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Effects of e-bikes on bicycle use and mode share

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ABSTRACT

In Norway, as in many countries, a political goal is to increase bicycle use, and the e-bike is promising in this respect. However, concerns have been raised about mode-share effects. It has been argued that if the e-bike's only function is in cycling becoming cycling with electric assistance, there would be no benefit to either the environment or public health. Little is yet known about the use of the e-bike, or of its potential in reducing motorized travel. In the current study, 66 randomly selected participants were given an e-bike to use for a limited period of time and the results compared with those of a control group ($N = 160$). E-bike cycling trips increased from 0.9 to 1.4 per day, distance from 4.8 km to 10.3 km and, as a share of all transport, from 28% to 48%, whereas with the control group there was no increase in cycling. The effect of the e-bike increased with time, indicating a learning effect among users, and was greater for female than for male cyclists. There were no differences with age. Overall, the results suggest that the e-bike is indeed practical for everyday travel.

Introduction

Background

Bicycling is associated with health, environment, efficiency and life quality benefits, (OECD/ITF, 2013) and the European Commission (2011) acknowledges its importance as an integral part of future urban mobility and infrastructure design. In Norway, the political goal is that all future growth in urban mobility is absorbed by the sustainable transport modes of walking, cycling and public transport. More specifically, the aim is for 8% of all transport to be by bicycle by the year 2023, which will necessitate a bicycle market share of between 10% and 20% in the largest cities (Ministry of Transport and Communications, 2012).

At present, the share of bicycling in Norway is just under 5% (8% in summer and 1% in winter), and it is stable or declining rather than rising. Among youth, cycling declined from 15% around 1990 to 9% in 2010 (Vågane et al., 2011). Total overall cycling shares in the neighbouring countries of Sweden, Finland and Denmark are approximately 10%, 11% and 18%, respectively (Pucher and Buehler, 2008b), and suggest that there is unexploited potential for increased cycling in Norway. The large proportion of short car trips in Norway, as well as in other European countries, is a further reflection of this (Pucher and Buehler, 2008a). Car journeys of less than 3 km account for 30% of all car trips and 46% of these are over less than 5 km. It has been estimated that 35% of all short trips by car could potentially be by bicycle (Lodden, 2002).

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The e-bike (also called pedelec or EPAC) is promising in respect of increased bicycle use. It has an integrated battery augmenting the pedal-power of the rider and, in Europe, legally classified as a bicycle if it fulfils certain criteria, one of which is a maximum speed limit of 25 km h^{-1}. The e-bike is considerably heavier than an ordinary bike because of the battery and is hard to pedal when the battery is switched off or flat. Energy efficiency is better than that of any other mode of transport (except a traditional bike) – even walking! The e-bike is therefore environmentally superior to other motorized modes of transport (Dave, 2010; Wiederkehr, 2012). Giving the sensation of cycling with a tail wind or slightly downhill, the e-bike is quicker, it enables longer trips over hilly routes and it is an alternative for people who for various reasons are averse to bicycling. Compared to local public transport and rush-hour driving, the e-bike offers competitive travel speeds. Clearly, it has the potential to replace many car and public transport trips, all to the benefit of the environment, public health and other motorists.

In Asia, there has been a large increase in sales of e-bikes (Wu et al., 2012) and in Europe even more so. From 2006 to 2012 annual sales of e-bikes in Europe grew from just under 100,000 to 1,000,000 (www.colibi.com), with Germany, the Netherlands and Switzerland the largest markets. In Norway, e-bikes occupy a very small share of the market, whereas official sales statistics show that more than 400,000 traditional bicycles are sold annually. With only 5 million inhabitants, this puts Norway at the top in Europe when it comes to bike sales per capita (www.bike-eu.com). Official statistics for e-bikes are hard to come by, but it has been estimated by industry representatives that around 1% of annual bicycle sales are of e-bikes (www.bike-eu.com).

Despite the large increase of e-bike sales in many countries, little is yet known about their use or of the effect they are having on motorized travel. Concerns have been raised that e-biking will, at best, only replace other non-motorized travel, i.e. cycling and walking. A Dutch study has shown that e-bike users cycle on average 30 km per week compared to the 18 km per week of normal cyclists (Fietsberaad, 2013). However, because this study did not provide information on people's travel behaviour prior to their acquiring an e-bike, we do not know whether it was the e-bike itself that brought about an increase in cycling, or whether these people cycled more than others prior to purchase.

Neither have previous studies of e-bikes assessed their mode-share effects. There has therefore been a call for studies controlling for other transport use in order to assess the effects e-bikes have on bicycling as a share of total transport (and not just total distance cycled), and also for studies testing the effects before and after the purchase of an e-bike (Dill and Rose, 2012). In assessing the causal effect of e-bikes, a randomised experimental study can function as proxy to a study of actual purchasers.

One particular issue that has been raised concerning bicycle use is the large gender differences in some countries. In cities or societies with poor infrastructure and low cycling shares, the majority of bicyclists tend to be male (Garrard et al., 2008). In places with higher shares, the gender balance is more equal, with some researchers proposing that women can function as "indicator species" for bike-friendly societies (Baker, 2009). The reason for this gender imbalance is not known (Krizek et al., 2005), but it can be speculated that women, because of their less muscular strength, suffer more from challenging topography than men do, or that they perceive the risk of cycling differently (Emond et al., 2009). Hence, it is of interest to examine the different effects e-bikes have on males and females.

Sales figures indicate that the earliest adopters of e-bikes have been the elderly (Fietsberaad, 2013). Figures from the Netherlands suggest that e-bikes even out the differences in cycling habits among age groups. Whereas the average weekly distance cycled has fallen from 20 to 15 km when comparing the age groups <46 and >60 years for normal bike users, there are no differences across age groups for e-bike users (Fietsberaad, 2013).

From the point of view of health, any increase in active mobility is positive, and from the perspective of transport planning and sustainable mobility, the biggest challenge is in creating shifts in the most habitual types of travel, i.e. people's everyday commute. Creating lasting changes in travel habits has proved a major challenge (Eriksson et al., 2008). From a psychological perspective, habit strength is known to be among the strongest predictors of behaviour (Verplanken et al., 1998). In the current study, our aim is to distinguish the effects e-bikes have between commute and non-commute travel.

Any new technology or any new acquisition can be subject to a novelty effect. It is known that interventions can often have short-term effects that do not necessarily transform into long-term behavioural shifts. On the other hand, it is established that experience of a transport mode following incentives or marketing initiatives is associated with positive attitudes (Donaghy, 2011), increased use (Taniguchi and Fujii, 2007) and long-term adoption (Jones and Sloman, 2010). Learning from consumption means that experience of a transport mode increases the propensity for its use over time. There is evidence that as more and more contexts and situations are discovered an e-bike replaces a bicycle (Dill and Rose, 2012). This process is likely to take time and therefore delay any increase in bike use, probably countering any novelty effect that might occur. It would therefore be of interest to learn whether length of the trial period influences the effect the e-bike has on travel behaviour.

Study objectives

The aim of the present study is to analyse the effect e-bikes have on cycling, both as absolute distance travelled and as share of total transport. More specifically, we hypothesize that:

1. E-bikes will increase the amount of cycling, expressed as both number of trips and distance cycled.
2. E-bikes will have a greater effect on female than on male cyclists.