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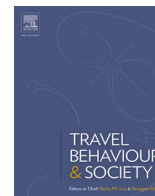
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Exploring expectations and lived experiences of Low Traffic Neighbourhoods in Birmingham, UK

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ABSTRACT

In the UK, urban environments suffer disproportionately from pollution and community severance due to private vehicle use and related infrastructure. During the COVID-19 pandemic, local authorities implemented Low Traffic Neighbourhoods (LTN) to encourage active travel and improve urban residential environments. This research explored people's expectations and lived experience of two LTNs in Birmingham, a large city, providing insights for future schemes. Birmingham City Council held pre-LTN (July–November 2020) and post-LTN consultations (February–April 2021). A qualitative thematic analysis of respondents' responses explored thoughts on local transport issues, expectations, and lived experiences of LTNs. There were 3751 and 791 responses to pre- and post-LTN consultations. Most respondents were female local residents; with 45–54 years olds the most frequent responders. Overarching categories: (i) Pre-LTN transport concerns and proposed solutions; (ii) Anticipated and reported benefits from the LTN and (iii) Anticipated and reported disadvantages from the LTN. Cited benefits included reduced traffic and safety concerns, increased active transport and an improved sense of community. Disadvantages included frustration, inconvenience and great resentment between residents of roads with and without filters. Both support and opposition to LTNs was found. LTNs addressed some, but not all local traffic concerns. Feelings of discrimination were noted by residents of streets without filters; high street residents encountering displaced traffic and disabled car users. Piecemeal LTN implementation may undermine community cohesion. Networks of modal filters across neighbouring residential areas with measures addressing the interplay between residential, business, school and faith environments and additional measures supporting boundary roads may maximise LTN benefits.

1. Introduction

Urban environments house 82 % of the population in England and Wales (Office for National Statistics, 2011). Such settings provide accessible facilities and proximity to employment but also suffer most from vehicular air and noise pollution (Eenkel et al., 2020; European Environment Agency, 2020). Vehicle use in the UK has expanded in recent decades, with total annual vehicle miles increasing from 125 to 298 billion from 1970 to 2021 (Department for Transport. Road traffic statistics: Traffic volume in miles, 2022). The road transport sector remains the largest contributor to UK domestic Greenhouse Gas emissions, responsible for 27 % of carbon dioxide emissions in 2019, over half of which was due to cars and taxis (Department for Transport, 2021). Private vehicle dependency in urban areas causes significant health harms including increased exposure to air and noise pollution. Poor air

quality increases the risk of developing childhood asthma (Khreis et al., 2017) hypertension (Hudda et al., 2021) cardiovascular disease (Raaschou-Nielsen et al., 2012) pre-term birth (Padula et al., 2014) low birth weight (Stieb et al., 2016) childhood behavioural issues (Loftus et al., 2020) and all-cause mortality (Wong et al., 2015; Wong et al., 2010). Noise pollution has been associated with the onset of anxiety, depression and sleep disturbance (Beutel et al., 2020). Vehicular traffic carries direct risks of physical injury and death (Yiannakoulis and Scott, 2013), reduces physical activity (Bassul et al., 2021) and has wider consequences for climate change (HM Government).

In UK cities, poor infrastructure planning contributes to community severance and social inequality (van Schalkwyk and Mindell, 2018). Traffic itself and poorly designed transport infrastructure can become a barrier between people, goods and services, resulting in lower self-rated health (Higgsmith et al., 2022). These issues are much more likely to

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affect people from an ethnic minority background as they are more likely to live in urban environments, including Birmingham, where 47 % of the population are from ethnic minority groups (Council and Census, 2011). The adverse impacts of motorised traffic also disproportionately affect disadvantaged people who are less likely to have access to a car, including disabled people, female headed households, children and older people (Lucas et al., 2019).

Replacing short car journeys with walking and cycling will help mitigate air pollutant and Greenhouse gas emissions, reducing associated risks of premature mortality and morbidity. However, achieving such reductions is a public health challenge requiring effective policy interventions. Low Traffic Neighbourhoods (LTNs) use modal filters such as bollards or planters to restrict through traffic in residential areas whilst allowing vehicular access to homes (Supplementary Figure 1). A reduction in through traffic is intended to bring a plethora of public health benefits including reduced air and noise pollution, fewer road traffic injuries, improved social spaces and enhanced aesthetic quality and liveability, leading to improved quality of life (Sustrans, 2020). Evidence from early London schemes suggests that LTNs may support behaviour change, including reducing unnecessary car trips, encouraging modal shift to walking, cycling and public transport and reducing car ownership (Aldred and Goodman, 2020).

During the COVID-19 pandemic, facilitating social distancing through changes to urban street layouts became an urgent Government priority (Dunning and Nurse, 2020). In May 2020 the UK Department for Transport enabled local authorities to rapidly implement trial LTNs via Experimental Traffic Regulation Orders funded within the Emergency Active Travel Fund scheme (Transport, 2020). In 2020, Birmingham City Council proposed implementing LTNs in Birmingham (total population 1,144,900) (Birmingham City Council, 2022). Kings Heath (population 18948) and Moseley (population 21676) were chosen for interventions; neighbouring residential suburbs five miles south of Birmingham city centre (Birmingham City Council, 2018; Council and Factsheet, 2016) (Supplementary Figures 2, 3 and 4).

The purpose of this research was to explore the views and experiences of residents, commuters and business owners within newly erected LTNs outside of London, filling a gap in the current research which is very London-centric. London has a very well evolved public transport system including the London Underground; over ground trains; extensive bus, tram and taxi coverage. The frequency and connectivity offered by this array of transport options, which is not replicated in other UK towns and cities, is likely to have a direct bearing on the feasibility of restrictions to personal car use and the public's response to such restrictions. Furthermore, there is limited evidence regarding attitudes towards schemes rapidly administered within the Emergency Active Travel Fund scheme. Importantly, there also remain gaps in current evidence regarding the impacts of LTN schemes on people's experience of their local environment for living, commuting and socialising.

The aim of this research was to explore peoples' views of their local transport environment before the introduction of LTNs, followed by their expectations and lived experiences of LTN schemes in residential areas of a large UK city outside of London.

