Can walking and cycling for train access improve road safety?

Duc C. Phan [a], Long T. Truong [a], Hien D. Nguyen [a], Richard Tay [b]

[a] School of Engineering and Mathematical Sciences, La Trobe University
[b] School of Business IT and Logistics, RMIT University

Abstract

This paper investigates the impacts of train commuters' access modes on road safety at a network-wide level, using a case study in Victoria, Australia. Crash and census data were aggregated at the Statistical Area Level 1 (SA1) for the analysis. Results of negative binomial regression models illustrate positive effects of using train for commuting, either with walking or car access modes, on reducing both total crashes and severe crashes. The safety effects of commuting by train with the cycling access mode appear to be positive, which however were not statistically significant.

Background

Previous research has shown that commuting by public transport, particularly train, would reduce the total crashes and severe crashes (Truong & Currie, 2019). However, to connect to public transport, particularly train, travellers need to use various types of access modes (e.g., walking, cycling, or driving), which have very different safety implications (TIC, 2018). Walking and cycling are usually promoted in place of car travel due to their health benefits, low cost, and low environmental impacts (Cervero, 2001; Cervero, Caldwell, & Cuellar, 2013). However, pedestrians and cyclists are also widely considered as vulnerable road users (Zegeer & Bushell, 2012). Yet, little research has been done to investigate how train access modes contribute to the overall safety, especially at a network-wide level. This paper aims to investigate the impacts of train commuters' access modes on road safety at a network-wide level using negative binomial regression. The state of Victoria, Australia is selected as a case study.

Method

Census data in 2016 and road crash data from 2014 to 2018 were aggregated at the Statistical Area Level 1 (SA1). Two models were then developed for the total crashes and severe crashes, respectively, using negative binomial regression. Independent variables include journey to work mode shares (train with different access modes, tram, bus, walk, bicycle, motorcycle, and car), transport network (proportion of freeways and arterials, number of signalised intersections, train stations, bus and tram stops), sociodemographic characteristics (proportions of 0-14 age group and unemployment), and land use entropy. Population was used as the exposure variable. While traffic volume passing through SA1s was not considered in the analysis, transport network variables can act as its proxies. The proportions of train access by car (car driver and car passenger), cycling and walking were derived from the multi-modal journeys of train commuters. For simplicity, commuters who use bus or tram to access train are also considered train commuters with walking access.

Results

Table 1 showed that a higher proportion of commuting by train with car or walking access was strongly associated with fewer total crashes and severe crashes. The coefficients of commuting by train with cycling access were negative, suggesting positive safety effects that were however not statistically significant. Positive safety effects of commuting by tram and bus were also evident. Overall, the increase in public transport usage might reduce the number of private cars on the roads and therefore associated crash risks. Commuting by walking or motorcycling would increase both total crashes and severe crashes. Bicycle commuting would also increase total crashes. Results also confirmed the expected effects of sociodemographic and transport network variables.

Table 1. Results of negative binomial regression for total crashes and severe crashes

Variables	Total crashes		Severe crashes	
	Estimated	SE	Estimated	SE
Intercept	-0.433	0.117 ***	-1.071	0.145 ***
Log of population	0.076	0.02 ***	0.06	0.025 *
Proportion of 0-14 age group	-1.655	0.184 ***	-2.208	0.242 ***
Proportion of unemployment	-0.702	0.229 **	-1.89	0.303 ***
Land use mix - entropy	0.036	0.026	-0.133	0.034 ***
Proportion of freeway and arterial network	1.854	0.045 ***	1.668	0.057 ***
Number of signalized intersections	0.261	0.012 ***	0.175	0.014 ***
Number of train stations	0.193	0.058 ***	0.232	0.071 **
Number of bus stops	0.133	0.003 ***	0.13	0.004 ***
Number of tram stations	0.102	0.018 ***	0.108	0.022 ***
Proportion of commuting by train with car access	-5.529	0.54 ***	-6.561	0.729 ***
Proportion of commuting by train with walking access	-1.547	0.126 ***	-2.303	0.168 ***
Proportion of commuting by train with cycling access	-1.416	3.459	-2.357	4.684
Proportion of commuting by bus	-2.62	0.382 ***	-3.466	0.506 ***
Proportion of commuting by tram	-1.99	0.235 ***	-2.924	0.306 ***
Proportion of commuting by walking	3.008	0.158 ***	3.239	0.191 ***
Proportion of commuting by cycling	0.87	0.434 *	-0.514	0.577
Proportion of commuting by motorbike	7.705	1.068 ***	9.134	1.316 ***
Dispersion parameter (θ)	1.13	0.02 ***	0.91	0.02 ***
Log-likelihood	-31,944		-19,719	
AIC	63,925		39,476	
Sample size	13,768		13,768	

Note: * p<0.05; ** p<0.01; *** p<0.001; SE = Standard error; AIC = Akaike information criterion

Conclusion

In summary, mode shift from private vehicle to train for commuting, either with walking or car access modes, would significantly reduce both total crashes and severe crashes at a network-wide level. While cyclists are vulnerable road users, there is no evidence of negative safety impacts of cycling as a train access mode. An important implication of this study is that promoting walking for public transport access, particularly train, would create a synergistic effect on public health, road safety, the environment, and economy. Future research should enhance the modelling approach by explicitly considering traffic passing through an area or vehicle distance travelled.

References

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