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Cycling and other active modes in the UK: how and why are they changing?

Future of Mobility: Evidence Review

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Cycling and other active modes in the UK: how and why are they changing?

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Contents

The review addresses the following questions in relation to the active modes in the transport system (cycling, electric bikes, longboards; walking is covered elsewhere in a separate evidence review): how they are changing, how the user is engaging with them, and how technology is changing active modes. In each of these areas, the implications for decisions that need to be made today are considered. The final section of the report discusses a study on e-bike use in China and the UK that has relevance for this active mode of transport.

1. How are the active modes changing?

Relevant population projections and age-related changes

Out to 2039 there will be increases in all population age groups except those under four years of age and in age range 35–55; the largest increases will be in the over-55 age group (DfT, 2016; ONS, 2016). There will be increases in the numbers of people both with and without disability, especially in the over 75 age range, and those with disability may be prevented from walking or cycling. There is ample evidence of some age-related changes that may reduce working memory, response times and decision-making, attention-switching and situation awareness, but also evidence of increases in counteracted behaviours, resilience and positive emotions and less risk-taking; these issues can impact upon older drivers of all vehicles, although decisions taken at 15 mph allow longer response times than at 30 mph or 40 mph (e.g. Brumback et al., 2005 and 2011; Park and Schwartz, 2012; Magai, 2001; Brouwer et al., 1991; Guo et al., 2016).

‘Traditional’ cycling and public transport use

Of the over-65s, only 8% of men and 3% of women ever cycle, and there is evidence that numbers using bicycles in these older groups is not set to increase (Holley-Moor and Creighton, 2015). Other research suggests that there is, in any case, an upper limit to the numbers adopting cycling (a saturation of 43% is indicated) and the likely reasons for this include hilliness, safety and security, the weather, user fitness and that infrastructure alone is not enough to engender high levels of cycling (e.g. Parkin et al., 2008).

The use of public transport is decreasing other than in London (Guo et al., 2016). Trips made by private transport are increasing, and this increase includes journeys of under 2 miles (Kim and Ulfarsson, 2008). Evidence from China (Weinert et al., 2014) would suggest that electric bikes (e-bikes) are likely to take travellers from cycles and public transport and allow them to travel longer distances than by, say, walking. However other research suggests that the picture is unclear and it could be car drivers who could take up e-bikes (Fishman and Cherry, 2015).

Who is cycling, and why?

A large and complex study of 150 countries (1.25 billion households) in 2015 found that, there has been a steady decline in bicycle ownership worldwide outside of India and China (which has the highest bicycle ownership by number, but which is proportionately highest in northern Europe) (Olufolajimi et al., 2015). This has been accompanied by increases in the numbers of motor vehicles. Pan et al. (2009) point out that a pedestrian/cyclist-friendly urban form is an essential base if automobile dependence is to be limited. Within the large study, there are some countries with higher levels of bicycle ownership, such as the Netherlands and Japan; Steele (2012) and Mitanoska et al. (2012) both address why such countries have high bicycle ownership. The major conclusions are the importance of enabling infrastructure, such as separation of cyclists from pedestrians and from automobiles in the Netherlands, and the positive bicycle culture developed since the post-war period as a means of aiding social and economic development in Japan. Beck and Immers (1994) point out the obstacles to increasing bicycle ownership/use further are hazardous traffic conditions, theft, long distances, the absence of luggage-carrying facilities, lack of comfort and the availability of other means of transport.

Within the UK, there are gender and ethnic differences in numbers cycling; for example, using the Cycle Hire Scheme in London. Affluent white men dominate cycling in London (Steinbach et al., 2011); women prefer slower-traffic streets and where cycle routes are offset from roads; and gender differences in attitudes and behaviours are seen in cycling all over the UK (Beecham and Wood, 2014; DfT, 2016). The ratio of recreational to utility cycling is 1.58:1, with utility cycling, which includes shopping and commuting, being more likely in urban areas and recreational cycling being more likely in rural areas[1]. In addition, all types of cycling decline steadily with age from 16–24, in contrast to walking where the decline starts later at 54. Cycling rates have not changed but vary greatly between authorities, such as where there are large numbers of students (Cambridge is the best example of this), whereas over the same period walking numbers and frequencies have been rising almost everywhere (DfT, 2016). In terms of frequency of cycling, the largest number cycle only once a month or less (10% utility, 6.5% recreationally) dropping to 0.6% and 1.5% for five times a week (DfT, 2016).

