The effect of cycle paths and lanes on cycling to work: a case study of Edinburgh

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Summary

This paper examines the influence of cycle paths and lanes on the level of cycling to work in Edinburgh, Scotland. The cycling to work data are from the 2001 and 2011 censuses at the output area level. Proximity to cycling facilities is defined for output areas if they are within 400 metres from their centroid to a cycle route. A number of socioeconomic factors are included in order to identify the independent effect of cycle facilities. Regression modelling results show that proximity to off-road paths is associated with increased levels of cycling to work but proximity to on-road lanes shows no effect.

KEYWORDS: Cycling to work, Census, GIS, Regression model, Edinburgh.

1. Introduction

In recent years, promoting cycling as a means of transport has been put on multiple policy agendas, including health, transport and climate change (Department of Health and Department of Transport, 2010). Despite potential benefits of cycling, its levels have declined in the second half of the twentieth century in Britain (Goodman, 2013). In the past 20 year there has been some evidence that trends may be partly reversing.

In order to promote cycling a number of infrastructures, programs, and policies have been implemented in cities around the world (Krizek and Johnson, 2006; Pucher et al., 2010). Most cities in the western countries have provided separate cycling facilities such as off-road cycle paths and on-road cycle lanes (Buehler and Pucher, 2012).

Research has been carried out to assess the role of an improved cycling infrastructure in promotion of cycling behaviour. However, findings on the relative importance of off-road paths compared to on-road lanes are mixed and sometimes contradictory. Moudon et al. (2005) find that households proximity to cycle paths increase the propensity to cycle, but they find no effect for cycle lanes. Cervero et al. (2009) and Dill and Voros (2007) report no positive correlation between cycle lanes and cycling levels. By comparison, a study in a US city by Krizek and Johnson (2006) finds an increased likelihood of cycling for people living within 400 m of a cycle lane, but no significant impact of cycle paths.

In UK only a limited number of studies were carried out. Parkin et al (2008) use the 2001 census data to analyse determinants of levels of cycling to work at the ward level in England and Wales. They find that the proportion of cycle routes that are off-road is significantly associated with cycling as a share for commuting means. Wardman et al (2007) analyse national travel surveys and report similar findings. None of the research up to date has focused on Scotland where the proportion of cycling to work is lower than the rest of UK.

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This paper uses the city of Edinburgh as a study area. Edinburgh has a population of 489,000 covering an area of 264 km² and a density of 1800 per km², which indicates that it is a compact city thus ideal for trips by cycling (Hull and O'Holleran, 2014). The Edinburgh Active Travel Action Plan sets out an ambitious target for cycle modal share of 10% by 2020 (CEC, 2010).

In this paper we aim to assess the influence of off-road cycle paths and on-road lanes, by examining whether proximity to two types of cycle route is associated to the level of cycling to work. The research findings has potential to provide further evidence on policy interventions in promoting cycling to work through development of new cycling infrastructures.

2. Data and methods

We use data from both 2001 and 2011 censuses. In the census all respondents aged 16–74 with a current job were asked to respond to the question ''How do you usually travel to work?''. The commute modes include cycling; walking; public transport; private motorised transport (car, van or motorcycle, as a driver or passenger); and other modes. We calculated the level of cycling to work as the proportion of all people in employment. The data used are aggregate to the output area (OA) level with an average population of 150. The cycle route data were digitised from the SPOKES cycle path map of Edinburgh in 1999 and in 2010.

A GIS operation was carried out to identify OAs that have a centroid within 400 metres of cycle routes using the near function in ArcGIS, which measures the straight line distance from the OA centroid to the nearest cycle route. In 2001 45% and 14% of OAs are within 400 metres of off-road paths and on-road lanes while the equivalent figures increase to 55% and 29% by 2011.

The dependent variable is proportion of people who travel to work by bicycle. Thus, GLM logit regression is employed to estimate the effect of proximity to cycle routes on the level of cycling to work (Papke and Wooldridge, 1996). Proximity to off-road path is represented as a dummy variable indicating any OA whose centroid is within 400 metres of an off-road path. Similarly proximity to on-road lane refers to any OAs whose centroids are within 400 metres of an on-road lane.

