Methods to prioritise pop-up active transport infrastructure

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Contents

1 Abstract

In the context of reduced public transport capacity in the wake of the COVID-19 pandemic, governments are scrambling to enable walking and cycling. A range of pop-up options exist. The focus of this article is lane reallocation, which represents a 'quick win' for cities with roads that have a spare lane during reduced motor traffic conditions. We found that the methods could condense the complexity of cities down to the most promising roads, which match intuition. The evidence resulting from the methods, and future refinements, could support more evidence-based use of resources that have been made available to support implementation of pop-up schemes.

2 RESEARCH QUESTIONS AND HYPOTHESIS

Much attention has focused on the impacts of COVID-19 on long-distance travel patterns (e.g. Iacus et al. 2020; Jittrapirom and Tanaksaranond 2020). Yet short distance travel patterns have also changed, with a notable increase in active travel, particularly cycling, in some areas (Harrabin 2020). The two main explanations for this are 1) the need increased need for exercise close to home during lockdowns for mental and physical health (Jiménez-Pavón, Carbonell-Baeza, and Lavie 2020), and 2) a reduction in both public transport options and use (e.g. Tian et al. 2020). The second reason is particularly important given that many 'key workers' are low paid, with limited access to private automobiles.

Local and national governments are working out how best to respond. Many options are available to ensure that citizens can benefit from outdoor activity while minimising health risks, ranging from the hand sanitiser provision to the creation of extra active transport space (Freeman and Eykelbosh 2020). Installation of 'pop-up' active transport infrastructure has been endorsed and implemented in many places (Laker 2020). The Scottish government, for example, has provided £10 million "to keep key workers moving" by "reallocating road space to better enable this shift and make it safer for people who choose to walk, cycle or wheel for essential trips or for exercise" (Transport Scotland 2020). On 9$^{\text{th}}$ May 2020, the UK government announced a £250 million package for pop-up active transport infrastructure (Reid 2020). Significantly, alongside this funding comes updated guidance on pop-up infrastructure and safety (Government 2020). Evidence is needed to ensure that such investment is spent effectively and where it is most needed.

Most pop-up active transport infrastructure can be classified into three broad categories:

1. 'filtered permeability', e.g. as shown in (Salford City Council 2020)
2. banning cars and to pedestrianise streets, as in New York's 'Open Streets' scheme (Litman 2020)
3. the reallocation of one or more lanes on wide roads to create pop-up cycleways and pavements (Orsman 2020).

The focus of this article is on the third category. The research question is:

> How can automated data analysis and interactive visualisation methods help prioritise the reallocation of road space for pop-up active transport infrastructure?

Because of the recent, localised and often ad-hoc nature of pop-up infrastructure, it is difficult to make, let alone test, hypotheses related to the research question. Our broad hypothesis is that digital tools based on open data, and crowdsourcing such as the interactive map used to support community-level responses to COVID-19 in Salford (Salford City Council 2020), illustrated in Figure 1, can lead to more effective use of resources allocated to pop-up interventions.

