Electric bicycle adoption: Drivers and barriers from a user perspective

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***Abstract*—Recent technological advances has led electric bicycles to represent novel opportunities to replace car journeys. However, despite the potential for societal gains, there is relatively little research that studies why potential users either choose to ride an electric bicycle, or not. Accordingly, this study investigates drivers and barriers of using an electric bicycle for everyday trips through a case study in western Sweden.**

***Index Terms*— Bicycles, Consumer Behavior, Electric Vehicles**

I. Introduction

In comparison to conventional bicycles, electric bicycles offer the means to go further, carry heavier loads, and with ease tackle more types of climates and terrains. Hence, for the everyday commuter, the electric bicycle presents novel opportunities to replace car journeys with bicycling. If the adoption of electric bicycles indeed replaces car use, vast potential societal and environmental benefits can be reaped [1][2][3]. However, in order to insure a growing adoption, better understanding of which drivers and barriers the existing and potential users experience is necessary. In terms of research on electric bicycles and cyclist behaviour, numerous studies have covered safety aspects (e.g. [4][5][6]), as well as who the users are and their purchasing rationale [7], how they use it and in place of which modes [8][9]. However, fewer studies present structured explorations of everyday user experiences of riding an electric bicycle, although such knowledge is beneficial when developing and prioritizing measures aimed at increasing adoption. Accordingly, this study investigates the drivers and barriers of using an electric bicycle for everyday trips. A door-to-door framework is adopted to analyse narratives gathered during an explorative case study in western Sweden.

II. Methodology

An interview study with electric bicyclists was conducted in conjunction with a promotion project, Testcyklisterna [10]. Participants were lent bicycles for 6 months in exchange a promise to replace at least three days' worth of car journeys with cycling. The interview study comprised seven electric bicyclists, whereof one rode an electrified freight bicycle and two had additional trailers (Table 1). Interviews occurred at the end of the project, and covered e.g. participants' experiences of riding an electric bicycle for everyday use, and the pros and cons of electric bicycles. Data was analysed in two parts: (1) to identify common components of a typical trip, (2) to identify barriers and drivers the electric bicycle affords in relation to those trip components.

TABLE I
Participant Overview

P.	M/F	Age	Type of EB	Motivation for EB	km/day
1	F	33	3-speed pedelec with trailer	Long distance commute	35
2	F	45	3-speed pedelec with 3 assist levels	Assistance needed due to injury	20
3	M	52	7-speed pedelec	Long distance commute, no shower facility	35
4	M	36	3-speed pedelec, adj. shock absorbers	Assistance needed due to health issues	20
5	M	45	Electric assist 3-wheel freight bicycle	Transporting children in hilly terrain	15
6	F	29	3-speed pedelec with trailer	Long distance commute	50
7	M	41	7-speed pedelec	Long distance commute	50

III. Findings

The analysis showed that participants' collected narratives of their cycling trips contained a set of defined trip components. These components have been put together into a type trip (Fig 1); a roundtrip from home to work to home, representing the participants' archetypal cycling purposes, i.e. commuting, transporting children, and running errands.

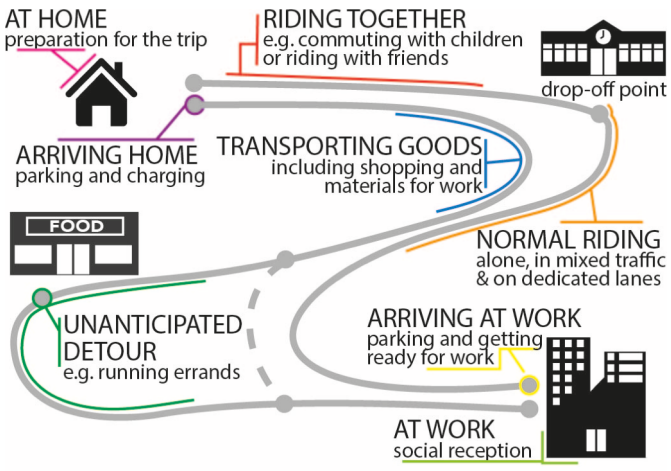

Fig. 1. The typical components of an electric bicycle trip as experienced by the participants.

