Safe routes to schools: the value of school travel data for cycle planning

Joey Talbot and Robin Lovelace

Contents

1 Introduction

The goal of this project is to explore how the incorporation of travel to school data can add additional value to the Propensity to Cycle Tool. We demonstrate how this can be used for a range of purposes, including in combination with travel to work data, to aid in cycle infrastructure planning.

In residential neighbourhoods, various measures have been shown to improve road safety and raise cycling levels, such as the promotion of 'liveable streets' - where the emphasis is on reducing vehicle speeds and volumes (TfL 2019), 'filtered permeability' - where elements of separation give sustainable modes an advantage over private motor traffic in terms of speed, distance and convenience (Melia 2015), and the construction of protected or on-road cycle routes (Aldred et al. 2017). But where can these techniques be applied to best effect? We aim to provide the tools that planning officers, consultants or others can use to determine where the best locations are for these measures to be put in place, and the evidence that can be used to support their introduction.

Using data from Leeds and West Yorkshire, we illustrate:

- Different methods of visualising cycle potential across a wide area
- Residential zones that can be served by a major safe route to school

- How to join routes to schools into a series of connected networks and to identify where the largest potential network can be found
- Combining school and commute journeys to explore overall cycle potential.

1.1 Why cycle to school?

There are numerous reasons why increasing the number of children who cycle to school is an important policy goal. Inactivity is a major cause of a range of physical and mental health conditions. Meeting recommended levels of physical activity can prevent or manage 20 chronic health conditions and diseases, help people to maintain a healthy weight, and reduce the risk of mental health conditions such as depression, stress and anxiety, as well as providing opportunities for social interactions (BMA 2019). Only 22% of children in England and 18% of children in Wales are currently achieving the Chief Medical Officers' recommendation of 60 minutes of physical activity per day, outside of in-school activities (BMA 2019). Enabling children to travel safely to school by bicycle will help them to stay active while at the same time helping to ameliorate a range of other problems such as air pollution, congestion and carbon emissions.

Reducing air pollution in the vicinity of schools is a key concern. In London alone, nearly 9,500 premature deaths each year are attributable to poor air quality (Walton et al. 2015). This was recently highlighted by the London Councils Environment Directors' Network and the Association of Directors of Public Health, who call for "action to mitigate pollution hotspots, particularly those around schools" (London Environment Directors' Network 2019). As well as causing air pollution, driving to the school gate can also have serious road safety implications (Kingham et al. 2011).

The UK has committed to zero carbon emissions by 2050, yet while CO_2 emissions from energy generation have fallen, emissions from transport remain high. In 2018, transport was the single largest-emitting sector, responsible for 33% of UK CO_2 emissions (BEIS 2019). To minimise this, we need to move away from private motor vehicle use and towards active travel. Highlighting the current concern surrounding travel to schools, Leeds has recently seen a proposal to build a new car-free primary school, designed with no parking spaces for staff or visitors and where drop-offs will be discouraged.

1.2 Beyond the school gates

Travel to schools can also be seen as a proxy for other journeys within residential areas. In contrast with workplaces, which tend to be highly concentrated in city centres and out-of-town employment zones, schools are much more widely dispersed throughout residential areas such as suburbs, towns and villages; thus school journeys are likely to more closely align with the other non-commute journeys that people make within these residential areas, such as visiting friends or accessing local shops and services. Therefore, combining school and commute travel data can help us to better represent the overall propensity for cycle journeys of a wider range of purposes.

2 Methods

To investigate cycle potential, we make use of the Propensity to Cycle Tool (Lovelace et al. 2017; Goodman et al. 2019). To ensure transparency and reproducibility, the code underlying the results presented in this report have been published, at github.com/npct.

2.1 Visualising cycle propensity

To explore cycle propensity it can be helpful to visualise the prospects for cycling across a given area. This might be the entire area covered by a Transport Authority, an individual town or city, or a smaller neighbourhood. The existing PCT methods generate vector route networks. As illustrated in Figures 1 and 2, we investigate converting these into raster representations, which may be better at revealing the big picture across an area as a whole. For example, a raster approach can reveal areas with a high density of cycle routes, in situations where there may be several parallel streets that are identified as part of a vector route network. A raster approach is especially useful when combining schools and commute data, because the differing destinations of cyclists will increase the likelihood that these flows are routed along different streets.