2. Materials and methods

2.1. Study Setting

This research was conducted in the Birmingham suburbs of Kings Heath and Moseley, residents of which have the 10th and 14th highest average incomes of the 69 Birmingham city wards, indicating that they are relatively affluent areas of the city (Birmingham City Council, 2018; Council and Factsheet, 2016). However, both suburbs have a similar average income to that of England as a whole (Birmingham City Council, 2018; Council and Factsheet, 2016). Kings Heath has a population density of 4855.4 residents per square kilometre, with Moseley at 3696.3 (Population density, 2022), indicating that these suburbs have

similar population densities to Birmingham overall (4275.4) and a much higher population density than England and Wales generally (Population density, 2022).

This research was conducted using data from consultations administered by Birmingham City Council via the online 'Birmingham Be Heard' Platform (Council and Heard, 2022). Residents of Kings Heath and Moseley were informed about these consultations via social media, information on the Birmingham Be Heard Platform and via an area-wide letter drop. Ethical approval to analyse the public consultation data provided by Birmingham City Council was obtained from the University of Birmingham Science, Technology, Engineering and Mathematics Ethical Review Committee (ERN_18-1998C).

The first two (pre-LTN) consultations on the proposed LTNs in Kings Heath and Moseley were conducted between July and November 2020 prior to the completion of the LTNs, construction of which commenced in September (Kings Heath) and October (Moseley) 2020 and was completed in November 2020. Respondents were asked what they felt were the important traffic related issues in the local area (e.g., speeding, safety) and the changes they would like to see (e.g., stopping rat runs, more green spaces) by selecting from a number of pre-determined statements (Birmingham City Council, 2021). Respondents were also provided with free text sections to detail 'any other comments' (Kings Heath) or 'What do you think of the proposed modal filter on 'x' street' (Moseley).

The combined Kings Heath and Moseley post-LTN consultation, conducted between February and April 2021, was also a combination of selection from pre-determined statements regarding current transport issues and possible solutions and free text responses to the question 'Do you have any comments about the temporary changes made last year?' (Birmingham City Council, 2021).

Quantitative data relating to the public's responses to questions with fixed drop-down responses and a quantitative summary of respondents' free text responses from Kings Heath and Moseley prior to the installation of the LTNs has been reported by Birmingham City Council, as part of a report on consultations held before the implementation of a range of emergency active travel schemes (Supplementary Figure 5) (Birmingham City Council, 2021). This report revealed the controversial nature of the proposals, with Birmingham City Council reporting that 41 % of responses were in favour of the LTN and 36 % against, with the remainder being some degree of positive, negative or neutral (Birmingham City Council, 2021).

A short summary of findings from the first stage of the Kings Heath and Moseley LTNs has also been provided as part of the introduction to a report looking at the public's response to later iterations of these schemes (Jacobs, 2022). However, rigorous qualitative analysis of the public's initial response to the Kings Heath and Moseley LTNs has not been conducted. The following thorough qualitative analysis was conducted using the free text responses rather than the respondents' selection of pre-prepared options to reduce acquiescence bias and provide depth and insight into the public's initial response to new LTN schemes.

2.2. Data analysis

Qualitative survey response data were analysed iteratively and thematically (Braun and Clarke, 2006). The data were studied, and an inductive coding framework developed with cross-checking from all authors. The coding framework was then applied to the data, with adjustments made as new data were coded. This process was concluded at the point of coding and data saturation, where no new codes, or novel content within these codes emerged (Kerr et al., 2010). As a substantial number of responses were seen, the point of coding and data saturation was reached before all of the data were included within the analysis. Data within each theme were then summarised, links and discrepancies between different themes identified, overarching categories determined and findings presented. The aim of this form of qualitative analysis was not to provide an exhaustive record of responses from the public

consultation, but a thematic summary of the public’s overall response, capturing the major themes and issues raised.

3. Results

In the pre-LTN consultation there were a total of 3751 responses, 3238 to the Kings Heath consultation and 513 to the Moseley consultation (Table 1). The age of respondents ranged from 16 to 24 to over 85 years, with those in the 45–54 bracket being the most frequent responders (723, 25 % after the removal of missing data); indicating that respondents identified as slightly older than the residents of this area in general, with Kings Heath (31 %) (Birmingham City Council, 2018) and Moseley (34 %) (Council and Factsheet, 2016) having the largest proportion of their residents in the 25–44 age bracket and Birmingham in the 35–49 age bracket (19 %) (How life has changed in Birmingham: Census, 2021).

Table 1
Kings Heath and Moseley Respondent characteristics (pre and post-implementation).

	Category	Pre-LTN, N: 3751 (%)	Post-LTN, N: 791 (%)
Age Group	Missing	884 (23.6)	204 (25.8)
	Prefer not to say	22 (0.6)	2 (0.3)
	16–24 years	42 (1.1)	11 (1.4)
	25–34 years	335 (8.9)	58 (7.3)
	35–44 years	670 (17.9)	126 (15.9)
	45–54 years	723 (19.3)	153 (19.3)
	55–64 years	579 (15.4)	136 (17.2)
	65–74 years	400 (10.7)	76 (9.6)
	75–84 years	94 (2.5)	24 (3.0)
	85 +	2 (0.1)	1 (0.1)
Gender	Missing	920 (24.5)	212 (26.8)
	Female	1541 (41.1)	325 (41.1)
	Male	1215 (32.4)	242 (30.6)
	Prefer not to say	67 (1.8)	9 (1.1)
Connection to the area (not mutually exclusive)	Other	8 (0.2)	3 (0.4)
	Missing	836 (22.3)	36 (4.6)
	I live here	2592 (69.1)	692 (87.5)
	I do my shopping here	1024 (27.3)	3 (0.4)
	I have family and friends here	824 (22.0)	2 (0.3)
	I work here	498 (13.3)	100 (12.6)
	My children go to school here	495 (13.2)	98 (12.4)
	I do the school run here	324 (8.6)	0 (0.0)
	I commute through here	283 (7.5)	1 (0.1)
	I live nearby	220 (5.9)	1 (0.1)
	I’m here for leisure	199 (5.3)	0 (0.0)
	I own a business here	83 (2.2)	28 (3.5)
	Other	32 (0.9)	0 (0.0)
	I study here	27 (0.7)	0 (0.0)
	I make deliveries here	21 (0.6)	0 (0.0)
Car ownership	I’m just visiting (regularly)	15 (0.4)	199 (25.2)
	Car owner	2513 (67.0)	791 (62.1)
Usual method of local transport	Walk	2202 (58.7)	452 (57.1)
	Car driver	2080 (55.5)	407 (51.5)
	Bus	1073 (28.6)	228 (28.8)
	Cycle	997 (26.6)	251 (31.7)
	Car passenger	717 (19.1)	179 (22.6)
	Run/Jog	401 (10.7)	93 (11.8)
	Taxi	305 (8.1)	91 (11.5)
	Walk with pushchair	265 (7.1)	54 (6.8)
	Train	87 (2.3)	30 (3.8)
	Scooter	32 (0.9)	8 (1.0)
	Motorcycle/moped	32 (0.9)	8 (1.0)
	Mobility scooter/wheelchair	23 (0.6)	32 (4.0)
	Commercial vehicle	22 (0.6)	10 (1.3)
	Metro	4 (0.1)	2 (0.3)