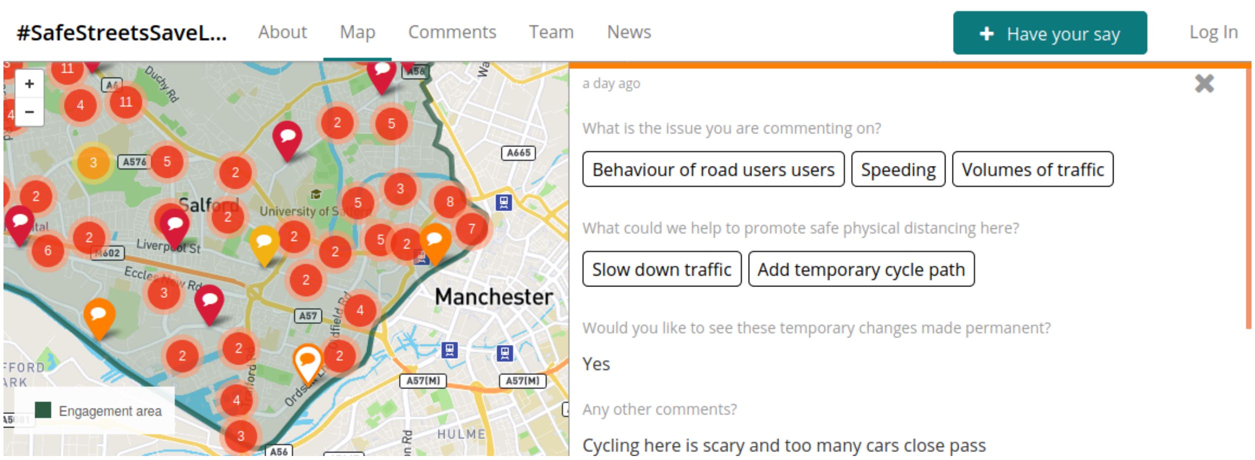

Figure 1: Screenshot from the website salfordliveablestreets.commonplace.is to support local responses to the COVID-19 pandemic, including the prioritisation of pop-up active transport infrastructure.

3 METHODS AND DATA

Three key datasets were used for the project:

- Estimates of cycling potential to work at the street segment level from the UK Department for Transport funded Propensity to Cycle Tool (PCT) project (Goodman et al. 2019; Lovelace et al. 2017)
- Data derived from OpenStreetMap, with several new variables added to support cycling infrastructure planning (see www.cyipt.bike for an overview)
- A list of hospital locations from the UK's National Health Service website www.nhs.uk

Datasets from the PCT and CyIPT project were merged, resulting in crucial variables summarised in Table 1. A map showing the spatial distribution of hospitals in the case study city of Leeds is shown in Figure 2.

Table 1: Summary of the road segment dataset for Leeds

	20 mph or less (N=39123)	30 mph (N=42474)	40+ mph (N=3322)	Overall (N=84919)
highway_type				
cycleway	1455 (3.7%)	0 (0%)	0 (0%)	1455 (1.7%)
footway	16654 (42.6%)	0 (0%)	0 (0%)	16654 (19.6%)
other	4024 (10.3%)	886 (2.1%)	1813 (54.6%)	6723 (7.9%)
pedestrian/living_street	290 (0.7%)	0 (0%)	0 (0%)	290 (0.3%)
primary	14 (0.0%)	1476 (3.5%)	992 (29.9%)	2482 (2.9%)
residential	1373 (3.5%)	29125 (68.6%)	2 (0.1%)	30500 (35.9%)
secondary	24 (0.1%)	1403 (3.3%)	164 (4.9%)	1591 (1.9%)
service	14948 (38.2%)	47 (0.1%)	0 (0%)	14995 (17.7%)
tertiary	163 (0.4%)	5526 (13.0%)	274 (8.2%)	5963 (7.0%)
unclassified	178 (0.5%)	4011 (9.4%)	77 (2.3%)	4266 (5.0%)
cycling_potential				
Mean (SD)	5.33 (39.5)	27.3 (71.0)	92.9 (84.6)	19.7 (62.1)
Median [Min, Max]	0 [0, 1330]	0 [0, 896]	72.0 [0, 577]	0 [0, 1330]
width				
Mean (SD)	5.10 (2.96)	6.61 (2.11)	8.83 (2.39)	6.25 (2.58)
Median [Min, Max]	5.00 [0, 28.0]	6.00 [0, 24.0]	9.00 [2.00, 21.0]	6.00 [0, 28.0]
Missing	20849 (53.3%)	4278 (10.1%)	471 (14.2%)	25598 (30.1%)
n_lanes				
1	37105 (94.8%)	2304 (5.4%)	484 (14.6%)	39893 (47.0%)
2	1999 (5.1%)	39417 (92.8%)	2380 (71.6%)	43796 (51.6%)
3	19 (0.0%)	521 (1.2%)	314 (9.5%)	854 (1.0%)
4+	0 (0%)	232 (0.5%)	144 (4.3%)	376 (0.4%)