There are potential safety issues relating to cycling. For example, ‘Boris Bikes’ hired out by Transport for London’s bike hire scheme show a 32% lower use of helmets, which several authors suggest will probably lead to more accidents with head injuries. Furthermore, if these hire bikes are picked up spontaneously, then the users may not carry crash helmets with them (Smith and Thompson, 2013; Robinson, 2006). Interestingly, in 1976 the US Congress removed a mandatory requirement for motorcycle helmets and later in 1995 repealed incentives for this. Motorcycle deaths since then continue to rise and account for 5% of economic costs and 8% of societal harm for traffic crashes (7% and 10% if pedestrians and cyclists are included), Teigen et al., 2015).

In the UK, overall wearing of cycle helmets has been increasing year on year, albeit with a few gender, ethnic, age, cycle and route type variations, whereas in the Netherlands

[1] It is difficult to ascertain how much of utility cycling is for local shopping and how much for commuting, but DfT (2016) show 3.1% cycling 3+ times/week and 11% less than 1/week or 1/month, so it is possible to propose that more frequent travelling may be commuting, less frequent for other place-to-place trips

few people wear helmets at all. Wearing a helmet may be associated with how cyclists view risk, reduced head injuries, fewer violations and more use of lights. Thus, the issue of legislation on wearing helmets remains a controversial one (Sharratt et al., 2009; Robinson, 2006). The UK government has been conducting an open consultation on the Cycling and Walking Investment Strategy and the issue of cyclist safety runs through this, including the suggestion that governments should focus on speeding, drink-cycling, failure to obey road rules, poor road design and cycling without lights (DfT, 2018).

Active modes of travel: attitudes vs behaviour

The number of short trips by car is increasing (Mackett, 2003; Kim and Ulfarsson, 2008). The question is how might people be discouraged from taking short trips in cars in favour of more active transport modes? Heinen et al. (2011) suggest that the choice to use a cycle to commute is influenced by safety, awareness and direct trip-based benefits – especially so for shorter distances. Perceived health and environmental benefits are also a factor, especially for longer distances. VTI (1998) in Sweden suggest that the most important determinant in predicting walking, driving or cycling is perceived behavioural control and habit. This notion of control is interesting, because it is higher for car journeys, walking and cycling than for public transport; however, within that, car journeys are dependent on the vagaries of other traffic, while walking and cycling are dependent on the vagaries of the weather and safety worries, so none of these modes show a lot of 'control' (e.g. Bergstrom and Magnusson, 2003; Heinen et al., 2011). Schneider (2013) proposes a five-stage strategy to promote walking and cycling: awareness and availability; safety and security; convenience and cost; enjoyment; and habit. While this approach has failed to make much impact on numbers for cycling and walking, we suggest it will have an impact for e-bikes. Anable and Gaterleben (2005) show how affective issues are important in mode choice; for example, car users see other modes as inferior in terms of convenience and flexibility, despite rating other modes as healthier.

A study of mode choice for short journeys (<2 miles) in the USA showed 75% travel by car, 23% walk, 1% bicycle and 1% bus (Kim and Ulfarsson, 2008); the main group responsible were older drivers who felt unable or unwilling to use public transport or walk. Other research into longer journeys mode choice has shown land use attributes such as hilliness and condition of the road, weather and travel time considerations to be important (Limtanakiil et al., 2006; Parkin et al., 2008).

There are many reasons why people choose not to use active modes, including: length of route (the most important); safety and security; convenience; but less so the environmental reasons. It would seem that shortening the route (e.g. closer bus stops etc.) has been shown to work to some extent and so has social interaction (others doing it) (Burbidge and Goulias, 2009; Panter et al., 2008; Panter and Jones, 2010). In terms of demographics, it is the older, female and short-journey users who are not really engaging with active modes in the system. One other group with increased car usage is the 'school run': McDonald (2008) found that getting more people to walk was dependent on walk travel time but there are a number of policy implications for transportation, school and land use planning, factors which may of course be relevant to all active modes.

While many studies into attitudes make little or no differentiation between the various active modes, those that do show differences in relation to use, proximity to trails and retail, attitudes to the neighbourhood – for example seeing it as 'walkable' or 'drivable' – and generally more positive attitudes to walking than to cycling; the latter often due to bad experiences with traffic, and the need for planning and equipment (Krizek and Johnson, 2006; Handy and Mokhtarian, 2005; Pooley et al., 2011).