After the removal of missing data, 54 % (1541) of respondents identified as female, with 43 % (1215) identifying as male, this indicates that our population included slightly more females than the area in general, with Kings Heath reporting 51 % female, 49 % male (Brandwood, 2021); Moseley 50 % female, 50 % male (Moseley Profile View, 2021) and Birmingham 51 % female, 49 % male (Birmingham Profile View, 2021).

The majority of respondents were residents (2592, 69 %), followed by shoppers (1024, 27 %); those with resident friends and family (824, 22 %); local employees (498, 13 %) and those with children at school in the area (495, 13 %). These categories were not mutually exclusive. The most popular forms of transport were walking (2202, 59 %); driving a car (2080, 56 %); taking the bus (1073, 29 %) and cycling (997, 27 %). Car ownership was reported at 67 % (2513), similar to Birmingham as a whole, where 68 % of households report car or van ownership (Office for National Statistics, 2021).

In the post-LTN consultation (Table 1), there were 791 responses from a combined consultation including views on both the Kings Heath and Moseley LTNs, a substantially smaller response than to the pre-LTN consultations (3751). Respondents were similar in age (mode: pre: 45–54 years; post: 45–54 years) and gender (pre: female 1541, 41 %; post: 325, 41 %) to those replying to the pre-LTN consultation; however a slightly larger proportion of respondents were residents (pre: 2592, 69 %; post: 692, 88 %) or were visiting the area (pre: 15, 0.4 %; post: 199, 25 %). Post-LTN, a smaller proportion were shoppers (pre: 1024, 27 %; post: 3, 0.4 %) or residents’ friends and family (pre: 824, 22 %; post: 2, 0.3 %). Post-LTN, 62 % of respondents identified as car owners; the largest proportion of respondents still identified walking as their usual local travel method (452, 57 %) followed by driving (407, 52 %), cycling (251, 32 %) using the bus (228, 29 %) and being a car passenger (179, 23 %).

3.1. Overarching categories

Respondents’ comments fell into three overarching categories; (i) Pre-LTN transport concerns and proposed solutions; (ii) Anticipated and reported benefits from the LTN schemes and (iii) Anticipated and reported disadvantages from the LTN schemes. The themes that emerged within these overarching categories are described in more detail below (Table 2).

Following each quote, an ID code provides an anonymous number for each responder; whether the responder was providing feedback for Kings Heath (KH), Moseley (M) or both (KHM) and whether the response was provided prior to the LTN (Pre-LTN) or after its implementation (Post-LTN).

4. Findings

4.1. Pre-LTN transport concerns and proposed solutions

This section will consider concerns raised about the experience of transport in Kings Heath and Moseley before the LTNs and solutions proposed by respondents.

4.2. The domination of cars

Pre-LTN, there was great strength of feeling among some residents about the progressive domination of motor vehicles over their “village”, whether in the form of traffic influxes around schools and the high street or hostile, reckless driving on roads and pavements.

‘Kings Heath is a wonderful area blighted by the dominance of motor vehicles and the bad behaviour of their drivers’ ID KH Pre 1

A shift in priority towards active travel was hoped to imbue a lost sense of neighbourhood by making residential areas safer.

Table 2
Overarching categories and definitions of thematic content.

Overarching category	Theme	Description of theme
Pre-LTN transport concerns and proposed solutions	The domination of cars	Cars were felt to be dominating and harming the local residential environment
	Encouraging active transport	The improvements needed to encourage public and active transport
	Danger and fear	Physical and psychological harm resulting from dangerous driving
	Speed reduction and other safety measures	Suggested measures to reduce dangerous driving and rat running
	Enforcement of current traffic measures	A need to enforce current traffic measures before considering further restrictions
	Parking priorities	The conflicting priorities of residents and visitors regarding parking
	High street business access and usability	The conflicting transport needs and views of business owners and business users
Anticipated and reported benefits from the LTN schemes	Pollution and the local environment	The effects of traffic on the environment and ideas to improve local aesthetics.
	A sense of community	Improved community experience anticipated/experienced due to the LTN
	An attractive setting for businesses	Improvements in the high street anticipated/experienced due to the LTN
	Health Benefits	Physical and mental health benefits anticipated/experienced due to the LTN
	Safety improvements	Safety improvements for cyclists and pedestrians anticipated/experienced due to the LTN
	Change in transport methods	Encouragement of active travel anticipated/experienced due to the LTN
	Anticipated and reported disadvantages from the LTN schemes	Increased traffic congestion
Shifting the problem		Negative and divisive effects of modal filters on traffic in neighbouring roads anticipated/experienced due to the LTN
Inconvenience for private vehicle users		Inconvenience to journeys felt to necessitate car use anticipated/experienced due to the LTN
Restricted parking		Restrictions to parking availability anticipated/experienced due to the LTN
High street traffic and businesses		Increased high street traffic and longer journeys to the high street anticipated/experienced due to the LTN
Health and safety issues from traffic and pollution		Negative effects on pollution and safety on roads without modal filters anticipated/experienced due to the LTN
Alternative solutions to the current LTN		The need for an expanded LTN or other green, integrated transport strategy

4.3. Encouraging active transport

Incentives were felt to be needed for residents to leave the car at home. Access to safer, less expensive public transport was raised as a necessity.