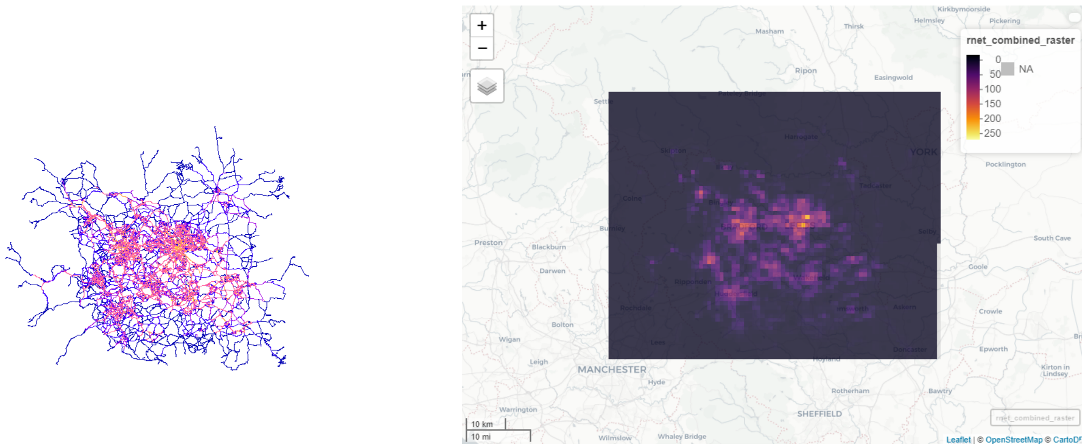

Figure 1: Demonstration of vector vs raster representations of combined commute/school travel route networks in sample region (West Yorkshire).

For the raster images in Figures 1 and 2 pixel values have been calculated using the route network length multiplied by its mean usage (under the Go Dutch scenario). These raster images show the combined propensity for both travel to school and travel to work, but images could equally be generated to show cycle to schools only. Figure 2 shows the aggregation effect of rasterising the road data, with two different spatial resolutions. We can see how individual roads are lost, but the overall picture is retained.

The raster approach should be helpful in identifying areas where several relatively high-usage cycle routes lie close to one another, such as areas close to schools perhaps. This is good for identifying the general locations where cycle improvements are likely to benefit the greatest number of people. Meanwhile, the vector approach reveals the underlying network of potential cycle routes, with a higher level of detail that enables us to pick out the actual roads that cyclists may be using.

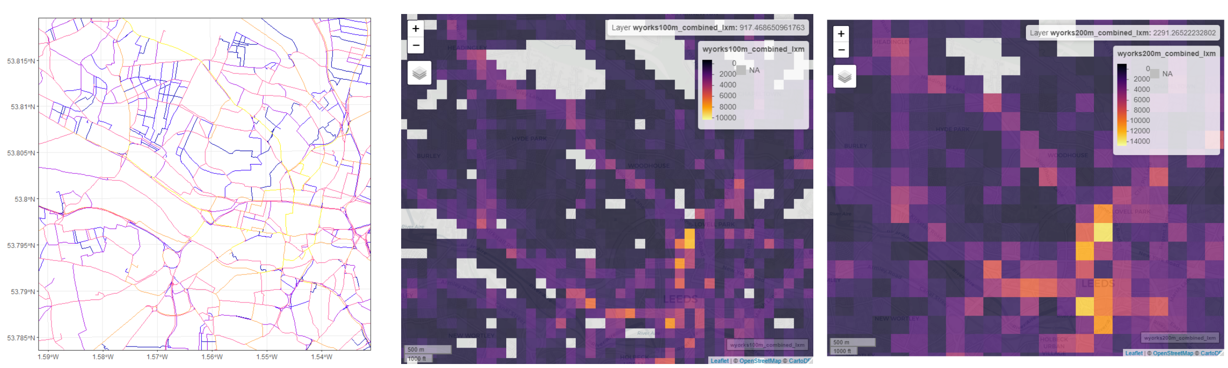

Figure 2: The vector route network, 100m and 200m resolution raster images for the centre of Leeds, showing the combined commute/school travel networks.

