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"Cycling was never so easy!" An analysis of e-bike commuters' motives, travel behaviour and experiences using GPS-tracking and interviews☆

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ABSTRACT

The market for electrically-assisted cycling is growing fast. When substituting motorized travel, it could play an important role in the development of sustainable transport systems. This study aimed to assess the potential of e-bikes for low-carbon commuting by analysing e-bike commuters' motives, travel behaviour and experiences. We GPS-tracked outdoor movements of 24 e-bike users in the Netherlands for two weeks and used their mapped travel behaviour as input for follow-up in-depth interviews. Most participants commuted by e-bike, alternated with car use. E-bike use was highest in work-related, single-destination journeys. It gave participants the benefits of conventional cycling over motorized transport (physical, outdoor activity) while mitigating relative disadvantages (longer travel time, increased effort). The positive experience of e-bike use explained the tolerance for longer trip durations compared to other modes of transportation. Participants were inclined to make detours in order to access more enjoyable routes. Results demonstrate that e-bikes can substitute motorized commuting modes on distances perceived to be too long to cover by regular bike, and stress the importance of positive experience in e-bike commuting. This provides impetus for future actions to encourage commuting by e-bike.

1. Introduction

A major development in transportation in the past years has been the growth of electrically assisted cycling or e-biking. Defined here as pedal-assisted or bicycle-style electric bicycles, e-bikes make it possible to cover longer distances at higher speeds against reduced physical effort. In many countries like Germany and the Netherlands, e-bikes account for a rapidly growing share of new bikes sold (CONEBI, 2016). Findings from previous studies suggest that e-bike adoption can to some extent lead to substitution of trips formerly made using motorized transportation (Jones et al., 2016; Lee et al., 2015). It thus appears a viable alternative to commuting by automobile and public transportation. An increasing amount of research has focused on e-biking, but less attention has been paid to e-bike use for commuting, and the extent to which it can substitute motorized commuting. A better understanding of the mode choices and their effects are needed to guide future actions to encourage functional e-bike use, in attempts to further establish low-carbon commuting habits. This paper addresses these issues by providing further insight into the potential for mode substitution.

The aim of this study was to assess the potential of e-bikes for sustainable commuting by analysing e-bike commuters' motives, travel behaviour and experiences. To accomplish this aim, we GPS-tracked the daily travel behaviour of 24 e-bike commuters in the north of the Netherlands and held follow-up in-depth interviews discussing their motives and experiences. In the remainder of this paper, we first discuss prior research on e-bike use and the need for comprehensive travel behaviour data as input for policy. We then present and discuss the methods and results of the study.

1.1. Prior research on e-bikes

There is growing consensus that current levels of motorized transport negatively impact environmental quality, quality of life, and accessibility to the extent of being unsustainable (Kenworthy and Laube, 1996; Steg and Gifford, 2005). E-bikes, especially if they are of the pedal-assisted type, provide a sustainable, healthy alternative for motorized transportation on distances too long to cover by regular bike. As such, the e-bike has attracted a considerable amount of research attention (Fishman and Cherry, 2015; Rose, 2012; Dill and Rose, 2012; MacArthur et al., 2014; Popovich et al., 2014; Jones et al., 2016). This research has mostly focused on relative advantages and disadvantages of the e-bike compared to other modes of transportation regarding

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aspects like health, comfort, safety, travel speed and travel distance (Fishman and Cherry, 2015).

As pointed out by Fishman and Cherry (2015) e-bike use is especially high in countries with traditionally high levels of conventional cycling, such as most northern European countries. In these countries, safety and infrastructural barriers to cycling have largely been overcome, making it possible to utilize the full benefits of e-bikes. Research to date indicates that e-bikes, as opposed to conventional bikes, permit bridging longer travel distances, reduce travel times, mitigate physical effort, overcome geographical or meteorological barriers, and facilitate cycling for elderly or physically impaired individuals (Dill and Rose, 2012; Johnson and Rose, 2015; Jones et al., 2016; Popovich et al., 2014; Fyhri and Fearnley, 2015; Lee et al., 2015; MacArthur et al., 2014). However, there has been some concern for the effects of e-bikes on safety, health and environment. Evidence so far shows that e-bike users are subject to slightly higher risks of injury (Fishman and Cherry, 2015). The likelihood of hospitalization is higher for older or physically impaired victims. Contributing factors are heaviness of the e-bike, increased speeds and cycling without protection. Yet, crashes are often one-sided (Schepers et al., 2014; Vlakveld et al., 2015). The lower levels of physical activity compared to conventional cycling have also caused concern for health. However, preliminary evidence suggests that assisted cycling can still satisfy moderate-intensity standards and thus promote good health (Sperlich et al., 2012; Simons et al., 2009; Gojanovic et al., 2011).