3.1 Geographic subsetting

We set a modifiable parameter `city_centre_buffer_radius` with an initial value of 8 km (5 miles) to geographically subset potential routes. 5 miles represents a distance that most people have the physical ability to cycle. Figure 3 shows the result of subsetting based on physical distance from the centre vs plotting all possible transport network segments within the city boundaries. To ensure roads that could serve key destinations were included, the parameter `key_destination_buffer_radius` (initially set to 5 km) was used.

3.2 Attribute filtering and grouping

At a time of reduced travel, fewer lanes dedicated to motor traffic are needed. Based on this observation, we defined roads with a 'spare lane' as those on which there is more than one lane in either direction. This definition assumes no reduction in mobility for motor vehicles (making two-way lanes one-way is another option not explored in this analysis).

To identify road sections on which there is a spare lane we developed a simple algorithm that takes the OSM variable `lanes` if it is present and, if not, derives the number from the highway type and presence/absence

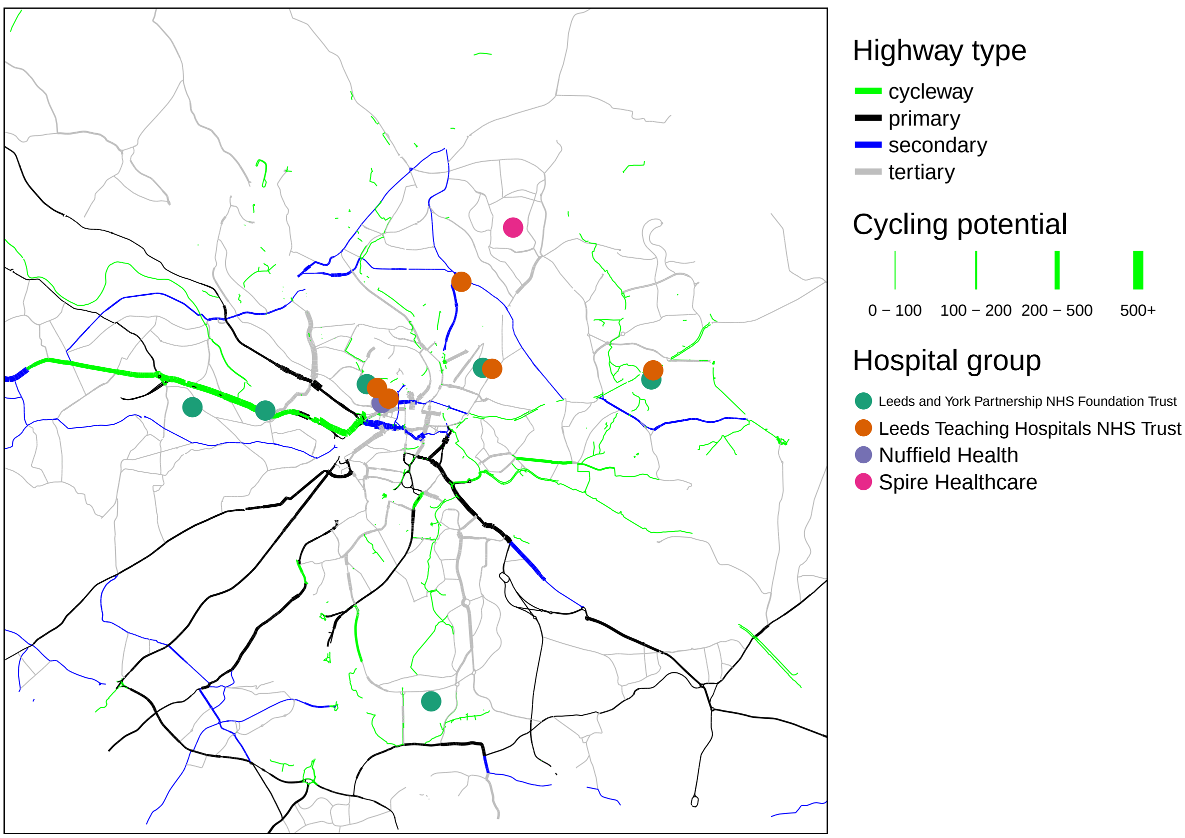

Figure 2: Overview map of input data, showing the main highway types and location of hospitals in Leeds