2.2 Residential zones

Another application of this research is to identify residential zones that would be served by a major safe route to school. This can provide evidence supporting interventions to promote cycling in these areas. Individual schools can better understand how to promote cycling and where to focus their attention, and Local Authorities can view the prospects for introducing measures such as 'liveable streets' or 'filtered permeability.' As well as aiding travel to school, measures within residential zones are likely to be beneficial for other cycle journeys and for road safety in general.

To do this, we must first locate the bounds of residential zones then look at where these zones might be served by major safe routes to schools. Residential zones are identified using built-up areas as defined in ONS data (ONS 2019), then further refined using distance from LSOA centroids.

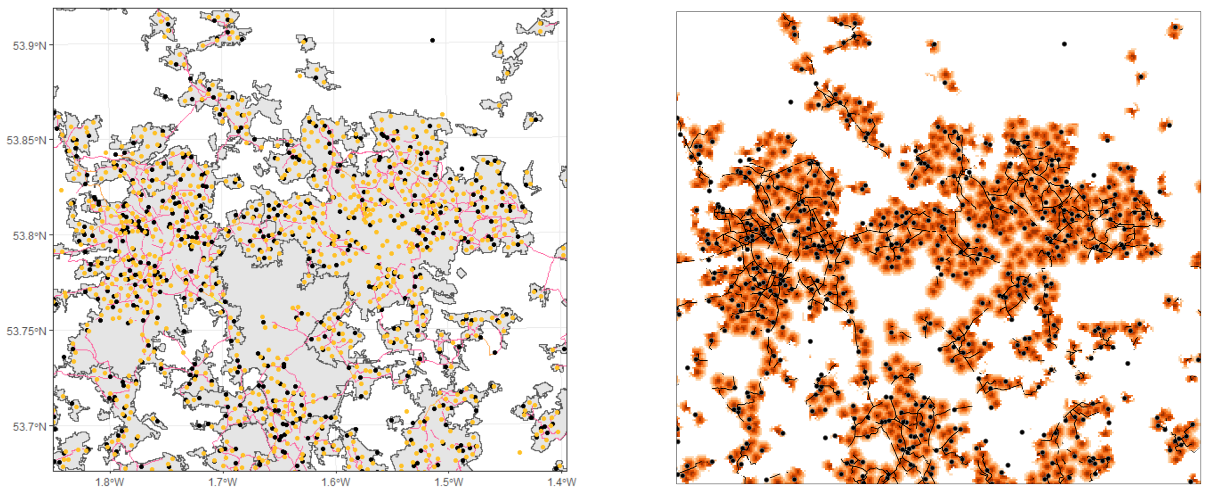

Figure 3: The location of schools, residential areas, and heavily used routes to schools in the Leeds and Bradford area.

Figure 3 shows routes which are estimated to carry at least 100 journeys to school under the Go Dutch scenario. On the left, schools are in black, with LSOA centroids in yellow, and built-up areas in grey as derived from ONS data. On the right, schools are in purple, with residential areas defined as areas within 500m of an LSOA centroid, masked to the ONS-defined built-up area. Routes are clipped within these residential areas.

We can now see where the major routes to school coincide with residential areas.

2.3 Connected networks

An additional method we applied to the route network data was to group the streets into connected networks. This was to highlight larger areas, not just single streets or school catchments, where a dense network of cycle infrastructure could be particularly beneficial. To do this, we again selected only the route segments forecast to carry at least 100 school journeys per day under the Go Dutch scenario.

A simplified visualisation of the results of this grouping process, which was undertaken using the graph analysis R package `igraph`, is shown in Figure 4. The largest network is centred on the city of Bradford, including routes connecting to Bingley and Keighley in the northwest and Queensbury in the southwest. This network has a total length of 128km, with an average of 265 cyclists per day passing any given point on the network under the Go Dutch scenario. The second largest network is in North Leeds and has a total length of 69km, with any given point on the network seeing an average of 229 cyclists per day under the Go Dutch scenario.