Finally, concerns have been raised regarding e-bike batteries. During the rapid uptake of lead-acid powered e-bikes in China in the late-1990s and early 2000s, poorly regulated production, disposal and recycling of lead batteries negatively affected environment and public health (Cherry et al., 2009; Weinert et al., 2007). In recent years, the industry has shifted to the use of Lithium-Ion batteries, which offer performance and environmental benefits over lead-acid batteries (Fishman and Cherry, 2015). In Europe, collection and recycling of batteries are regulated in the “battery directive” adopted by the European Parliament in 2006 (EUR-Lex, 2006). This directive prohibits disposal of batteries in landfills or by incineration, and states that all collected batteries should be recycled.

Although e-bikes are increasingly popular, their contribution to sustainable transport behaviour is still limited. In the Netherlands, e-bike use is especially high among older adults, who predominantly use it for leisure purposes (KiM, 2016, pp.17, 18). And despite findings that e-bike trips can substitute trips by car and public transport, Kroesen (2017) suggests that e-bike ownership to date mostly substitutes conventional bike use. Nonetheless, e-bikes hold growing appeal to increasingly younger populations including students, commuters and parents, who carry children and groceries or travel long distances on a day-to-day basis (Stichting BOVAG-RAI Mobiliteit, 2016; KiM, 2016; Peine et al., 2016; Plazier et al., 2017). Considering the disproportionate impacts of motorized commuting on congestion and environmental pollution, transport officials are increasingly interested in the potential of e-bikes as a sustainable alternative for motorized commuting. As yet, however, little is known about the opportunities and barriers for commuting by e-bike.

1.2. Travel behaviour in research and policy

In general terms, sustainability in transport is related to balancing current and future economic, social and environmental qualities of transport systems (Steg and Gifford, 2005). In recent years, research on sustainable transport behaviour has used insights from psychological theories to provide practical guidelines for the development of personal travel campaigns, awareness raising and promotion of alternative transport options (Heath and Gifford, 2002; Bamberg et al., 2003; Groot and Steg, 2007; Hiselius and Rosqvist, 2016). These guidelines have to a large extent relied on financial rewarding schemes and elements of gamification, which focus on individual reasoned action in order to achieve major social change (Barr and Prillwitz, 2014; Te Brömmelstroet, 2014). A major limitation of these approaches, however, is that they do not take into account that a large part of people's travel decisions are not deliberately made, but are based on routines and activated by daily situational cues (Müggenburg et al., 2015). The question remains to what extent sustainability in itself forms a motive to change travel behaviours.

In recent years, mobility research has increasingly taken a perspective in which travel is considered a routine activity shaped by a complex and ever-changing context, instead of the result of individual decision making (Guell et al., 2012; Cass and Faulconbridge, 2016; Müggenburg et al., 2015). Within this approach, deliberate intentions, like concerns about sustainability, have been accorded less importance, while social and structural contexts have been argued to be significant shapers of individual travel behaviour.

However, while this more comprehensive approach to travel behaviour is gaining importance in travel behaviour research, application to e-bike use is limited. Qualitative insights on the subject are offered by Jones et al. (2016), who consider e-bike users' motives, experiences and perceived changes in travel behaviour in the Netherlands and the United Kingdom. They found that motives for purchasing an e-bike were commonly related to a personal sense of decline in physical ability, but emphasized that it was often the outcome of multiple reasons including personal and household circumstances or critical events that led them to reflect on lifestyle and travel behaviour.

The present study examines the habitual travel behaviour of e-bike users by combining perceived and actual travel behaviour characteristics. In general, the value of combining these data has widely been recognized in the social sciences (Driscoll et al., 2007) and mobility and transport studies (Meijering and Weitkamp, 2016; Grosvenor, 1998; Clifton and Handy, 2003). We formulated three research questions: (1) What were motives for purchasing and starting to use an e-bike? (2) Under what conditions can e-bikes substitute motorized commuting? (3) Which role do travel experiences play in the daily commute by e-bike? The behaviour of this group can provide important insights into the potential of the e-bike for commuting.

2. Method

2.1. Study area and participants

To study the commuting behaviour of e-bike users, we integrated two-week GPS data logs with follow-up in-depth interviews. The GPS data from individual participants informed the development of individual interview guides, whereas data retrieved from the interviews helped to control and validate the recorded GPS data.

The study took place in the north-eastern part of the Netherlands around the city of Groningen, at the intersection of the provinces of Groningen, Friesland and Drenthe (Fig. 1). Groningen is the largest city in the north of the Netherlands, with a population of approximately 200.000. It attracts a considerable amount of daily commuter traffic from the surrounding region. Around the city, most of the population lives in villages and small towns. The land mostly consists of grass- and farmland, and has a flat topography. Like the rest of the Netherlands, it has a temperate oceanic climate influenced by the North Sea, with average temperatures in the coldest months above zero, but regular frost periods. Periods of extended rainfall are common.

Twenty-four participants (12 men, 12 women), aged 25–65 years old (M = 45 years, SD = 9.3) participated in the study. All participants lived and worked in the study area. Nineteen participants commuted from their home village to the city of Groningen, two participants commuted from an outer suburb to Groningen, and three participants commuted from village to village in the area southwest of the city. Participants owned their own e-bike, and had been using it regularly for a period ranging from a month up to four years at the time of the study. Twenty-one participants owned a regular e-bike, which is the most