‘Cheaper bus fares would help. We need to make it so much more convenient and pleasant to use active travel that driving isn’t considered a viable alternative.’ ID KH Pre 194

There was a view that cycling needed to be made a safer, more realistic prospect in Kings Heath.

‘I’d love to cycle more but there is no way I feel safe enough to do that through Kings Heath.’ ID KH Pre 118

Respondents suggested redesigning unsafe yellow box junctions and right filter lights. A truly connected system of physically segregated cycle ways was also proposed to make cycling a safe, realistic mode of transport. A desire for such improvements may have reflected the inconvenience of the numerous short, unconnected cycle ways in the locality.

‘Would it be possible to create a cycle way that connects Moseley and KH High St and then the surrounding through routes? That would truly be innovative and make a massive difference.’ ID M Pre 232

4.4. Danger, fear and safety measures

Speeding cars, including “boy racers” were seen to dissuade people from walking, playing and cycling in the streets. On the roads themselves, several cyclists described feeling intimidated by motor traffic. Respondents reported witnessing serious accidents, damage to parked cars and property, pets being killed and experiencing ‘near-misses’.

‘Crossing the road in Kings Heath often feels like an extreme sport’ ID KH Pre 60

In particular, the atmosphere created by speeding and inconsiderate driving was felt to be incompatible with the safe, orderly passage of children to the many local schools.

‘As a father of two, I am concerned at the huge risks pedestrians take just by walking down [name] road and the level of abuse, threats of violence and general stress that the current situation exposes us to.’ ID M Pre 77

Additional speed reduction and safety measures were felt to be needed to combat aggressive driving and deter through traffic, including full width speed bumps; lower speed limits; improved speed limit signage; one-way systems; replacing unsafe junctions with roundabouts and re-siting bus stops away from zebra crossings and narrow paths. Speed cameras were also a popular suggestion.

‘Issue residents with speed cameras to catch the idiots whose brains cease to function on entering a motor vehicle!!!’ ID KH Pre 248

Enforcement of current restrictions was felt by some to be needed before further measures were taken, to reduce a perceived sense of entitlement amongst drivers. Such issues seemed to particularly resonate amongst male respondents. Traffic wardens tackling inconsiderate or illegal parking; speeding fines; identification of boy racers to prevent accidents and property damage; and tackling of noise pollution were suggested. For some, 20mph limits were counterproductive.

‘20mph speed limits in the hope some drivers keep to 30mph is a confusing and misleading approach. What is needed is for existing traffic law to be enforced not forcing sensible drivers to lengthen journey times in an effort to affect the behaviour of dangerous drivers who will ignore the changes anyway’ ID KH Pre 132

4.5. Parking priorities

Inconsiderate parking was felt to be narrowing roads, reducing visibility at junctions and restricting pavements for pedestrians, pushchairs and wheelchair users. People parking in side streets for shopping and school drop offs was seen to be leading to confrontations.

‘Crowded roads around [school] and [school] at school drop-off and pick-up times, leading to road-rage incidents and verbal abuse to local residents.’ ID KH Pre 207

Removal of on-street parking in the high street was also described as leading to illegal behaviours.

‘I think it’s the most annoying thing you have done in taking away parking spaces on KH High St and [name] Rd. People are parking more illegally, and

it has become more of a hazard, I have had to climb the pavement just to get past to get the traffic flow to normal again' ID KH Pre 124

When seeking solutions to parking issues, double yellow lines were suggested to improve traffic flow on narrow roads. Residents parking schemes near train stations, schools, parks and adjacent to the high street were suggested to prevent displaced parking, especially on residential streets with terraced housing where parking was already limited.

'Local residents are fed up of the misuse of our neighbourhood for random driving and parking and the misuse of road markings. We would love residential parking on all our roads running adjacent to the high street and schools.' ID KH Pre 206

Conversely, there was also a view that residents should not be claiming ownership of roads.

'People forget the road is for driving and not a resident's own personal parking slot. Park on your own land i.e. drive or have one side of a road only redesigned with resident permits only one car per household and allow traffic to drive safely on the roads that were built for them!' ID KH Pre 228

4.6. High street business access and usability

Business owners raised concerns about the removal of parking bays creating difficulties for non-local customers, affecting their competitiveness.

'It is already difficult enough competing with online trade. When we make it more difficult for customers to visit us because parking is such a nightmare...this all isn't just about residents but for some of us it will affect our livelihood!' ID KH Pre 139

However, customers, including many residing in neighbouring areas, broadly reported desiring measures such as pedestrianisation, improvements in cycling infrastructure, closure of parking bays, widening of footpaths and reduction of road widths to create pavement culture, enable outdoor dining, reduce air and noise pollution and make the high street a more desirable destination.

'Some parking bays on the High Street are currently suspended... Would be wonderful for this to become permanent, with planters between the pavements and the busy main road. This would make the High Street feel more like a shopping street with traffic passing through, rather than a traffic jam with shops on the side.' ID KH Pre 158

Marked bays for disabled use on the high street were also felt to be important in a society seen by some as unsupportive of people with disabilities.

'In 5 working age adults are disabled and society is already extremely ableist. So any changes to reduce traffic must also allow for access for those who need it most - not easy to achieve.' ID KH Pre 148

4.7. Pollution and the local environment

The overall level of neighbourhood traffic, stationary traffic, engines left idling and stop-start traffic due to numerous bus stops and zebra crossing were described as contributing to a poor atmosphere. The perceived high level of air pollution and its close proximity to pedestrians on narrow roads were points of great dissatisfaction.

'Cars stagnating because of traffic increases pollution. Children in push-chairs often have to breathe at the level of exhaust pipes' ID KH Pre 178

Much of the emphasis for improving the environment was, again, focused on the high-street, with a desire to improve aesthetics and air quality. Suggestions included converting parking and other spaces into parklets or simple green spaces; introducing planters; green walls and planting pavement trees. Suggestions were also raised to improve urban biodiversity.

'pay attention to plants and the insects, birds and other wildlife that flourishes where it is allowed to be undisturbed, e.g. no mow policies where there are grass verges.' ID KH Pre 15

5. Anticipated and reported benefits from the LTN schemes

This section will provide a summary of the local benefits respondents anticipated from LTN schemes, and those they actually reported post-implementation.