To identify independent effects of cycle routes we controlled for a number of demographic and socioeconomic factors that might also predictive of cycling. We included proportion of men in employment and proportion of young workers who were aged 16 to 24. These factors have been shown to be linked to a higher level of cycling to work (Parkin et al, 2008). Car availability is related to a lower level of bicycle use. We thus included percentage of households that owned a car. The average commuting distance of each OA is also included. Long distance is a barrier to cycling to work. We also adjust for Scottish Index of Multiple Deprivation (SIMD), which is developed by the Scottish Government and based on data zones.

3. Results

Roughly 4.3% of people in employment used bicycle to travel to work in 2011 a 1.3 percentage points increase from the percentage in 2001. This level of cycling to work in Edinburgh is three times the national average, and more than double the levels in other large cities. Figure 1 shows the distribution in levels of cycling to work in Edinburgh in 2011. It can be seen that there is a higher level in the central areas and a lower level in the peripheral areas.

Table 1 shows modelling results from linear regression models. Two models were fitted for 2001 and 2011 separately with the first a univariate model including only the proximity to off-road path indicator and the second a multiple regression model adjusting for other factors. The 2001 models show that proximity to an off-road path is related to elevated levels of cycling to work. On average, the level of cycling to work is 10% higher (0.3% percentage points) among OAs that are close to off-road paths than among other OAs after adjusting socioeconomic variables. The positive association between proximity to off-road path remains in 2011 but the effect size decreases slightly.

Additional modelling results are in Table 2. In these models a dummy indicator showing proximity to on-road lane is also included in addition to proximity to off-road path indicator. Again models were fitted for 2001 and 2011 separately. It can be seen that proximity to on road lane does not display any significant effects on the level of cycling to work.