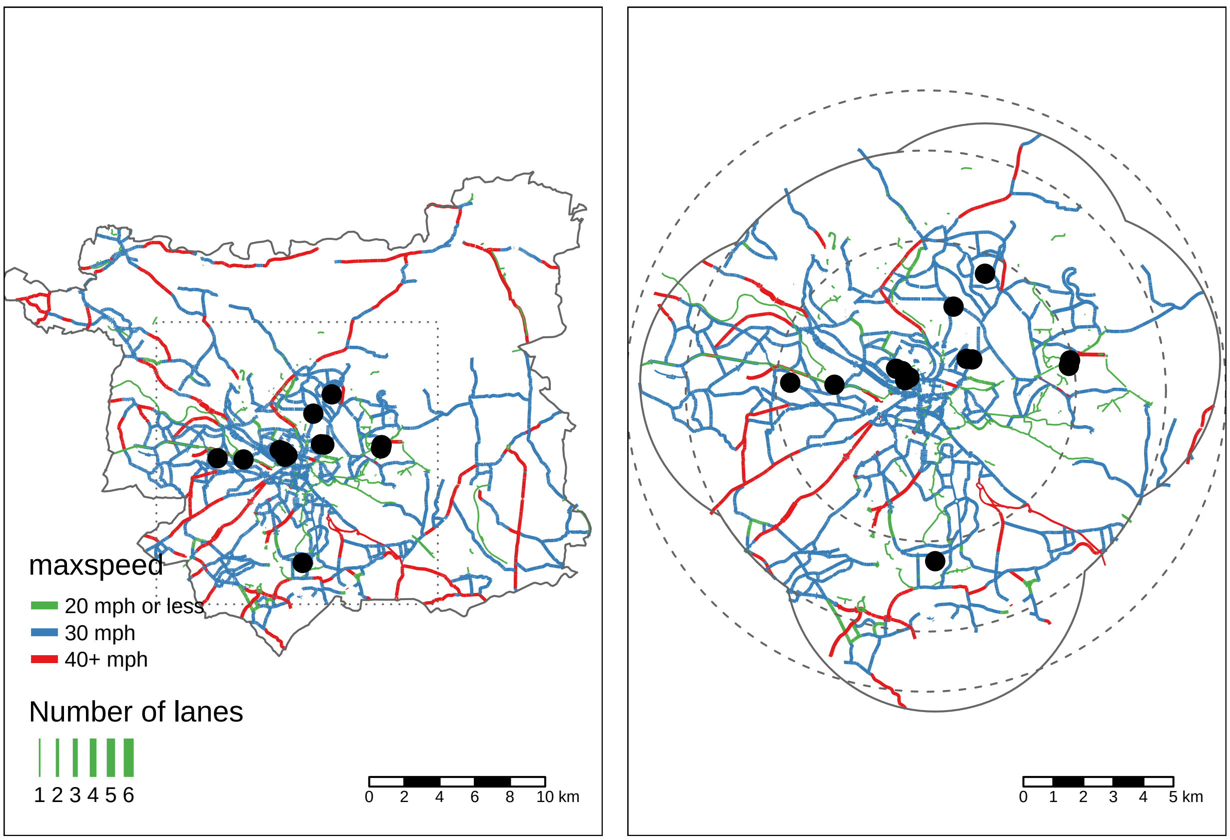

Figure 3: Illustration of geographic subsetting based on distance to a central point (Leeds city centre in this case) rather than based on location within somewhat arbitrarily shaped city boundaries. Radii of 5 km, 8 km and 10 km are shown for reference (note that some roads within 10 km of the center are outside the regional boundary).