5.1. A sense of community

Pre-LTN, many respondents were hopeful that the scheme would improve people's experience of living in residential areas; improving the sense of community and reducing loneliness with pleasant outdoor socialising. LTNs were expected to mirror the quieter atmosphere experienced during lockdown and create a better place to live.

'when there was less traffic during lockdown, the street was much more pleasant to be on, and neighbours could meet and chat safely on the footpath. If this is what a low traffic neighbourhood feels like, bring it on!' ID KH Pre 171

Respondents, in particular residents of roads with modal filters, felt that post-LTN, their streets had become calmer, more pleasant, more social environments.

'I would be extremely angry at the number of people speeding along the narrow Kings Heath streets at truly dangerous speeds. I'm a dad of a [child] and there are lots of children in that area...The atmosphere has changed. It's much more pleasant, safer, quieter and a nicer place to live.' ID KHM Post 118

Post-LTN, there was also a feeling that journeys to the high street and in some cases the high street itself, had become more attractive.

'Since the barriers were put into place, the traffic has almost been fully eliminated, which makes it quite pleasant to walk or cycle between the two village centres. In addition, it is much more enjoyable to spend time along the Kings Heath High Street with the LTN.' ID KHM Post 58

5.2. Health Benefits

Some respondents anticipated both physical and mental health benefits from the LTNs, partly through the encouragement of active travel.

'It had forced me to reconsider my car usage. I've now gone from driving 6 days a week to only driving twice a week. It's made me healthier.' ID KHM Post 111

However, overwhelmingly, the health benefits anticipated related to improvements in air quality and reduced noise pollution.

'It would raise our quality of life immensely; less noise pollution, less air pollution and the ability to socially distance on the street. For children and the elderly in particular it would be fantastic.' ID M Pre 253

Post-LTN, respondents reported feeling that the quality air had indeed improved in streets with modal filters.

'I was worried about the air pollution for my two kids growing up. Now it feels much more pleasant walking and it's nice going to walk to local businesses.' ID KHM Post 55

5.3. Safety improvements

Improvements in safety for cyclists and pedestrians were anticipated from the LTNs by many respondents through a reduction in rat runs, speeding, traffic flow through dangerous junctions and narrow roads, and driver aggression.

'I'm over the moon about this...It will make it so much safer and a better place to live. It will hopefully also stop the boy racers who have been very active in lockdown and have frightened my children when we were out for a walk- it's an accident waiting to happen' ID M Pre 60

Post-LTN, respondents reported a perceived decrease in speed related accidents.

'I really like the change that the planters have brought. There are far less accidents on [name] Rd and less speeding cars travelling down [name] Rd and [name] Rd. I am keen for them to stay' ID KHM Post 12

Such improvements in safety and aesthetics were particularly noted amongst respondents using active travel who did not live on a street adjacent to one with a modal filter.

5.4. Change in transport methods

Pre-LTN, some respondents envisaged that modal filters would stop rat runs, discourage car use and encourage active travel.

'This whole area could be transformed by removing through traffic... Footfall to businesses will increase, safety and pollution will improve, active travel/cycling etc can be encouraged.' ID KH Pre 25

Among some respondents, there was an acceptance that unpopular decisions may be needed to encourage active transport.

'I strongly believe that the only way vehicle use can be reduced is by making it less convenient to drive.' ID M Pre 30

Post-LTN, this inconvenience to motor travel did indeed prompt change among some residents.

'a friend who complained about the circuitous route she had to drive, and that it would have been as quick to walk, laughed and said that of course that's the point - I'll walk next time' ID KH Post 82

For some residents, perceived improvements in safety led to more active travel. Positive views of active travel were also shared by some non-residents visiting the area by cycle or on foot.

'It is now considerably safer to cycle in Kings Heath and Moseley...I've been able to take my children... cycling on the roads for the first time, building their confidence and independence.' ID KHM Post 14

Post-LTN, there was support for an expansion of the modal filter network, with a view that this would replicate beneficial effects.

'They're brilliant. Really love the improvements made to so many parts of the area, and I'm eager for more to be put in place.' ID KHM Post 99.

Overall, following the implementation of the Kings Heath and Moseley LTNs, a similar proportion of respondents were supportive and unsupportive of the changes, furthermore it is worth noting that there was a great deal of feeling on both sides. The thoughts of those who reported negative issues with the LTN schemes will be discussed further below.

6. Anticipated and reported disadvantages from the LTN schemes

This section will describe respondents' perceptions of the potential disadvantages of becoming an LTN and the disadvantages experienced after their introduction.

6.1. Increased traffic congestion

Post-LTN implementation, a perceived increase in overall traffic on residential streets without modal filters was a major point of displeasure. The community environment on such residential roads was felt by some respondents to have suffered.

'More noise from traffic engines, idling outside our properties, blaring car radios, queues of traffic' ID KHM Post 148

Similarly, some respondents were not convinced of any overall increase in active transport.

'After several months of the trial, the predicted 'traffic evaporation' doesn't seem to have happened.' ID KHM Post 86

The Kings Heath and Moseley LTNs were implemented in November 2020 and the timeliness of encouraging public transport during a pandemic was raised, as well as the difficulty of judging its effectiveness.

'I feel that this trial has been at a totally inappropriate time as we have been told to not use public transport unless unavoidable ... Car numbers have been skewed and those walking, cycling- just to get out of the house and avoid being locked in has also made it appear that more people are walking or socialising!' ID KHM Post 29

6.2. Shifting the problem

A major topic of respondents' thoughts prior to the LTNs was their propensity to shift issues from one road to another, diverting it onto unsuitable, narrow roads.

'Your plans only benefit the affluent properties in Moseley Golden triangle. Nothing has been done to actually reduce traffic, provide more safe cycling paths. You have merely pushed the problems into a few other roads such as [name] Rd and will significantly increase congestion, pollution, danger and noise there.' ID M Pre 250

Post-LTN, displacement of traffic onto other unsuitable residential roads or the high street was indeed noted by respondents.