In the UK there is an increasing awareness that active modes and electric power have more positive health and environmental impacts than conventional transport modes, and government's recent announcement (Financial Times, 2017) on banning the sale of petrol and diesel vehicles by 2040 is consistent with this. However, this does not often translate to increased walking and especially cycling, where the risk to health may include inhalation of toxic fumes as well as risks of accidents. Nevertheless, it is a truism that people agree that more active modes are generally healthier (e.g. de Hartog et al., 2010; Rojas-Rueda et al., 2011). So why do people not readily change, instead making increasingly more car journeys? To understand this, we need to explain why people do not behave consistently in a way that reflects their health-related beliefs, and for decades psychologists have put forward several theories (e.g. the Health Belief Model and its derivatives, the Optimistic Bias Theory, Theory of Planned Behaviour, and nearly 200 others). These have been applied in areas such as health, sustainability and recycling (e.g. Ajzen, 1991; Harvey et al., 2014; Price et al., 2002; Becker and Rosenstock, 1987). Some of these theories emphasise perceived behavioural control, and others the social effects of other people, while others emphasise the barriers to prevent the behaviours, such as discomfort and inconvenience. In addition to health beliefs not being strong predictors of healthier behaviour, there is evidence that the environment plays little part in travel mode choice or even driving behaviours (Harvey et al., 2014, Harvey et al., 2013). So while active modes are largely considered to be healthier, this belief does has not translated into action. However, it can be said that the theories are more consistent with e-bikes (than walking or cycling) being selected as an alternative transport mode; the notions of perceived behavioural control, social effects, comfort and convenience are the most relevant and must form the basis of any approach to encouraging e-bikes (see following section on implications).

The rise of e-bikes

In China, which is the largest consumer of e-bikes[2] (and e-scooters, which are yet to be clearly distinguished from e-bikes and are not strictly regulated in China), there were over 160 million e-bikes in 2012, and these share the non-motorised lanes with cycles in many cities. The number of e-bikes is increasing globally and China, Netherlands and Germany have the highest sales as of 2016 (Bai et al., 2013; Fishman and Cherry, 2015).

E-bikes are perceived by users, especially women, as preferable to conventional bicycles (c-bike); therefore, increased take-up is more likely to be from women. E-bikes appeal to most age groups, including the elderly, and may be used for commuting as well as leisure (Fyhri and Fearnley, 2015; Weinert et al., 2014; Vllakveld et al., 2015). In an online survey, MacArthur et al. (2014) found the effects of e-bikes to be: greater amounts of travelling, travelling longer distances, carrying more 'cargo' and allowing people with physical limitations to travel. Our own current research into choosing an e-bike in China has identified advantages such as 'allows door-to-door journeys', 'avoid being stuck in

[2] In China e-bikes are sometimes referred to as mopeds.

traffic', 'easy to park' and 'less effort to ride' compared to c-bikes. These factors offer some of the behavioural control that is important as well as convenience; this is consistent with our findings in relation to older people engaging with new technology (Guo et al., 2016).

Regarding longboards, the literature indicates that there are currently issues with braking and safety, the regenerative braking system, wireless control systems and terrain compensation (Duyan et al., 2013; Keays and Dumas, 2014; Marrero et al., 2010). Once the more technical issues are resolved, many of the same issues inferred for e-bikes will apply, although standing on longboards will inherently have more safety issues (falls, balance issues, cargo, etc.) than sitting on an e-bike and therefore the market is likely to remain the domain of younger males.

The evidence of increasing sales in China, Netherlands and Germany (28% of all cycle sales in Netherlands,12.5% in Germany and 20% of all cycles in China (DfT, 2016; China Dialogue 2013)) points to likely large increases in the numbers of e-bikes in the UK. We believe the evidence suggests a time within one or two decades when e-bikes will well outnumber c-bikes. This increase may take the form of a 'S-shaped' curve, and various estimates from 2008 to 2015 would support continued year-on-year increases so we may be at the beginning of the steepening part of the curve (bike-eu.com, 2014 and 2016). Interventions may change the nature of the 'curve' in forthcoming years, including for example, the injection of funds by the Swedish government in 2018, or the increasing development of electric cargo bikes in Germany (Cycling Industry News, 2017). In 2014, 49,000 e-bikes were imported into the UK, more than any previous year. Worldwide sales in 2016 were 31.7 million (1.6 million in Western Europe[3]), a figure projected to rise to 40.3 million by 2023 (Statista, 2017).