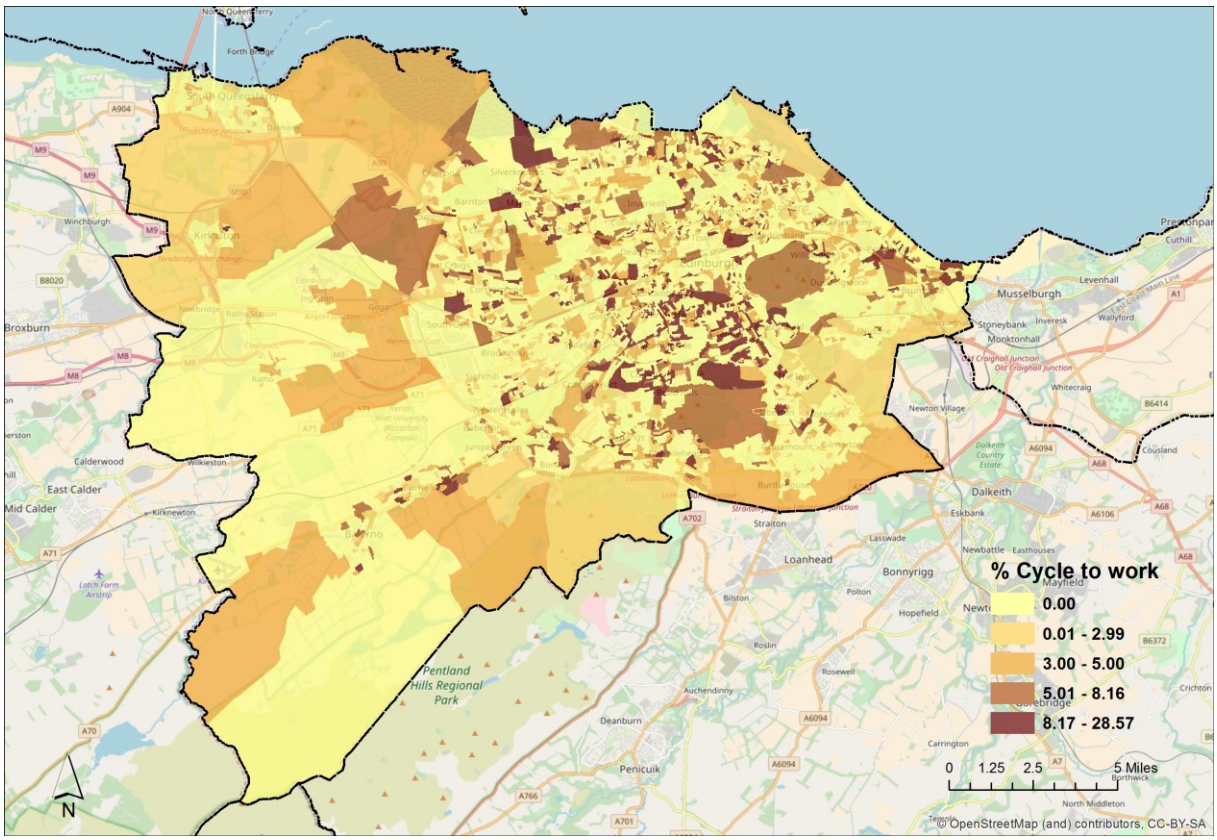

Figure 1 Levels of cycling to work at the output area level in 2011.

Table 1 Modelling results predicting the level of cycling to work with proximity to off-road cycle paths in Edinburgh

Variable	2001		2011	
	Model 1	Model 2	Model 1	Model 2
Proximity to off-road path (<400m)	0.125***(0.039)	0.100**(0.039)	0.069**(0.031)	0.087***(0.030)
% male workers		0.007***(0.003)		0.002(0.003)
% young workers		0.000(0.004)		0.000(0.002)
Mean distance to work		-0.007**(0.003)		0.002(0.019)
% households with car		-0.010***(0.002)		-0.005***(0.001)
SIMD decile		0.121***(0.009)		0.123***(0.006)
Constant	-3.510***(0.030)	-4.072***(0.198)	-3.039***(0.023)	-3.752***(0.165)

** p<0.05 , ***p<0.01. standard errors are in bracket. 2001 N=3975, 2011 N=4322

Table 2 Modelling results predicting the level of cycling to work with proximity to off road cycle paths and on road cycle lanes in Edinburgh

Variable	2001		2011	
	Model 1	Model	Model 1	Model 2
Proximity to off-road path (<400m)	0.121***(0.039)	0.098**(0.039)	0.069**(0.031)	0.088***(0.030)
Proximity to on-road lane (<400m)	0.078(0.054)	0.037(0.052)	0.015(0.034)	-0.045(0.033)
% male workers		0.007***(0.003)		0.002(0.003)
% young workers		-0.000(0.004)		0.001(0.002)
Mean distance to work		-0.007**(0.003)		0.002(0.018)
% Households with car		-0.010***(0.002)		-0.005***(0.001)
SIMD decile		0.121***(0.009)		0.123***(0.006)
Constant	-3.519***(0.031)	-4.070***(0.198)	-3.044***(0.025)	-3.741***(0.165)

** p<0.05 , ***p<0.01. standard errors are in bracket. 2001 N=3975, 2011 N=4322

4. Discussions and Conclusions

This paper explores the association of cycle paths and lanes and the level of cycling to work in Edinburgh. We find a significantly positive relationship between proximity to off-road paths and the proportion of trips to work by bicycle for both 2001 and 2011 but no relationship for on-road lanes. The findings support previous literature (Parkin et al, 2008; Wardman et al 2007; Beuhler & Pucher, 2012) but differ from others (Krizek and Johnson, 2006). Our methods use GIS functions to derive measures of proximity to cycle routes which has advantages over previous measures that quantify the density of cycle paths at local authority level and ignore the heterogeneity of spatial distribution across areas (Parkin et al, 2008). Although this is by no means indicative of a causal relationship, this research provides further evidence on the effects of cycle facilities on cycling behaviour, lending support on policy interventions that cycle facilities can be built to promote cycling to work.

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Biography

Zhiqiang Feng is a senior lecturer in human geography at the School of Geosciences of University of Edinburgh. His research interests are health geography, GIS, spatial analysis, population geography and longitudinal data analysis.

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