'This has been a nightmare for my son, partner and their children my grandchildren living at the top of [name] Road. Traffic jams and idling cars belching out fumes outside their house all day, these measures are poisoning the children when they leave the house' ID KHM Post 132

Perhaps surprisingly, some respondents wishing to use more active transport methods also felt disadvantaged:

'As a cyclist I would say that overall they've made things worse by making the rat run roads worse to ride on, roads that are necessary to use to get anywhere.' ID KHM Post 51

Post-LTN, the issue of new boundary roads was a divisive one, with many respondents noting

'the unfairness of traffic displacement on the physical, social and mental health of residents on the newly created "boundary" roads' ID KHM Post 44

The divisive nature of selected modal filters was raised, with some respondents indicating that the plans felt discriminatory and were not beneficial to the community as a whole.

'I think that it is an excellent way of undermining community cohesion. The fact that it is being implemented shows that are the council are aware that closing [name] Road will result in traffic finding alternative rat runs down the other parallel streets. This simply privileges one road over others and does nothing to solve the problem of reducing traffic in the area.' ID M Pre 234

6.3. Inconvenience for private vehicle users

Some concern was raised that closing roads to vehicles would hinder residents' ability to use what they saw as their own streets. Modal filters would make deliveries harder, with u-turning cars and vans in narrow roads. A concern was raised about the LTN interfering with journeys that necessitate a car, such as shopping for large quantities or dropping children at school then going on to work – a concern mentioned more often by female responders.

'The measures don't take into account how residents in these affected streets will continue to use their own cars on their own roads. Surely something as important as this should be consulted on fully and not pushed through quickly by politicians with their anti-car agenda.' ID KH Pre 242

Notably, both concerns about increased local journey times and dissatisfaction at the degree of consultation on the LTN measures were most frequently mentioned by male respondents. Post-LTN, some journeys seen as necessitating a vehicle were indeed felt to be disrupted.

'The whole LTN approach seems based on the false assumption that people use cars for fun. This may be true for a minority of young drivers, and they will keep on using their cars simply for the fun of it. The rest of us use them as the practical and efficient way of moving oneself and one's stuff from place to place. (Try moving a roll of loft insulation on a bike!).' ID KHM Post 6

Those with a need to travel to Kings Heath and Moseley from other areas and those experiencing physical barriers to active transport also felt unconsidered.

'I am appalled by the changes. I am partially disabled and have to use my car to get to Kings Heath High Street. No Equality Impact Assessment was done before these changes were implemented. Is it now going to happen? The changes have a severe effect on the elderly and disabled members of the community.' ID KHM Post 3

Issues regarding discrimination against disabled people were a particular concern amongst female respondents.

6.4. Restricted parking

Parking was a divisive issue. Many residents voiced their frustration over inconsiderate parking. However, other respondents raised concerns about the limiting effect of the LTNs on parking options, including for those dropping off children by car and the safety issues this may cause.

'Where are the School Kids going to Park?? They couldn't park on Valentine's, Springfield, or Popular road before. Now they won't be able to park on School Road... This is deeply dangerous for School Kids. This will cause more Chaos and parents "dropping off" more dangerously where they can't stop.' ID M Pre 229

For other respondents, the LTNs had failed to tackle existing traffic flow and parking issues.

'I am aware that the traffic on my side street off the high street which already had a lot of traffic is not really benefitting in the ways the other local streets are because of the heavy traffic to the mosque which also takes parking from the street at various times meaning I need to park on another street and this is not better'. ID KHM Post 405

6.5. High Street traffic and businesses

Pre-LTN, there were concerns that increased traffic congestion on the high street would affect willingness to use local businesses.

'Goodbye High St. Very poorly thought out and the tail backs on the high street will be horrendous.' ID M Pre 246

Post-LTN, perceived increases in high street traffic did indeed lead to a feeling that fewer people were willing to support the high street.

'I find the changes to be a waste of resources, that have made the high street too awkward to visit, I used to shop at Asda's, but now find the 20 mins sitting in traffic to get to the car parked, has put me off going into Kings Heath. I now drive to the Asda's in Shirley' ID KHM Post 20

This reluctance amongst car drivers to negotiate longer queues and access the high street was perceived by business owners to be affecting trade.

'the LTN is having a hugely detrimental effect on businesses. [business name], [business name] and the [business name] are losing business as people can't easily drive to the shops and park outside to purchase goods.... Bollards are not helpful.' ID KHM Post 79

6.6. Health and safety issues from traffic and pollution

Post-LTN, respondents reported that increased traffic on roads without modal filters led to an increase in antisocial and dangerous driving.

'But these modals on other streets have made our street even more hellish than before: constant reversing, hitting/damaging parked cars, constant idling traffic, speeding vehicles, vehicles at a stand still, even more pollution etc. My family don't feel safer and want to walk round the area more quite the opposite.' ID KHM Post 4

Pollution was seen to increase on streets without modal filters, affecting respiratory health.

'The volume of traffic and permanent congestion on [name] Road has been shocking. Car fumes make me cough when I come out of my house for the first time in ten years of living here.' ID KHM Post 122

Particular concerns were raised about the health of children on newly designated boundary roads.

'It is totally negligent of the council to introduce this scheme without any plan for boundary roads. The council talk of a greener and healthier future but they have increased my children's chances of developing a serious lung condition..' ID KHM Post 43

A direct impact on emergency situations was noted.

'I have witnessed ambulances having to turn around on [name] street and [name] road because bollards were blocking them get to local residents in need of urgency medical care..' ID KHM Post 79

6.7. Alternative solutions to the current LTN

For some respondents, the natural solution to the negative effects of traffic displacement on adjacent residential roads was a wider network of modal filters.

'I would like to see the LTN made permanent and extended to other areas. I live in one of the areas that has not had an LTN implemented and the biggest problem is drivers driving dangerously at high speeds.' ID KHM Post 34

For others, alternative solutions were preferred. Post-LTN, there was support amongst respondents for a one-way system, pedestrianisation and enforcement of current speeding and parking restrictions. Disappointing public transport alternatives were also raised, highlighting the need for improvements to alternative infrastructure.