The assigning of routes to schools into networks such as these allows analysis at both zoomed out and fine grained scales, and enables the identification of natural cycle catchment areas.

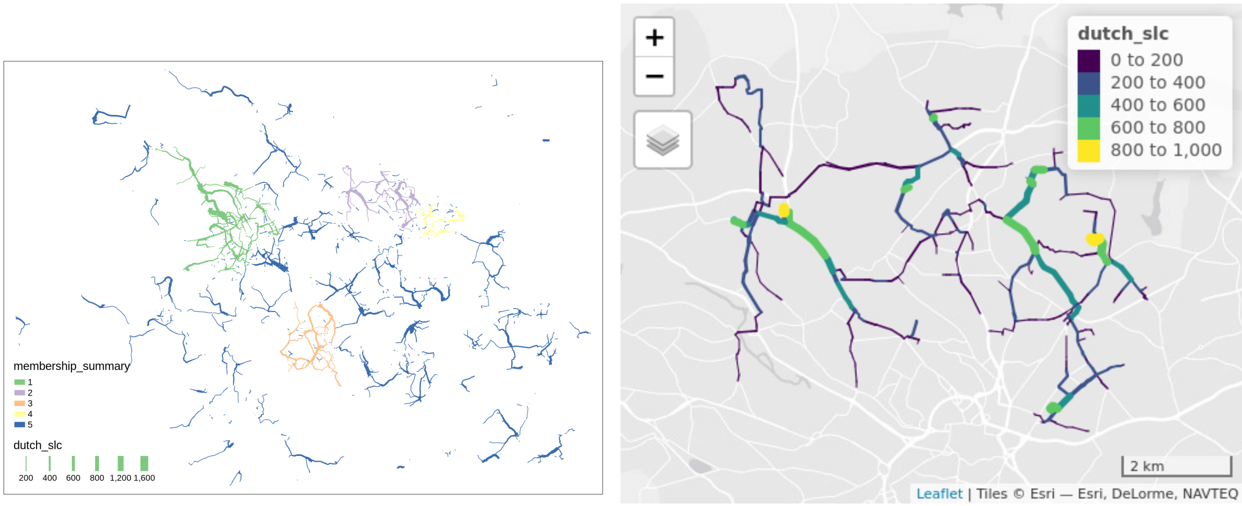

Figure 4: Route networks with high cycle to school potential (100+ trips per day under Go Dutch) grouped by connectivity, with the largest 4 groups in terms of number of segments highlighted by colour (left). A zoomed-in view of the second largest group.

2.4 Schools and commuter journeys

To gain a broader picture of where people cycle, we can combine routes to schools with cycle routes used for commuting. This will be of benefit for holistic travel planning, since the more types of journey modelled, the closer we will be to understanding the overall pattern of cycle flows. As we've seen, travel to schools mostly takes place within residential areas, while commuter journeys are more strongly focused on town and city centres. Leeds provides a striking illustration of this, since in recent decades there have been very few city centre residents. The population of Leeds city centre is now rising (this mostly post-dates the 2011 Census) but it remains low, and there are no schools within the core city centre. The combined analysis of commuter and school journeys reveals propensity to cycle across the city as a whole.

Table 1: Cycle trips per person per year (National Travel Survey 2018)

Purpose	Trips
Commuting	6
Business	-
Education / escort education	2
Shopping	1
Other escort	-
Personal business	1
Leisure	6
Other including just walk	0
All purposes	17

People travel for a wide range of purposes. As we can see in Table 1, the National Travel Survey 2018 recorded an average of 17 bicycle trips per person per year (DfT 2019). Of these, 6 were for commuting, 2 were for education/escort education, and the remainder were for various other purposes including leisure, shopping and personal business. However, this underestimates the potential uptake of cycling for non-commute purposes. In England, 3.3% of commute trip stages are currently cycled, but this falls to 1.9% for leisure trips, 1.3% for education/escort education, and below 1% for personal business and shopping (Aldred 2019). There are likely to be a wide range of reasons for this variance, perhaps including parents' safety concerns regarding children cycling, and the fact that commuter journeys tend to be particularly regular and predictable, while for other journeys people may be less certain that they can find an acceptable cycle route and facilities at the destination. However, in high cycling countries such as the Netherlands this discrepancy between commute and other trip purposes does not exist. Thus the PCT Go Dutch scenarios record close to a six-fold increase in cycle commuting but a 22-fold increase in cycling to school (CEDAR 2017; Goodman et al. 2019).

