# Tools for planning future Active Travel networks

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**Summary**

To reduce carbon emissions in the transportation sector, the UK aims to increase cycling rates for short journeys. However, the UK has a disjointed and undeveloped cycle network which is unable to facilitate this increase in its current state. This project aims to study the cycling infrastructure connectivity within the UK and internationally to determine if the UK is able to host a developed cycle network and where development would be required. This abstract presents the author's PhD project, to be developed over the next three years and intended to provide evidence for the future of UK cycle network development.

**KEYWORDS:** Cycle infrastructure, connectivity, urban form, low-traffic neighbourhoods, community detection.

## 1 Introduction

Active travel provides a low-carbon, health-beneficial and low-cost alternative mode of transport for short duration journeys when compared to motorised vehicles. It has proved to be a viable supplement to motorised transport, particularly within Northern Europe. However, despite similar climatic conditions, population characteristics and economy to nations within the area, the UK has not developed a similar active travel culture (Chapman et al., 2018; Department for Transport, 2022). Only 2% of journeys are completed by bicycle in the UK, compared to 25% to that of the global leader of the Netherlands (Statistics Netherlands, 2015). This difference has been attributed to the lack of investment into active travel infrastructure. However, due to the threat of the climate crisis (Lamb et al., 2021), government COVID-19 strategies (Department for Transport, 2022) and the success of active travel in other nations (Lovelace et al., 2017), the UK has begun to expand its resources for active travel. This has unlocked funding to facilitate improvements to the active travel network. This funding is aimed to develop further and expand existing infrastructure. It also aims to level up areas which are significantly lacking in the infrastructure to enable equitable levels of accessibility and travel.

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The government's Cycling and Walking Investment Strategy (Department for Transport, 2022) has attempted to tackle walking, wheeling and cycling in two main strands. Firstly, there has been a drive to make existing streets more accessible and 'people friendly'. This has been attempted via the implementation of Low Traffic Neighbourhoods (LTN), allocating greater pavement space and pedestrianisation of town centres (Department for Transport, 2020). The second step of the government process has been to redesign towns, cities and neighbourhoods to enable greater accessibility to active travel. Creation of new cycle paths and major changes to road infrastructure is planned as part of this initiative.

Whilst some improvements to the active travel network have been made through the Cycling and Walking Investment Strategy, there is still much to be desired to reach an acceptable level of infrastructure. Developments have largely been in isolated sections of the network, aiming to provide better access along a particular segment. This has led to a sprawling but highly disconnected network within UK cities (Figure 1). Cycling particularly suffers under this scenario, where users may not be comfortable sharing space with motorised transport on links between protected infrastructure. This fragmentation creates an undesirable network with low accessibility across a region, whilst simultaneously reducing the priority of new active travel links being developed due to low usership rates compared to other nations.

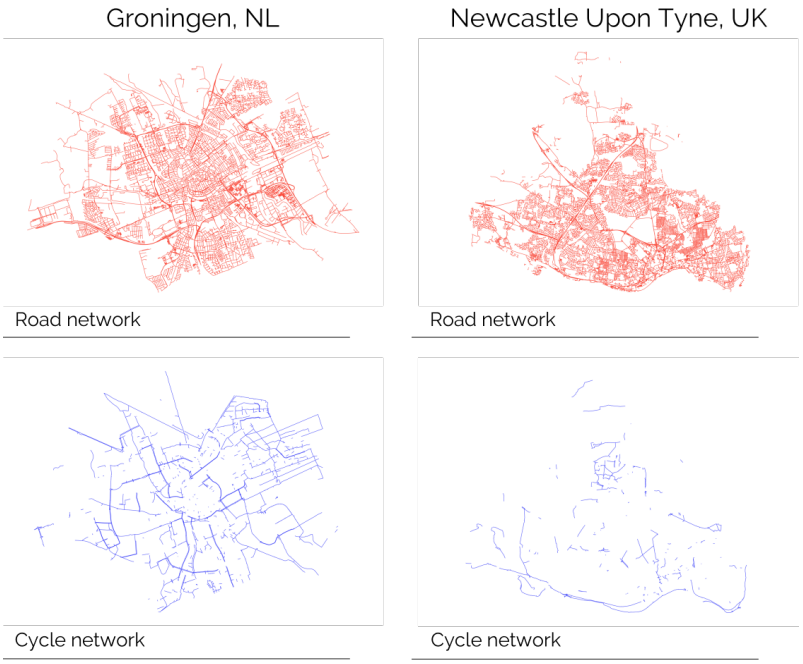


Figure 1: A comparison of cycle networks between Groningen and Newcastle Upon Tyne. Newcastle displays a highly disconnected cycle network, whilst Groningen is highly connected network. 60% of all journeys are completed by bicycle in Groningen, compared to just 7% in Newcastle (International Groningen, 2019; Newcastle City Council, 2017).