of bus lanes. All segments defined as having a spare lane using this method is shown in Figure 4 (left). In future, this methodology could be enhanced to take into account the effect of lane widths, which increase the effective available space, and the presence of vehicle parking bays, which reduce it. The result of filtering by distance and cycling potential before and after grouping using graph membership of touching roads is shown in 4 (middle and right, respectively). Grouping linked roads before filtering results in a more cohesive network.

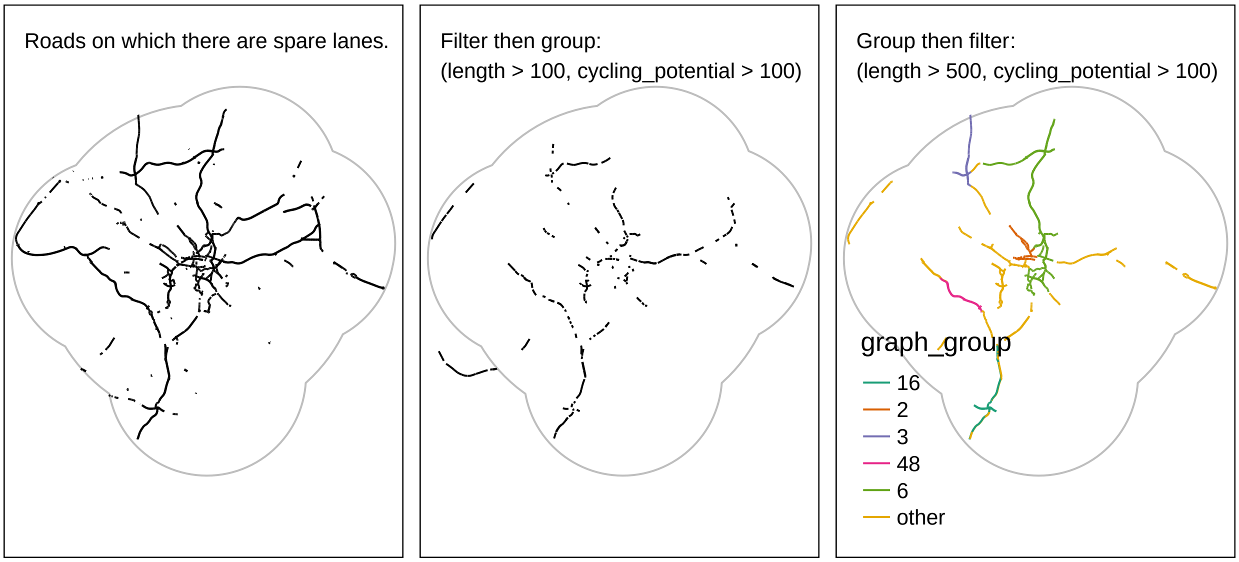

Figure 4: Illustration of the 'group then filter' method to identify long sections with spare lanes *and* high cycling potential

4 FINDINGS

The results of the method are summarised in Figure 5 (see here for interactive version) and Table 2. We found that analysis of open transport network data, alongside careful selection of parameters, can generate plausible results for the prioritisation of pop-up cycle infrastructure. Reducing the 85,000 road segments for Leeds down to a handful of candidate segments with more than 1 lane near key destinations has great potential to support policy-makers, especially when decisions need to be made fast.

The approach is not without limitations. Its reliance on data rather than community engagement represents a rather top-down approach to transport planning. To overcome this issue, future work could seek to incorporate the results such as those presented above into a participatory map of the type shown in Figure 1. Further work could also extend the method in various ways, for example by refining estimates of cycling potential based on new parameters such as proximity to key destinations and estimates of road width. We welcome feedback on the results and methods [link to code].