To illustrate how the overall distribution of cycle trips can be represented, we included in the final panel of figure 5 a combined route network in which the weighting of the cycle to school component is doubled. This is in recognition that travel to school is likely to be better than travel to work at providing a proxy for the other types of journey that take place within residential areas, and that there is greater scope for increased uptake of cycling for these trip purposes than there is for commuting.

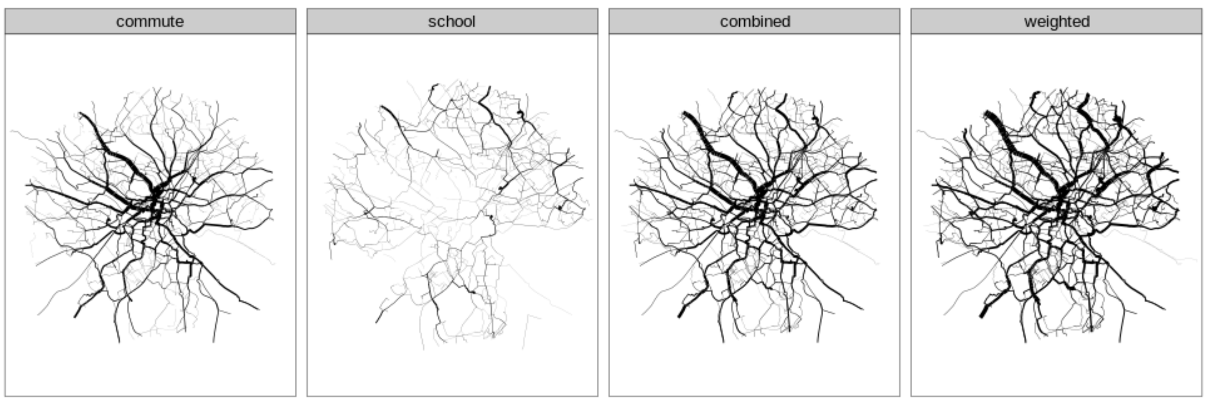

Figure 5: Route networks of commute, school, combined and weighted cycle propensity in the 5km zone surrounding Leeds Railway Station. In the weighted panel trips to school are given a weighting of 2.

3 Discussion

These analyses provide a range of valuable insights. As well as revealing where people cycle today, we can give information about where new cycle infrastructure would be best placed to enable more children and young people to cycle to school in future.

The tools shown here can be used to investigate patterns of cycle propensity at various scales; to explore the best locations for new cycle-related infrastructure, and how this relates to residential areas; to identify key cycle catchments; and to investigate the distribution of cycle journeys for different purposes.

It is important to be aware that while these route networks can reveal a great deal about where people cycle, any given road section within the network may not necessarily be the one that is best suited to cycling or to cycle improvements. It may be there is a parallel street or off-road route that is better suited to cycling, and knowledge of local streets and conditions is vital here.

For example, the vector map of the centre of Leeds shown in Figure 2 shows a high-usage cycle route passing along Albion Street, Short Street and Lower Basinghall Street. This is a heavily used cycle corridor leading towards Leeds rail station, but local knowledge suggests that a more appropriate route for these journeys would most likely be on the nearby Park Row, which runs broadly parallel to these streets. Thus, this tool can provide an invaluable representation of the cycle route networks in a town or city, but a decision to undertake cycle improvements on a particular street also requires detailed knowledge of the local road conditions. This is the kind of information that CyIPT has been developed to assist in providing (Leeds 2018).