Summary and implications

Based on these observations, we can say that there are sufficient issues to suggest that there is a limit to which conventional cycling, i.e. without added power, can be increased, and this is particularly true for the over-55 age group, for women and for short journeys. London may be an exception, especially as there is increasing infrastructure to help; however, this is not enough in itself to shift many people into more active modes. We conclude that no shift towards active modes is likely to take place **without some intervention**, even for short distances, and that the reasons for this are various: journey times; length of journey; safety and security; fitness; the weather; convenience; and topography are all included. However, we think that **e-bikes have the potential to be that intervention**. The two categories where there is likely to be least take-up of cycles and walking, i.e. the over-55 age group and women, and for shorter journeys in particular, are also large opportunity areas for e-bikes.

[3] In the EU, 98,000 units in 2006, 588,000 in 2010, 1.14 million in 2014, 1.357 million in 2015 (Statista, 2017)

Implications for decisions that need to be made today

- To consider how present and future infrastructure can handle at least a doubling or trebling of cycling traffic, which may comprise e-bike cyclists potentially using roads without cycle lanes and travelling at 15km/h, with less experience than conventional cyclists.

- To consider areas outside of London separately in terms of infrastructure development.

- To reconsider the issues, policies, guidelines, requirements, etc. associated with e-bikes (and longboards) alongside the mopeds and small scooters they will potentially replace.

2. How is the user engaging with active modes in the system?

Risks of e-bikes

E-bikers have been found to be more likely to take risks than cyclists. When they caused accidents, it was due to red-light running, although by far the most accidents were caused by automobile drivers (Bai et al., 2013). We suggest the results of the risky behaviour are likely to be due to speed, the inexperience and lack of training as more or less anyone can ride an e-bike currently, and that this will worsen as the take-up of e-bikes by inexperienced users increases, who see them as an alternative to other modes for short journeys. Chen et al. (2014) look at risks in China when there is a high ratio of e-bikes to cycles when they are turning left into oncoming traffic, and how this constricts automobile drivers considerably; cycle groups and websites recognise that intersections are the largest problem area to be addressed (e.g. MakingSpaceforCycling, 2014). We suggest that in the UK there will be similar traffic management implications for increasing numbers of cyclists, many motorised, turning right at junctions. Dozza et al. (2016) showed that e-cyclists travelled faster than conventional cyclists and experienced different conflicts at intersections, or when vehicles were stationary on bicycle lanes. They also suggested that increasing the visibility of e-bikes to other road users would improve safety. Lin et al. (2008) found that the average speed of e-bikes was 21.9 km/h, 7 km/h faster than bicycles. Here, the authors raise safety issues, alongside rider gender and age, as salient issues. We have already commented earlier on likely safety issues with longboards, but see them as a niche market.

Are some users likely to engage less than others?

We have already shown that women cycle less, yet hold stronger pro-health and environmental attitudes, than do men (e.g. Wardle et al., 2004; Arnocky and Stroink, 2011)). Assuming also that many people may continue to make shorter journeys to do shopping, then the possibility for e-bikes with panniers or trailers or ability to carry 'cargo' increases their attractiveness. This is especially the case for the over-55 age group, some of whom may be more infirm, and e-bikes may present a more viable option than conventional cycling. This is likely to continue to be the case in future decades as the cohort of over-55 age group increases in number (Guo et al., 2016; MacArthur et al., 2014). Both of these groups present possibilities for large increases in e-bike take-up up to 2040. However, there is now ample evidence that adequate infrastructure is an essential prerequisite, but not necessarily a causal determinant, for a potentially large take-up of cycling (e.g. Xing et al., 2010; Rietveld and Daniel, 2004; Pucher and Buehler, 2008).

Summary and implications

Users do not necessarily engage in the most healthy, cheap or environmentally responsible ways despite beliefs about their importance. We propose that engaging people on these beliefs alone is not going to be an effective strategy. The government's commitment to end the sale of new diesel and petrol cars and vans by 2040, and its support for electric vehicles, presents a legislative push that is needed. However, to be successful in presenting options that offer the potential to be healthier, e-bikes look the most promising, whereas longboards would only cater for a more limited cohort.

