. References

Australian Bicycle Council (2015). National Cycling Participation Survey.

Australian Bureau of Statistics. (2011). "Data and Analysis." 2017, from http://www.abs.gov.au/websitedbs/D3310114.nsf/Home/Census?opendocument&navpos=200.

Australian Bureau of Statistics. (2018). "Population" 2018, from http://www.abs.gov.au/Population

Bauman, A. E., C. Rissel, J. Garrard, I. Ker, R. Speidel and E. Fishman (2008). Cycling: Getting Australia Moving: Barriers, facilitators and interventions to get more Australians physically active through cycling, Cycling Promotion Fund Melbourne.

Department of Environment Land Water and Planning (2018). "Open source dataset ".

Heinen, E., B. Van Wee and K. Maat (2010). "Commuting by bicycle: an overview of the literature." Transport reviews 30(1): 59-96.

Infrastructure Australia (2015). Australian infrastructre audit. Australian Government.

Mertens, L., S. Compernolle, B. Deforche, J. D. Mackenbach, J. Lakerveld, J. Brug, C. Roda, T. Feuillet, J.-M. Oppert and K. Glonti (2017). "Built environmental correlates of cycling for transport across Europe." Health & place 44: 35-42.

Public Transport Victoria. (2015). "Passenger activity by Metropolitan Station 2008-09 to 2013-14." Retrieved June 22, 2017, from https://www.ptv.vic.gov.au

Public Transport Victoria. (2018). "Research and Statistics." Retrieved June 22, 2017, from https://www.ptv.vic.gov.au/about-ptv/data-and-reports/datasets/.

Rose, G., H. Weliwitiya, B. Tablet, A. Subhasinghe and M. Johnson (2016). "Bicycle access to Melbourne metropolitan rail stations." Australasian Transport Research Forum, Melbourne.

United Nations (2015). "World urbanization prospects: The 2014 revision." United Nations Department of Economics and Social Affairs, Population Division: New York, NY, USA.

Vandenbulcke, G., C. Dujardin, I. Thomas, B. de Geus, B. Degraeuwe, R. Meeusen and L. I. Panis (2011). "Cycle commuting in Belgium: spatial determinants and 're-cycling'strategies." Transportation Research Part A: Policy and Practice 45(2): 118-137.

VicRoads. (2017). "VicRoads Transport Open Data API." from http://api.vicroads.vic.gov.au/#data.