'Fix the city-wide problem with a proper green integrated transport strategy that takes most cars off the roads completely... LTN is a luxury that all residents should be able to look forward to once the technologically more advanced transport options are ready to be deployed in a properly designed an holistic way.' ID KHM Post 65

7. Discussion

A qualitative analysis of free text responses before and after the implementation of two Low Traffic Neighbourhood schemes in Birmingham has revealed great strength of feeling among respondents, both in support of and against the schemes. Cited benefits included reduced traffic, reduced fear and safety concerns, a greater inclination for active transport and an improved sense of community. However, respondents also described frustration and inconvenience, feelings of discrimination against those for whom vehicles were a necessity, great resentment between residents of roads with and without modal filters and a desire for alternatives to LTNs. There was substantial support for the schemes but also many concerns raised, including traffic displacement issues that were acknowledged by Birmingham City Council ahead of a consultation on further iterations of the LTN schemes (Jacobs, 2022).

7.1. Location and transport communities

Within any urban residential area, sub-communities exist drawn together by location (for example on individual roads), by how they use the area (resident, school drop off, visiting for leisure etc.) and how they choose to travel (car, walking, bike etc.). Whether respondents viewed the LTN schemes to be broadly a success or not depended to some degree on which communities they belonged to. Residents on streets with modal filters and in particular cyclists and walkers on such streets generally reported positive experiences of the LTNs. LTNs were perceived to have decreased traffic and even the inconvenience brought by LTNs was felt to have had a positive impact in prompting modal shift. A recent systematic review of motor traffic volume changes in 46 London LTNs supports respondents' beliefs that such schemes can decrease traffic on internal roads within LTNs (Thomas and Aldred, 2023).

Perceived improvements in air quality and physical and mental health benefits from a switch to active travel were certainly reported by this study. Research by Belcher et al. supports this belief among residents that LTNs can improve air quality and safety in urban environments (Belcher et al., 2021). UK research into the effects of LTNs on air quality is lacking, however, a study of three LTNs in Islington, London, supported these respondent's beliefs that such schemes can reduce air pollution (Yang et al., 2022).

Safety improvements via LTNs reducing speeding and accidents led to a feeling of increased safety when crossing roads and increased use of cycling on roads with modal filters. Other safety improvements have also been reported in previous research such as reductions in street crime (Goodman and Aldred, 2021). Improvements in the area's sense of community, with a calmer, less fraught environment were reported. These benefits align well with the LTN aim of improving the aesthetic

character of residential streets to encourage community socialising (Sustrans, 2020).

However, residents on streets adjacent to those with a filter and those on new boundary roads; disabled car users; those requiring a car for work, and those dropping off children by car then commuting to work held broadly negative views of the LTNs. They perceived a failure to achieve traffic evaporation. A review of LTN schemes in London identified both increases and decreases of traffic volumes on boundary roads across all included schemes, with no systematic pattern, suggesting that impacts are highly variable and dependent upon the local context. There is a lack of peer-reviewed studies exploring the impacts of LTNs on boundary roads outside London, consequently, the impact of such schemes on traffic evaporation and the factors associated with such changes remain uncertain. (Thomas and Aldred, 2023). Within our research modal filters were perceived to simply shift congestion from one road to another, especially to roads seen as already busy, narrow, or prone to accidents. Traffic, dangerous driving, noise and air pollution were felt to increase on roads adjacent to those with filters, boundary roads and high streets, directly affecting the health of children and other residents and providing a poorer environment for active travel. Concerns about traffic displacement from LTNs have also been highlighted by Belcher et al (Belcher et al., 2021).

The specific increases in traffic perceived along newly created boundary roads have been experienced within other LTNs (Thomas and Aldred, 2023). Several complementary measures have been suggested to encourage active travel on boundary roads such as widening footways to encourage walking (Sustrans, 2023), protected lanes for bikes and scooters; cycle crossings; bus priority measures and pedestrianisation of high streets and school streets (Bosetti et al., 2022). Consolidation or re-siting of loading bays (Sustrans, 2023) and traffic calming measures (Bosetti et al., 2022) have also been suggested to discourage personal vehicle use and thereby reduce overall traffic on boundary roads.

The selection of a limited number of roads for modal filters resulted in animosity between roads with and without filters, partially due to a belief that those securing filters had been the vocal, affluent few. The limited nature of the scheme was seen as undermining the sense of community. The natural solution proposed was as an integrated, contiguous network of modal filters, reducing the creation of new rat runs on residential streets and providing continuous active transport routes to key areas such as transportation hubs, the city centre and major areas of employment.

It is also worth noting that modal filters may disproportionately affect those who, for ability reasons, do not have an alternative option for journeys. (Blue Badge holders are not exempt from modal filter restrictions that form part of Low Traffic Neighbourhoods in Birmingham). This may be in conflict with the UK governments Inclusive Transport Strategy which aims to ensure that disabled people can travel easily, confidently and without extra cost (Department for Transport, 2020). Business owners and shoppers also raised concerns about the off-putting effect of protracted journeys to the high street.

7.2. An alternative vision

It is worth noting that no complementary measures such as subsidised public transport, additional bus routes or cycle hire schemes were created in the area during the implementation phase of the Kings Heath and Moseley LTN schemes. However, a range of alternative measures were proposed by respondents prior to LTN introduction, including lower speed limits, traffic calming measures, cameras, roundabouts and one-way systems to reduce aggressive driving and through traffic. Stationary and stop-start traffic caused by road features and overall traffic levels were perceived to be generating unpleasant levels of air pollution with parklets, planters, green walls and pavement trees suggested as solutions. Segregated cycleways and safe, less expensive public transport were suggested to incentivise modal shift. Previous research regarding LTNs in Lambeth, Wandsworth and Lozells also highlighted

that a balance of restrictive measures on car use and improvements in the ease of use and cost of public transport are needed (Belcher et al., 2021). Imposing an LTN before improvements in public transport are made may not effectively address local concerns.

7.3. To subvert or acquiesce

When faced with an obstacle to our usual patterns of behaviour, human nature guides us to either acquiesce to the obstacle and adjust our behaviour accordingly or try to subvert the decision and choose an unintended behaviour instead (Rousseau, 1997). Amongst respondents, there were two main behavioural reactions to modal filters, some people recognised the aim of the filters, including the inconvenience to local car journeys and switched to active travel instead. Others were unable or unwilling to switch their mode of travel, this led some respondents to reject their previous journeys entirely and, for example, support shops in other, now easier to reach areas. In some cases, the reaction was to subvert the physical blockage – driving round the modal filters, parking unsafely when appropriate parking was removed or driving on footways to pass inconsiderately parked cars now blocking two-way traffic. Transport within local urban areas has an impact on community quality of life (Mattson et al., 2021) and many respondents clearly felt a sense of possession and entitlement over ‘their roads’. In order to promote the intended change to active transport, the gains experienced from an LTN must out way the inconvenience for the majority of residents or such schemes will be at risk of physical subversion, which can pose a risk to other road users.

