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Motives, perceptions and experiences of electric bicycle owners and implications for health, wellbeing and mobility

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ABSTRACT

The sale of electrically assisted bicycles ('e-bikes') is growing at a rapid rate across Europe. Whereas market data is available describing sales trends, there is limited understanding of the experience of early adopters of e-bike technology. This paper investigates the motives for e-bike purchase, rider experience and perceived impact on mobility, health and wellbeing through in-depth interviews with e-bike owners in the Netherlands and the UK. Findings revealed that the motive for purchasing e-bikes was often to allow maintenance of cycling against a backdrop of changing individual or household circumstances. E-bikes also provided new opportunities for people who would not otherwise consider conventional cycling. Perceptions of travel behaviour change revealed that e-biking was replacing conventional cycling but was also replacing journeys that would have been made by car. There was also a perception that e-biking has increased, or at least allowed participants to maintain, some form of physical activity and had benefitted personal wellbeing. Technological, social and environmental barriers to e-biking were identified. These included weight of bicycle, battery life, purchase price, social stigma and limitations of cycle infrastructure provision.

Additional research is necessary to quantify actual levels of mode substitution and new journey generation among new e-bike owners and the impact of e-biking on promoting physical health and mental wellbeing.

1. Introduction

A significant contemporary phenomenon that may have a profound impact on mobility patterns is the emergence of the electrically assisted pedal cycle or what is more commonly known as the 'e-bike'. E-bikes typically incorporate a battery, which can be charged at an ordinary domestic power socket, linked to an electric motor in the bicycle transmission system. The rider controls the level of power assistance typically using a handlebar mounted computer display panel and controller. The term 'e-bike' is generic and includes a combination of different electrically powered two-wheelers some of which function by simply turning a throttle. The focus of this paper is the pedal assisted variety of e-bike (or 'pedelec') which only functions on condition that the rider also pedals. Pedelecs are the most common variety of e-bike within Europe and are regulated at 250 W maximum continuous rated power output and maximum speed up to 25 km per hour. They are permitted on cycle paths and other infrastructure specifically designed for pedal cycling (MacArthur et al., 2014).

There is evidence that e-bike sales are rising across Europe and are expected to continue to grow while sales of conventional cycles hold-steady(COLIBI/COLIPED, 2013; Pike Research, 2010). Authorities will need to consider where e-bikes fit within wider policies to promote sustainable mobility because this growth could have a significant impact on requirements for planning and designing cycle infrastructure. For example, e-bikes could replace short and medium distance car journeys and contribute to reducing traffic congestion and pollution in urban areas because they place less demand on road space and produce zero emissions whilst in operation (Ji et al., 2012). E-biking could also contribute to healthy mobility by enabling riders to incorporate moderate exercise into everyday travel routines. They could also help to increase accessibility for people unable or reluctant to use conventional cycles (e.g. older people and those with physical limitations) (Electric Bike Magazine, 2012; Gojanovic et al., 2011; Louis et al., 2012; Sperlich et al., 2012).

Despite this potential there are concerns that e-biking may wean people away from conventional cycling rather than tackling car use (Behrendt, 2013) and that promoting e-biking is distracting authorities from focusing on implementing good quality cycling infrastructure (Whitelegg, 2013). There is also concern about the potential risk of traffic injury to riders or other road users unaccustomed to their higher speeds (Du et al., 2013; Kahn, 2014; Papoutsi et al., 2014; Schepers et al., 2014;

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Yang et al., 2014). Finally, although e-bikes produce no emissions at source, there are environmental challenges posed by the manufacture and disposal of batteries (Cherry et al., 2009; Weiss et al., 2015).

This paper focuses on the motives, perceptions and experiences of e-bike owners in the United Kingdom and the Netherlands, two very different cycling cultures, that to our knowledge, has not previously been investigated. The paper moves beyond quantitative analysis of market trends or online surveys of users and responds to calls for more in-depth understanding of the complexities of travel behaviour through qualitative methods (Clifton and Handy, 2001). It addresses the following questions: *What are the motives for purchasing e-bikes*? *What effect has this had on personal mobility*? *What are the personal experiences of e-bike use*? We conclude with a discussion on the implications for promoting e-biking as healthy and sustainable mobility within two regions with very different cycling cultures and policies towards promoting cycling.

2. Background

Increased level of research interest in e-bikes has paralleled growth in sales. Over the past decade studies have focused on e-bike design and performance; sales trends; user demographics; safety; and environmental impact, but only recently has attention turned to motivations for purchase and impact on travel behaviour and personal health and wellbeing (Fishman and Cherry, 2015). Early adopters of e-bike technology in California are reported to be older, better educated and with higher than average income than the US population (Popovich et al., 2014) corresponding with the demographic profile of a study of Australian e-bike users (Johnson and Rose, 2015) while a study of Austrian e-bike users has shown that they were more likely to have lower educational and income levels than the general population (Wolf and Seebauer, 2014). The desire for increased speed and reduced physical exertion is reported to be the main motivation for the purchase of e-bikes(MacArthur et al., 2014; Johnson and Rose, 2015) particularly among those with physical limitations (Langford, 2013; MacArthur et al., 2014; Rose, 2012). A few studies also suggest that the desire to substitute car journeys is also a driver (Johnson and Rose, 2015; MacArthur et al., 2014; Popovich et al., 2014).