Other factors that could be worth investigating further include road safety and how the locations of collision hotspots match up with heavily cycled routes. It would also be interesting to look at which schools currently have the highest levels of cycling and whether those schools share certain characteristics. Further investigation is also required into the overall distribution of journey purposes, and how to best represent other types of journey such as shopping or leisure journeys.

4 References

Aldred, Rachel. 'Variation in active travel and the scope to increase participation: an analysis of Active People Survey and National Travel Survey data'. Commissioned by Sport England from the University of Westminster (September 2019). Accessed 12 November 2019. https://www.sportengland.org/media/14214/variation-in-active-travel-and-the-scope-to-increase-participation.pdf

Aldred, Rachel, Bridget Elliott, James Woodcock, and Anna Goodman. 'Cycling Provision Separated from Motor Traffic: A Systematic Review Exploring Whether Stated Preferences Vary by Gender and Age'. Transport Reviews 37, no. 1 (2 January 2017): 29–55. https://doi.org/10.1080/01441647.2016.1200156.

BEIS. 'Provisional UK Greenhouse Gas Emissions National Statistics 2018'. Accessed 28 October 2019. https://www.gov.uk/government/statistics/provisional-uk-greenhouse-gas-emissions-national-statistics-2018.

'BMA - Steps to Increase Physical Activity Levels in the UK'. Accessed 28 October 2019. https://www.bma.org.uk/collective-voice/policy-and-research/public-and-population-health/ steps-to-increase-physical-activity-levels-in-the-uk.

DfT. 'National Travel Survey: 2018'. Accessed 28 October 2019. https://www.gov.uk/government/statistics/national-travel-survey-2018.

UKCRC Centre for Diet and Activity Research (CEDAR). 'Evidence Brief Special (14) - England's Cycling Potential – Results from the Department for Transport-funded Propensity to Cycle Tool project, February 2017.' Accessed 12 November 2019. https://www.cedar.iph.cam.ac.uk/resources/evidence/eb-14-englands-cycling-potential/.

Goodman, Anna, Ilan Fridman Rojas, James Woodcock, Rachel Aldred, Nikolai Berkoff, Malcolm Morgan, Ali Abbas, and Robin Lovelace. 'Scenarios of Cycling to School in England, and Associated Health and Carbon Impacts: Application of the "Propensity to Cycle Tool"'. Journal of Transport & Health 12 (1 March 2019): 263–78.

Kingham, Simon, Clive E. Sabel, and Phil Bartie. 'The Impact of the "School Run" on Road Traffic Accidents: A Spatio-Temporal Analysis'. Journal of Transport Geography 19, no. 4 (1 July 2011): 705–11. https://doi.org/10.1016/j.jtrangeo.2010.08.011.

'London Environment Directors' Network | London Councils'. Accessed 28 October 2019. https://www.londoncouncils.gov.uk/our-key-themes/environment/london-environment-directors-network.

Leeds, The CyIPT team, led by University of. The Cycling Infrastructure Prioritisation Toolkit. Accessed 28 October 2019. Last updated 9 April 2018. https://www.cyipt.bike/report1/.

Lovelace, Robin, Anna Goodman, Rachel Aldred, Nikolai Berkoff, Ali Abbas, and James Woodcock. 'The Propensity to Cycle Tool: An Open Source Online System for Sustainable Transport Planning'. Journal of Transport and Land Use 10, no. 1 (2017): 505–28.

Melia, Steve. Urban Transport without the Hot Air: Volume 1: Sustainable Solutions for UK Cities. Cambridge, UNITED KINGDOM: UIT Cambridge Ltd., 2015.

ONS. 'Built-up Area Sub Divisions (December 2011) Boundaries'. Accessed 12 November 2019. https://geoportal.statistics.gov.uk/datasets/built-up-area-sub-divisions-december-2011-boundaries.

‘TfL Liveable Neighbourhoods Programme’, n.d., 91. 2019.

Walton, Heather, David Dajnak, Sean Beevers, Martin Williams, Paul Watkiss, and Alistair Hunt. ‘Understanding the Health Impacts of Air Pollution in London’. London: Kings College London, Transport for London and the Greater London Authority, 2015.