7.4. Implications for LTN interventions in current urban environments

A central tenet of this research was identifying whether local people felt an LTN addressed the issues they perceived as important in their local environment. It was found that an LTN may address traffic issues such as ‘rat running’, speeding, aggressive driving and overall traffic flow. Some improvements in pedestrian and cyclist safety were reported and encouragement of active transport brought mental health, environmental and social benefits for some. However, for some, speed bumps; camera enforcement of speed limits; residents parking and traffic warden enforcement offered more effective solutions to their principal concerns regarding speeding and dangerous parking, compared to an LTN. Notably, there was a view that providing an incentive by improving the convenience of public transport should come before restrictions on personal vehicle use. The high street was a particular focus for issues not addressed by an LTN intervention, with a suggestion that pedestrianisation would improve the high street, reducing traffic, whereas an LTN would displace traffic to the high street. The effect of settings such as schools, faith centres and businesses which can generate substantial volumes of traffic within residential areas at specific times may also not be addressed by LTNs alone, which are primarily designed to address through traffic. Additional measures to incentivise modal shift to active transport for local travel, such as car free school streets and improved public transport, should be considered in conjunction with LTNs.

7.5. Implications for future LTN implementation

The many benefits raised by those living on streets with modal filters, such as a reduction in overall traffic, improved air quality and a calmer environment more conducive to active travel must be weighed against the disadvantages to those living on surrounding roads and boundary roads without filters. Such roads are perceived to carry the burden of displaced traffic, increased journey times interfering with necessary travel, increased air pollution and perceived detriment to respiratory and mental health. The disparity of experience between different roads and a perceived lack of control as to where filters are implemented can lead to deep seated feelings of discrimination, threatening the social

cohesion of a neighbourhood.

7.6. Strengths and Limitations

This study represents the first rigorous qualitative analysis of the public's response to an LTN scheme outside of London. It was based on a large dataset, with the analysis performed shortly after the consultations were conducted, taking into account the political and social environment at the time.

The population responding to the consultations was broadly slightly older and included more female respondents than the local populations. It is perhaps expected that consultations which attracted mostly residents would include a slightly older population due to the decreased likelihood of children responding and the increasing age of home ownership. It is also a common finding that women are more likely to respond to consultation opportunities than men, indicating that more needs to be done during such consultations to encourage men to participate (Becker, 2022). Geographically, the number of respondents from Kings Heath was far greater than the response from Moseley. This is understandable given that many more modal filters were implemented within Kings Heath than Moseley, however it may have led to the population of Moseley being underrepresented within this consultation.

There were around four times as many responses to the pre-LTN compared to the post-LTN consultations. The characteristics of those responding to the two phases were also somewhat different, with a greater proportion of post-LTN responders being residents or visiting the area and fewer shoppers and friends and family of residents. These differences in response rate and composition may have influenced the overall data generated throughout the consultations, with perhaps those with the strongest views and those most affected - residents and frequent visitors - being more motivated to respond post-LTN implementation. Responder bias is a factor of all such public consultations and should also be borne in mind when considering our findings. It should also be noted that information on ethnicity was not collected as part of this BCC consultation, we would recommend collecting ethnicity data in future consultations to add further depth to any framework analysis and better understand future LTN implementation.

The Kings Heath and Moseley LTNs were implemented under the UK Department for Transport Emergency Active Travel Scheme in response to the COVID-19 pandemic. As a result of the need for rapid implementation under Experimental Traffic Regulation Orders, construction of the LTNs actually began one (Moseley) and two (Kings Heath) months before the end of the five-month pre-consultation period. While the pre-LTN public consultations were not a legal requirement, the overlap with construction during the later months does make it difficult to distinguish respondents' views on pre-LTN transport issues from their initial reactions to schemes themselves. Consultations conducted soon after implementation may also not be reflective of longer-term changes in traffic flow and travel behaviour as residents and visitors adjust to the new system.

The creation of the LTNs during the COVID-19 pandemic may also have affected the public's understanding of what caused the changes they experienced in their local transport environment. In addition to the modal filters, traffic patterns and choice of transport mode would also have been affected by successive public health restrictions, shifts to working from home, social distancing requirements, perceived risk of Covid-19 transmission in transport microenvironments and changes to recreational car use and socialising habits. The long term effects of the pandemic on transport use may not be fully understood for many years to come.

8. Conclusions

Our research has revealed that there is local support for LTNs and they do address many concerns raised about the local traffic environment, but there are also issues described with great interest and feeling

that are not addressed. There are questions as to whether a scheme will be accepted in the long term if it does not fully address the issues that are most important to the local population. Further local authority consultations and academic evaluations could be useful in studying changes in public acceptance of LTN schemes over time.

A feeling of discrimination was noted by several groups as a result of the LTNs, including those living on residential streets without filters adjacent to residential streets with modal filters: those living on the high street and new boundary roads dealing with perceived displaced traffic, and disabled car users. This disparity of experience led to animosity and great resentment within the community. A piecemeal approach to the introduction of modal filters has the potential to undermine community cohesion and reduce overall support for such schemes, especially in the immediate aftermath of their implementation.

Where possible, public consultations should identify issues across different residential streets, businesses, school and faith environments, and how they will interact with each other to avoid shifting issues elsewhere. The balance of voices of different transport users in an area should also be carefully considered. A co-ordinated network of modal filters across neighbouring residential areas, with complementary measures to reduce the impact on high street and other boundary roads, could help to realise the potential benefits of LTNs which are welcomed by local communities.

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CRediT authorship contribution statement

Ruth Pritchett: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Validation, Visualization, Writing – original draft, Writing – review & editing. **Suzanne Bartington:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Methodology, Supervision, Validation, Visualization, Writing – review & editing. **G Neil Thomas:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Methodology, Supervision, Validation, Visualization, Writing – review & editing.

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Appendix A. Supplementary data

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