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Determinants of mode and route change following the opening of a new cycleway in Sydney, Australia

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ABSTRACT

Background: The impact of new bicycle infrastructure is under-studied, particularly in cities with under-developed bicycle networks. This paper assesses the factors associated with people taking up bicycling, and changing their usual bicycle route, following the opening of a new cycleway separated from traffic in inner-city Sydney, Australia.

Methods: 783 people using the cycleway were intercepted and surveyed at two sites. Linear regression was used to identify factors predicting the extent to which respondents had diverted from the shortest route to use the cycleway. Logistic regression was used to identify factors associated with respondents who had changed transport mode or bicycle route since the cycleway opened. The models included observed gender and age, trip purpose, attire, length of time riding regularly, and intercept location.

Results: The average distance respondents had diverted to use the cycleway was estimated to be 351 m, with commuters diverting by 252 m on average, and non-commuters by 551 m on average. The 40% of respondents who had switched mode to bicycle were most likely to: have been riding regularly for two years or less (adjusted odds ratio (AOR) 8.14, 95% confidence interval (CI) 5.60–11.84); appear over 29 years of age (AOR 1.50, 95% CI 1.02–2.23); and, in the case of commuters, be female (AOR 1.68, 95% CI 1.05–2.68).

Conclusions: Government agencies that want to give non-regular riders and more women the option to travel by bicycle should consider building separated cycleways. People will take a longer route to use separated cycleways, but to a lesser extent if they are commuting to work or study. Cycleway routes intended for commuting purposes should be as direct as possible.

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1. Introduction

More than half of Australia's population are not sufficiently active ([Australian Bureau of Statistics, 2013](#)), placing them at a greater risk of heart disease, diabetes, and osteoporosis ([Australian Institute of Health and Welfare, 2016](#)). Giving more people the option to use a bicycle for everyday transport is often suggested as a way of increasing population physical activity, and has clear environmental, social and economic co-benefits ([Bauman et al., 2008](#)). For this reason, many governments worldwide have included in their transport strategies an objective to increase bicycle use (e.g., [City of Sydney,](#)

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2007; New York City Department of Transportation, 2008; Transport for London, 2013).

A proven strategy for achieving this objective on a substantial scale is to develop a network of bicycle routes that allow people to ride to activity destinations or public transport nodes without having to mix with high-speed/high-volume motorised traffic (Pucher et al., 2010). This can be realised by restricting motor vehicle volumes and speeds, and/or by constructing facilities that physically separate motor vehicle and bicycle traffic, e.g., laterally or grade-separated cycleways. In both cases, not only is the actual danger for bicyclists decreased – importantly, so too is the *perceived* danger (Manton et al., 2016; Schepers et al., 2015), thereby ameliorating one of the main deterrents to bicycling for a large segment of the population (Dill and McNeil, 2012; Pucher and Dijkstra, 2000).

In designing bicycle networks, and the individual facilities within them, consideration needs to be given to who will use them, and for what purpose(s). For example, a separated cycleway designed to allow children to ride to school in safety may not appeal to adult racing bicyclists (Pucher, 2001). Similarly, a meandering recreational cycleway may not suit commuters, who generally value minimising their travel time more so than non-commuters (Li et al., 2010).

When a new link in a bicycle network is opened, it is expected to change traveller behaviour in two important ways (Monsere et al., 2014). For people who previously used a different transport mode, the new link may reduce the generalised cost of bicycle travel sufficiently to incentivise them to change mode to bicycle. (The generalised cost of bicycling may include trip time/distance, as well as perceived danger, and be offset by enjoyment and perceived health benefit.) For people who already travel by bicycle, the new link may offer them a route option with a lower generalised cost than their regular one, incentivising them to change route to use the new link.

A number of previous studies have examined how decisions to travel by bicycle, or to use a particular bicycle route, are influenced by the amount of exposure to mixed traffic. These used stated preference (hypothetical) surveys (e.g., Börjesson and Eliasson, 2012; Poorfakhraei and Rowangould, 2015), self-reported travel data (e.g., Krenn et al., 2014; Monsere et al., 2014), or a combination of the two (Wardman et al., 2007). These studies consistently indicate that people, in general, will opt to avoid bicycling in mixed traffic by either (a) using a different transport mode, or (b) choosing a bicycle route or destination that minimises the time they spend in mixed traffic. Further, bicyclists will, in general, deviate from the most direct route to use separated cycleways and avoid mixed traffic. In addition, aversion to mixed traffic increases with age, decreases with bicycling experience, and is higher for females than males. However, these studies mostly focused on commuting trips, or did not investigate differences between commuters and non-commuters.

To our knowledge, no previous study has examined how propensity to change mode, or divert, to use a separated cycleway varies depending on both trip purpose and individual characteristics. In cities where bicycling is marginalised and the existing cycleway network is sparse and fragmented, rider behaviour and propensity to divert may differ considerably from cities with more established bicycle infrastructure. We know of no previous study that has investigated bicyclist route choice and propensity to divert in the context of an Australian city. It is also evident that intercept studies are rarely conducted after new bicycle infrastructure is developed, particularly in Australia.

With this in mind, the objectives of this study are threefold. First, to gather information about the users of a newly opened separated cycleway in a car-oriented Australian city, using an intercept survey. Second, to investigate individual characteristics and trip-related factors that may explain propensity to change mode or route following the opening of the cycleway. Third, to gain a deeper understanding of bicyclists' propensity to divert to use separated cycleways, by investigating the influence of individual characteristics, trip purpose and trip distance. This information would be of interest to those involved in the design of bicycle networks targeted at specific trip purposes (e.g., commuting or recreation), and/or specific population groups (e.g., unexperienced bicyclists or women), in similar cities with under-developed bicycle networks.

2. Material and methods

2.1. Setting

Like other Australian cities, Sydney is car-oriented and not conducive to everyday bicycling for a large part of the population. The speed limit on most arterial roads is 60 km/h, while for residential streets the default is 50 km/h. Bicycle lanes are often situated in the 'door zone' between parked vehicles and traffic lanes, and the few separated cycleways are disconnected and lack continuity. There are some recreational paths (shared with pedestrians) alongside motorways, rivers and beaches, but these are not planned with access to destinations or public transport in mind. Inner-city Sydney has a number of hills, and sales of electric-assist bicycles are growing (Charleston, 2016). The current climate is temperate, with warm summers and mild winters, and an average of 144 rainy days per year (Weatherzone, 2016).

The centrepiece of bicycle safety policy for the last 25 years has been laws that mandate the wearing of helmets for all types of bicycling, including low-speed recreational riding, with a fine of AUD\$319 for non-compliance (NSW Centre for Road Safety, 2016). However, the injury risk for bicyclists remains high by international standards (Garrard et al., 2010; Poulos et al., 2015).

While Australians buy more bicycles than cars (Austroads, 2014), suggesting a desire to ride, most do not in practice. In the Sydney metropolitan area, the bicycle mode share for trips under 10 km was 2.5% in 2012 (Bureau of Transport Statistics, 2013). According to the same source, in the 15–49 age category, the mode share for males (3.3%) was three times that for

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