Implications for decisions that need to be made today

- To consider alternative/improved ways of presenting and publicising electric-powered modes.
- To consider the over-55 age group and women as new users, and to promote the advantages for short journeys (not just up to 2 miles but 10–15 miles).
- To focus on perceived behavioural control, comfort and convenience, and social outcomes, as benefits in addition to health.
- To look to the provision of safe and secure means of parking e-bikes, which are of greater value than c-bikes, (if there are enough of them) in shopping and leisure areas, thereby addressing public concerns about this.
- To consider and plan for infrastructure required, especially outside of London, that are needed to overcome the increased risks of accidents associated with large numbers of relatively inexperienced e-bike users (such as at intersections) or where there are no cycle lanes.

3. How is technology changing active modes in the transport system?

Electric power

In the UK, out to 2040 vehicles are increasingly being electrically powered, with various maximum speeds and between 0–100% physical effort required. Currently, there is limited planning or regulating of e-bikes here or elsewhere (Weinert et al., 2014). In China, where bicycles are frequently used for carrying cargo, we are more likely to see three-wheel e-bikes, which are classified as electrically assisted pedal cycles (EAPCs) here in the UK. EAPCs do not require a licence or training and can be ridden by anyone over 14 years of age (DfT, 2016; Vllakveld et al., 2015; Rose, 2012).

The consequences of more e-bikes

One view for 2040 in the UK is of a trebling or quadrupling of travellers using e-bikes, e-scooters, and other electrically powered active modes such as e-mopeds, for short and medium journeys compared to c-bikes. Whether to segregate cyclists, pedestrians and automobile drivers or go for more ‘shared space’ approaches becomes much more important, as does how to handle large e-bike increases at intersections. The Chinese studies cited earlier indicate that many users of e-bikes and automobiles (and we know this is also the case for cyclists) do not always adhere to priority instructions at intersections, etc., and it would seem likely that they would not adhere to speed restrictions either. Electric vehicles will make little or no noise. With pedestrians increasingly using headphones (with their noise suppressing effects), keeping collisions down between cyclists and pedestrians may become more of an issue. In one possible future all these electrical modes could operate with built-in sensing and collision-avoidance mechanisms that communicate with one another and with connected and autonomous vehicles (Dhraief et al., 2007). Cycle trailers for c-bikes (especially for carrying children as they are advertised to do) require some level of fitness but for e-bikes this would present less of a problem. Nevertheless, the advice (Consumer Reports, 2009) given for e-bikes with trailers is that trailers on cycles are superior to mounted seats for children, as they are lower, easier to manoeuvre (considering weight and tipping points) and less risky (Powell and Tanz, 2000; Cyclinguk, 2017). These issues become more critical if there is the large uptake in e-bikes, relative to c-bikes, that we predict.

Effects of cycle growth on other active modes

Expanding the bicycle network has been proposed as a way of increasing the share of transport by cycling (Santos et al., 2013). In London, the full effects of cycle superhighways on numbers cycling will be only seen once these are completed. There are good examples of infrastructure improvement having positive effects; for example, in the Netherlands, where separate lanes and intersection management such as corner refuges, set-back crossings, bike-specific signals and phasing, and forward stop marks have all proved effective.[4] However, improving the infrastructure is not always a simple prospect. Having sufficiently wide cycle lanes, in addition to lanes for vehicles and pavements for pedestrians, may be difficult in narrow streets, and intersection management presents issues that may be less easily solved for narrow city roads in the UK (e.g. Cyclenation, 2014). Furthermore, there is evidence that improved infrastructure is not enough, particularly for older users or women or car drivers who place convenience and flexibility (of cars) as more important than the health effects of cycling (Parkin et al., 2008). Despite this, increased bicycle network infrastructure, especially with good intersection management, can be seen as an enabler for e-bikes, which will undoubtedly bring many formerly non-cyclists into the system, bringing with them too risks of overloading the network.