The limited evidence that is available on the impact of e-bikes on travel suggests that e-bikes may increase participation in cycling, increase the number of trips and distance cycled (Fyhri and Fearnley, 2015) and encourage users to replace car trips (Fyhri and Fearnley, 2015; Johnson and Rose, 2015; Popovich et al., 2014). Wolf and Seebauer (2014) reveal, however, that early adopters of e-bikes in Austria were mainly car owning older people for who the only shift from car trips to e-bikes seems to take place for leisure trips with no discernable effect on commuting or shopping trips. Questions remain, therefore, about the magnitude of effect of e-biking in substituting car journeys and indeed whether they are impacting household car ownership (Fishman and Cherry, 2015).

There is also growing interest in the role that e-bikes can play in promoting health and evidence that they can confer positive health benefits (Gojanovic et al., 2011; Hendriksen et al., 2008; Louis et al., 2012; Sperlich et al., 2012; Theurel et al., 2012). Although energy expenditure per unit time for e-biking is lower than conventional cycling (Langford, 2013) it can contribute to providing minimum physical activity requirements (Simons et al., 2009; Sperlich et al., 2012) and have positive influence on physiological parameters in untrained men and women (de Geus et al., 2013). Evidence is less clear on the psychological benefits of e-bikes although some studies have reported the sense of enjoyment conferred on their users (Fyhri and Fearnley, 2015, Popovich et al., 2014).

Few studies have investigated the barriers to e-bike use and those that do are mainly focused on users in the USA and Australia. Dill and Rose (2012), for example, conducted interviews with e-bike users in Portland, Oregon, and identified relative cost, weight of the bicycle, fear of theft, road danger, lack of supportive infrastructure and 'range anxiety' (i.e. the fear that the e-bike has insufficient battery power to reach its destination) as significant barriers to e-bike use. Popovich etal. (2014) also highlight stigma associated with riding electric bicycle versus conventional pedal cycles in California which could be inhibiting more widespread adoption of e-bikes.

3. Cycling in The Netherlands and the UK

The Netherlands and the UK are European regions with very different cycling cultures. Levels of cycling in the Netherlands are much greater than in the UK (1% of all trips in UK versus 27% in NL) largely a result of the Netherlands having a long history of implementing a 'multifaceted and mutually reinforcing' set of policies focused on supporting and promoting cycling (Harms et al., 2015; Pucher and Buehler, 2008). Dutch owners of e-bikes therefore benefit from favourable conditions for cycling and are able to use the existing network of approximately 35,000 km of cycle paths. Regional authorities are also investing in 'bicycle highways', which offer direct connections between urban centres (e.g. Arnhem and Nijmegen — see http://www.fietssnelwegen.nl) and there is a strong push to encourage e-bike use for commuting through the 'Beter Benutten' ('Optimizing Use') programme — see http://www.beterbenutten.nl/en). This includes providing employees with an e-bike free of charge for a trial period.

In the UK, where cycling infrastructure is much less developed, the government is developing a Cycling Delivery Plan (CDP) that will outline long-term investment programme for cycling. Under section 21 of the Infrastructure Act 2015 it is now obliged to produce a Cycling and Walking Investment Strategy (CWIS) specifying objectives, and more importantly, the financial resources that will be made available, and to review this every five years. The UK Department for Transport is starting to consider the potential of e-bikes as part of an overall strategy for sustainable transport. In September 2015, The Electrically Assisted Pedal Cycle Sharing Pilot Scheme awarded £700 K of funding to various cycle-hire schemes across the UK to enable them to expand their fleet with electric bikes (UK Department of Transport, 2015).

The Netherlands is now one of the biggest markets for e-bike sales in Europe (Fig. 1). Around 1 million e-bikes are now in ownership out of a total stock of 22 million cycles (Fishman and Cherry, 2015) and e-biking now accounts for around 12% of total distance travelled by cycle — roughly equivalent to 1.5 billion kilometres per year (KiM, 2014). Average journey distance covered by e-bike is 5.5 km—one-and-a-half times further than conventional cycling (3.6 km) (KiM, 2015). In terms of use by different age groups, e-biking accounts for one third of all cycling kilometres travelled by adults age 65 and above, 6% for adults aged up to 50 years and only 1% for adults aged up to 35. Older riders report using e-bikes for leisure and shopping whilst for younger adults commuting plays a more significant role (Fig. 2).

In the UK sales of e-bikes have also been increasing, though the absolute and relative numbers are much smaller compared to the Netherlands. A total of 30,000 e-bikes were sold in the UK in 2012 (compared to 175,000 in the Netherlands) roughly equating to 0.5 sales per 1000 population and only 0.8% of total cycle sales (COLIBI/COLIPED, 2013). Unfortunately, unlike the Dutch National Travel Survey, the UK National Travel Survey does not discriminate journeys by e-bike and therefore usage characteristics are difficult to assess.

4. Approach and methods

In the following sections we draw on evidence from interviews with e-bike owners living in the Randstad (Amsterdam and Utrecht) and Groningen in the Netherlands and also Oxford in the UK— characteristics of the case areas presented in Box 1. The approach to recruiting participants was through opportunity sampling — posting advertisements on noticeboards in public places and using social media — during May and June 2013. A total of 22 adult e-bike owners (12 in NL and 10 in UK) responded and were invited, to take part in the study. Participants