A major advantage of the approach is that it is scalable. It would be feasible to run the method for every city in the UK (and indeed beyond) for which there is data, given sufficient computer and developer resource. Given the recent interest in and funding for pop-up cycleways, rolling-out the method quickly, while being agile to adapt the method and parameters for different cities, could help ensure that funding for pop-up infrastructure is spent in an evidence-based way.

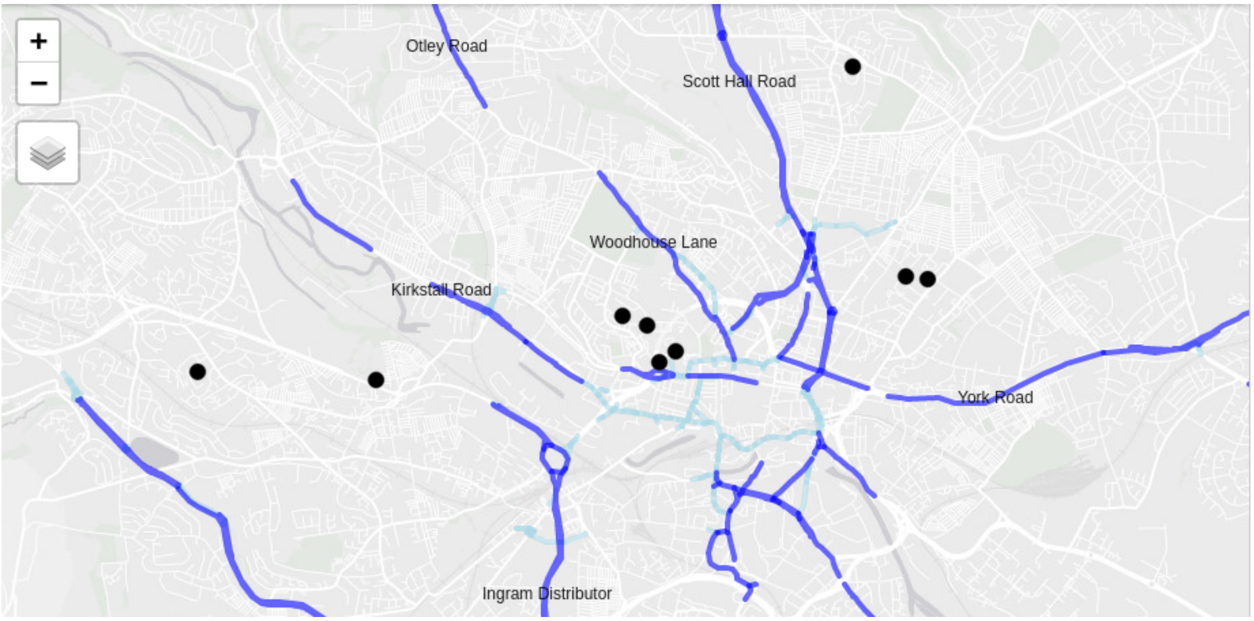

Figure 5: Results, showing road segments with a spare lane (light blue) and road groups with a minium threshold length, 1km in this case (dark blue). The top 10 road groups are labelled.

Table 1: The top 10 candidate roads for space reallocation for pop-up lane reallocation interventions. Roads with 'spare lanes' identified using methods presented in the paper are ranked by km cycled per day (length of section multiplied by potential) under the Government Target scenario, representing a doubling in commuter cycling levels compared with 2011 levels.

Name	Length (m)	Potential (Government Target)	Km/day (length * potential)
Otley Road	1766	758	1339
Scott Hall Road	8723	123	1073
Ring Road Low Wortley	5177	151	782
Dewsbury Road	4073	175	713
Woodhouse Lane	2206	295	651
Kirkstall Road	1557	341	531
Ring Road Moortown	4152	123	511
York Road	1883	242	456
Harrogate Road	3254	123	400
Ingram Distributor	2771	137	380

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