All active modes will be affected by the existence of more cycle lanes, with positive health effects arising from reduced toxic air as car fumes reduce, and as public transport is improved to meet the needs of the elderly. In addition, autonomous vehicles could mean that more of the very infirm elderly can travel. The projected increases in the number of older people (over-55 age group) is likely to mean many more people using the less active modes (such as e-bikes) than the fully-active modes. Given this, e-bikes are likely to proliferate if they have a choice of power-only operational mode. Even if ranges are not developed beyond 40 miles, this may not be an issue for shorter journeys. The evidence is clear: e.g. in Norway, where people were given e-bikes, usage rose rapidly to up to 48% of journeys, compared to the control group which had no increase in cycling; elsewhere e-bikes have been found to increase bicycle usage significantly (Rose, 2012; Fishman and Cherry, 2015). **This implies little change for cyclists but considerable change for e-bikes.**

Personalisable, comfortable and safe modes

In addition to comfort and safety, people like the opportunity to personalise their transport (e.g. Guo et al., 2016). E-bikes fit into this and there is evidence to suggest that they are easier to use than c-bikes. Technology developments that are likely to occur and that will affect cycling or new modes include: inter-vehicle communications and collision-avoidance; programmable e-bikes; gradual introduction of autonomous vehicles; affordable aids to prevent injury on bikes.[5] There will need to be improvements in comfort, charging, safety, etc. Changes in infrastructure would also be essential in the event of an upsurge in cycling, in particular for e-bikes, and this is likely to entail the separation of pedestrians, cyclists and automobiles, shared space and other novel solutions.

[4] Interestingly, the Dutch approach seems to suggest roundabouts work better than crossroads for cyclists (Dutch video in Making Space for Cyclists, 2014). This presents a dilemma when there seems to be trends to remove roundabouts and insert traffic lights in the UK.

[5] The airbag for cyclists (Hövding) is probably too expensive currently.

Implications for decisions that need to be made today

Regulation in the UK is currently a mixture concerning licences, maximum speeds and insurance, and it would benefit from being revisited and clarified; for example, by revising the rules for EAPCs and mopeds, and deriving an integrated approach to smaller two- or three-wheeled bikes that can be electrically powered or people-powered by choice.

In a future world of many and varied electrically powered vehicles, consideration will need to be given to:

- revision of the rigid differentiation by maximum speed; for example, if an EAPC exceeds the currently allowed 15.5 mph by riding downhill with a lot of effort, what will this mean?
- when a three-wheeled cargo e-bike ‘morphs’ into an electric car
- how to manage large increases of moderate-speed, quiet, two- and three-wheeled vehicles in all streets, especially narrow ones, including shared space issues
- guidance for local authorities to inform which traffic schemes are potentially harmful to cyclists

There are limits to numbers of conventional cyclists due to climate and topography, both of which are cited in the literature as issues. These limits will apply less to e-bikes.

We have shown that infrastructure is critical as a necessary base. However, this presents spatial challenges, where many roads in city centres do not have the space required to segregate vehicular, cycling and pedestrian traffic (Murphy, 2011). Decisions need to be made now about how this will be dealt with; for example, solutions may include shared space or limited access for vehicles, as well as intersection management.

Research gaps

A number of gaps in the available research have been identified. These include:

- the potential psychological and practical reasons for a take-up of e-bikes
- the mix of what e-bikes will replace: automobiles, public transport, bicycles or walking
- the performance of e-bikes in actual use on cycle lanes, roads, shared space, etc.
- prioritising cyclist safety in V2X[6] communications at intersections
- modelling traffic flows with a large influx of e-bikes at 15 mph in the mix
- design of the display and controls of e-bikes, and for receiving traffic-related information
- use of trailers and other accessories with e-bikes
- investigating intersection management for narrow roads and junctions

[6] V2X: refers to a form of technology that allows vehicles to communicate with other vehicles (V2V), with infrastructure (V2I). The collective term is V2X (vehicle to everything including bicycles).

4. Emerging evidence: an e-bike study

This study was carried out as part of the EPSRC-funded LC TRANSFORMS project and aimed to explore the potential of e-bikes to empower future mobility solutions in the UK through a better understanding of: 1) how e-bikes are used in China and the UK; 2) how users evaluate their experience; 3) what went wrong in China; and 4) whether shared e-bike schemes can remove some barriers to encourage more cycling in the UK. A large population of e-bike users (including e-scooters, which are yet to be clearly distinguished and regulated in China) and a newly launched e-bike sharing scheme in Nanjing enabled the street-intercept survey method to be adopted. Responses were received from 319 e-bike users with an average age of 35. However, in the UK, the number of e-bike users is still low which led to only 30 completed responses to the online questionnaire survey, 10 e-bike users and 20 c-bike users with an average age of 55. Four focus groups were therefore introduced to investigate: 1) why people cycle; 2) what are the key barriers; 3) what needs to be done to encourage more people to cycle; and 4) whether e-bikes will be the answer. In total, 21 people aged over 50 participated in the focus group discussions.