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Each trip component was found to be affected either positively or negatively, or both, by the electrification of the bicycles. Mapping these effects highlights a number of drivers and barriers for electric bicycle adoption, as listed below:

***At home*:** electric bicycles offer less mental resistance towards heading out in the morning, partly as they are easier to cycle, and partly because you can confidently dress for the weather by putting on warm or protective clothing, knowing that you will not be too sweaty later on, something that very much drives adoption.

Riding together: cycling together with others was seen as an obstacle as it was difficult for non-assisted cyclists to keep up with the tempo, especially children. Participants also felt less in control of their own speed. Freight bicycles and trailers simplified commuting with children, as they could ride as passengers. However, many children insisted on cycling themselves inspired by their parents.

***Normal riding*:** electric bicycles enabled the cyclists to travel longer distances and in hillier terrain (see motivations in Table 1). However, several barriers can be identified in relation to normal cycling. The bicycles were perceived as difficult to use safely in mixed traffic as they quickly accelerated from 0 to 25km/h causing a choppy and unpredictable pattern of movement. Because of the speed, the often poor quality of the road was a problem, including pot holes, curbs and speed barriers. For freight bicycles the problems were worse because of their bulk and tendency to tip over. However, some participants perceived the bicycles as too slow as well, wanting to go faster and gain more exercise.

***Arriving at work**:* The reduced need to shower and change when arriving at your destination constitute a driver. But a major barrier is need for safe parking as participants perceived the bicycles and batteries in risk of theft. Thus, they brought the battery with them after parking, which was cumbersome as the battery is heavy and bulky. Charging abilities at work also constituted a problem.

***At work**:* several participants mentioned the social reception of electric bicycles as a deterrent. Many of them were accused of "cheating" by colleagues and friends. Even if jokingly meant, it annoyed the participants; car drivers never get accused of cheating.

***Unanticipated detour**:* whilst the electric assist means that it is less of a bother to make an unanticipated detour, e.g. for running an errand, it relates to the issue of predicting the range available by the state of charge and whether you have enough left to make the detour. Participants were anxious about this as the bicycles are heavy to ride with when out of charge.

***Transporting goods**:* being able to transport goods, like your grocery shopping, is simplified by the added assistance, but transporting goods on the electric bicycle was perceived as unsteady. On the other hand, the freight bicyclist and those with trailers found that shopping had been made a lot easier, and that the bicycles could be used for other purposes as well, such as transporting work material and going on excursions.

***Arriving home**:* As the participants lived in detached houses with garages they had no problem with parking at home, but charging was a bigger issue. It was also perceived as slightly dangerous to handle and charge the battery.

IV. Discussion and Implications

A door-to-door perspective on electric bicycle usage opens up for a thorough understanding of the drivers and barriers for adoption, while dividing the trip into components allow for more effective encircling of them. Notably, if a barrier causes electric bicycles to be deemed unsuitable for a trip component, the whole trip will be made by another transport mode.

The participants of the study represent a comparatively younger group with more diversified needs than the older females typically cited as main users in Sweden, cf. [6]. This indicates that electric bicycles may attract further user groups due to the increased payload and practical range. Nonetheless, participants' adoption varied depending on the bicycle configuration and its quality implying that bicycles must be developed to meet the demands of these groups. Additional barriers to adoption should also be addressed, but the user experiences insight presented here suggests that some of the demands commonly associated with bicycles needs rethinking. The electric bicycles solve some issues associated with traditional bicycle usage, such as the need for shower facilities at arrival destinations, etc. On the other hand, they create new demands, such as safe parking and charging possibilities, and improved and better maintained bicycling infrastructure adapted to the high average speed of electric bicycles. To meet these demands, actors must be identified who can, and should, assume responsibility for the discovered improvement issues.

As indicated by the findings, combining electric assist and freight make bicycles a competitive offer compared to cars. However, freight bicycles are connected to even stricter demands on suitable infrastructure and bicycle quality than electric bicycles themselves. The current study does not offer enough information to confidently draw conclusions about the potential benefits or which measures are needed. Thus, further studies of electric freight bicycles are necessary.

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