This disconnect between infrastructure is not limited to just cycle dedicated paths. LTNs form a major component of both government strategy and the physical infrastructure for active travel in the UK (Bosetti et al., 2022; Department for Transport, 2022). From a planning perspective LTNs are seen as a low cost method of increasing active travel as vehicle travel becomes increasingly difficult, slow or expensive for short inter-urban journeys. Use of the streets is retained for walking or wheeling, often using modal filters. Lower traffic levels are conducive to higher active travel rates, as journeys are perceived as safer and less stressful (Aldred et al., 2021). However, LTNs suffer from the same connectivity problems as other dedicated infrastructure. LTNs currently often act as 'Islands of accessibility', where connectivity for Active Travel (AT) is good within the neighbourhood but poor when attempting to move between neighbourhoods. By considering connectivity between neighbourhoods, significant accessibility gains may be found.

Effective long-term planning of active travel networks can be used to tackle the low cohesion of the current networks and to access the benefits brought by active travel for a wider group of potential users. The rest of this abstract presents the author's PhD project, which looks to study the spatial aspects of active travel network development. This research will bring together research of urban form, network growth and accessibility to create an evidence base for planning stakeholders to develop active travel networks.

## 2 Research aims and objectives

Based on the identified research gaps and challenges, the following aim has been developed to address these knowledge gaps and guide this PhD project:

- *To develop a suite of geospatial tools to improve planning of active travel infrastructure in the UK*

In order to achieve the aforementioned research aims, four research objectives are stated to guide how the research aim is to be addressed. The objectives are as follows:

- **Objective 1**: Develop metrics for the comparison of the form, connectivity and accessibility of urban areas across the UK and internationally.
- **Objective 2**: Identify the characteristics of LTNs and automate the detection of these zones.
- **Objective 3**: Simulate optimal active travel network growth to create cohesive networks which links cycle infrastructure and LTNs.
- **Objective 4**: Assess the impacts of the generated networks in terms of emissions, noise pollution, congestion, public health and accessibility.

## 3 Methods and data

### 3.1 Methods

To investigate the relationship between urban form and the development of active travel networks, an exploratory data analysis will be performed using the street networks across cities globally. This analysis will be informed by urban morphology metrics as shown in Fleischmann (2019); Boeing (2019); Fleischmann et al. (2021, 2022). Measures of network attributes such as street width and counts of cycle infrastructure will also be collected to investigate fragmentation and the re-purposing of streets. Once metrics are determined, analytical comparisons between locations will be made. This will determine what impact (if any) urban form has on existing cycle infrastructure. This analysis will highlight where on the spectrum the UK resides, along with disparities within the UK.

To detect LTNs, community detection algorithms will be applied to street networks in urban areas to delineate neighbourhoods. This will enable areas to be partitioned based on their connectivity. Using known LTN zones, urban morphology and accessibility metrics will be used to determine the characteristics of LTNs.

With LTNs identified, the next step aims to simulate the growth of the cycle network to create a cohesive network. Growth of the network will be performed using an iterative algorithmic approach, as recommended by Orozco et al. (2020). Specifically, the Largest-to-Closest and Largest-to-Second methods, where infrastructure components are procedurally joined based on distances from other components. Within this simulation, LTNs will be considered as part of the infrastructure. The iterative nature of this growth procedure will be used to highlight the missing links between both cycle infrastructure and LTNs to create a truly cohesive network within a UK context.

The final step will be to analyse the impacts of the newly generated network. This analysis will include scenarios of change, where the number of users who cycle can be modified based on differing predicted levels of uptake in active travel. Modelling of changes in emissions, noise pollution, public health and accessibility will give a holistic indication of if a cohesive network would be beneficial to an given area. Along with the proposed network, these changes will be viewable via a webmap interface. This will allow stakeholders to engage with the findings of this proposed PhD.

### 3.2 Data and software

This project will utilise a open-source stack of data and software. Street networks will be accessed from OpenStreetMap via OSMNx (OpenStreetMap contributors, 2017; Boeing, 2017). All analysis will be undertaken using Python. Specifically, use of the momepy, NetworkX, pandana, GeoPandas and OSMNx packages (Fleischmann, 2019; Hagberg et al., 2008; Foti et al., 2012; Jordahl et al., 2020; Boeing, 2017). Social and environmental indicators will be accessed from open Government sources, such as the 2011 UK Census (Office for National Statistics, 2011).

## 4 Project Timeline

This project will be completed over the next three academic years. Six months are allocated to each of the research objectives. Remaining time will be allocated to visualisation of the findings of the project to ensure research can be communicated proficiently.

## 5 Acknowledgements

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## 6 Biography

Chris is a PhD student at the EPSRC Centre for Doctoral Training (CDT) in Geospatial Systems. He has completed both an undergraduate in Geographic Information Science and MRes in Geospatial Data Science at Newcastle University. His research interests lie within active travel, spatial networks and emissions reduction.

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