China findings

Results from the survey in China revealed that 44% of respondents shifted away from driving and 32% from public transport to e-bike as their main transport mode. The main reasons were to ‘allow door-to-door journeys’, ‘avoid [getting] stuck in traffic jam’ and ‘easy to park’. When compared with c-bikes, ‘quicker’ and ‘less effort to ride’ were highlighted. ‘Safe parking at destinations’ was the major concern regarding whether to cycle or not. Journey durations ranged from one minute to four hours, with an average of 23 minutes. In terms of commuting, the average journey duration was about the same as driving and 60% of the duration using public transport. Despite the above positive attitudes towards e-bikes, the Chinese government has decided to cap the number of shared bikes and to rule out shared e-bike schemes, for the following reasons:

- lack of enforcement action on speeding has led to many existing e-bikes exceeding the allowed top speed (20 km/h)
- lack of education and road safety training for riding heavier and faster e-bikes has led to the increase in road accidents and costs to the economy
- lack of fire protection built into public charging facilities for shared e-bikes could lead to hazardous events
- lack of proper bike maintenance increases risk
- increasing environmental pollution caused by more and more lead-acid battery disposal

UK findings

Results from the UK indicated that the main reasons for cycling were ‘healthier’, ‘more enjoyable’, ‘allowing door-to-door journey’ and ‘easy to park’. E-bike users also highlighted ‘less effort to ride’ in comparison with riding a c-bike. Decisions on whether or not to cycle could be influenced by traffic, weather or air quality, depended on what bike was used. Moreover, UK respondents tended to cycle for longer duration than their Chinese counterparts, with an average of 74 minutes (e-bike users) and 135 minutes (c-bike users) for their longest trip, and 26 minutes (e-bike users) and 55 minutes (c-bike users) for their typical trip. The focus group discussions demonstrated that, although participants were fully aware of the health benefits and evaluated their experience as ‘wonderful’, ‘playful’, ‘feeling young again’ and with ‘great pleasure’, they were extremely concerned about their safety if riding in traffic. Many of them reported that they would only ride their bike on cycle lanes and never went on the road. The key barriers to more cycling were identified as:

- poor quality road surface: e.g. potholes, drains, debris, subsidence
- cycling in traffic: feeling very unsafe from traffic, emission and noise
- cycle lanes come and go: lack of consistent and clear signage
- lack of widely available and affordable bike sharing schemes
- unawareness of cycle routes, rules and legislations
- expense of e-bikes with specific features, e.g. power-assisted braking for arthritic hands
- lack of social events that provide education and opportunities to practise in safe and secure places by local authorities
- concerns about the availability of good facilities at destinations: e.g. showers, changing rooms
- lack of full understanding of ways to improve health through cycling: should I use an e-bike or a c-bike?

Summary and implications

The UK sample size is rather small. However, the focus group discussions have yielded in-depth understanding that could not be achieved through a questionnaire survey. A larger sample size covering a wider demographic group could be used to test our initial findings. The findings below were viewed as having a positive impact on cycling:

- Create a safe cycling environment by:
  - building more continuous cycle lanes for an integrated cycling network
  - reducing road traffic and promoting clean vehicles to reduce pollution and increase the perception of safety
  - repairing roads and improving the quality of road surface and road signage
  - implementing advanced technology to enhance the visibility of cyclists
  - prioritising cycling over driving
- Strengthen the bicycle industry by:
  - creating more choice by providing a wider range of products
  - reducing the cost of e-bikes
  - producing more efficient clothing for safety and comfort in bad weather
  - promoting bike sharing schemes (e-bike and c-bike)
- Increase the awareness of health benefits associated with cycling by:
  - organising social cycling events
  - providing education and training

During the survey, observations were also taking place in Nanjing. While e-bikes are delivering convenience to everyday travel, the lack of enforcements on scooter-styled electric bicycles, which have exceeded the restrictions on weight and top speed, and the chaotic behaviour such as riding on the pavement, travelling in the wrong direction and at a speed significantly higher than 20 km/h, need to be tackled urgently. Policy interventions in China have played a critical role in promoting public bike-sharing schemes and encouraged more cycling. Relevant legislation should be introduced to regulate cycling behaviour to improve safety and traffic efficiency. For the UK, lessons can be learnt from such a practice if more e-bikes are to be introduced and promoted.

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