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Experiences of electric bicycle users in the Sacramento, California area

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ABSTRACT

In some parts of the world, electric bicycles (e-bikes) represent a significant share of daily travel, though they are still rare in the United States. The small size and maneuverability of e-bikes that are assets in cities in China may not be as important in the U.S., where cities are built to accommodate cars, but their potential as a substitute for cars makes them an important part of the discussion around sustainable transportation. In this study we conducted 27 interviews with e-bike users in the greater Sacramento area in which we asked participants about the reasons why they chose to invest in an e-bike, the ways in which they use their e-bikes, positive and negative aspects of using e-bikes, and reactions from friends and family members. Several important themes emerged from the interviews. The functional characteristics of e-bikes, particularly greater speed and acceleration than conventional bicycles with less exertion, contribute to several positive aspects of their use, including enabling more people to bicycle, more trips to be made by bicycle, and more fun for their users. The result, for these users, was an overall decrease in driving, with some users getting rid of their car altogether. Negative aspects cited by users include security concerns, safety concerns, unwieldiness, and range anxiety. Participants also discussed several misperceptions on the part of non-users that could inhibit their adoption. These results provide insights for the development of e-bike policy and guidance for future research.

Introduction

In some parts of the world, electric bicycles – often called "e-bikes" – represent a significant share of daily travel, especially in urban areas (Weinert et al., 2006, 2008). E-bikes provide many benefits in places like China, where annual e-bike sales now exceed $30 million and are projected to grow to $38 million by 2018 (Navigant Research, 2012). E-bikes are faster and require less physical exertion than conventional bikes, and they are cheaper and provide greater health benefits than cars. E-bikes can be fully charged for 15–20 cents depending on the price of electricity and the range and type of battery (NYCEWheels, 2013). In the densely populated settings where e-bikes are most common, traffic congestion makes the agility of e-bikes an important asset in terms of reducing travel times.

Despite the widespread adoption of e-bikes in China and parts of Europe, e-bikes are still rare in the United States. The small size and maneuverability that are assets in China may not be as important in the U.S., where the density of development is lower and auto ownership rates are much higher. In the U.S., the e-bike, like all two-wheeled modes, must compete for road space in an environment that that reflects decades of auto-centric development. With conventional bicycling accounting for just one percent of daily trips in urban areas in the U.S. (Pucher et al., 2011), current e-bike use is negligible. However, a qualitative study of the experiences of e-bike riders in Portland, Oregon found that e-bikes can enable people who could not or would not otherwise make the same trip by conventional bicycle (Dill and Rose, 2012).

This finding raises the possibility that e-bikes could substitute for car trips and thus contribute to a shift towards more sustainable transportation options even in the U.S. Life-cycle emissions analyses have demonstrated that riding e-bikes is a more environmentally-friendly way to travel than driving given that e-bikes emit substantially less pollution per mile than cars (Cherry et al., 2009); one U.S. study estimates that e-bikes emit 40 times less CO_2 than cars (Shao et al., 2012). But while many cities in the U.S. are promoting conventional bicycling as a sustainable mode of transportation through substantial investments in bicycle infrastructure and the implementation of bike-sharing programs, they have given little attention to the role that e-bikes might play. Even the legality of operating an e-bike on city streets is uncertain in places.

The purpose of this study was to consider the potential for wider use of e-bikes in the U.S. by exploring the experiences of early adopters of e-bikes. Our research team conducted 27 interviews with e-bike users in the greater Sacramento area in which we asked participants about the reasons why they chose to invest in an e-bike, the ways in which they use their e-bikes (e.g. trip purpose, trip destination, frequency), positive and negative aspects of using e-bikes as a mode of transportation, and reactions from their friends and family members. While each participant offered a

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unique perspective, several clear themes emerged that could help to shed light on the opportunities and challenges for expanding e-bike use in the U.S.

Background

E-bike use is on the rise around the world. There were an estimated 120 million e-bikes in China in 2010, and that figure has been growing rapidly (Yao and Wu, 2012). In China, e-bike trips are largely replacing walking, bicycling, and bus trips rather than substituting for car trips (Cherry and Cervero, 2007), and some evidence suggests that e-bikes serve as transitional vehicles from conventional bicycles to cars as Chinese incomes increase (Cherry and Cervero, 2007), negating their noted environmental benefits. Although not on the same scale as in China, Europe has also witnessed a rise in the popularity of e-bikes. Approximately 10% of bicycles sold in the Netherlands are electrically assisted, while annual e-bike sales in Germany have jumped from 200,000 to 380,000 in the last three years (Market size, 2013).

While e-bikes have yet to gain much traction in the U.S., their potential may be great. California, with the passage of climate change legislation and the introduction of a cap-and-trade emissions program, is searching for ways to swiftly reduce emissions from the transportation sector. A wider-spread adoption of e-bikes could help to reduce transportation emissions if their use replaces driving. Data collected from the first e-bike sharing program in the U.S. found that just 11% of e-bike trips replaced driving trips, while 58% replaced walking trips, and 11% would not have otherwise been made (Langford et al., 2013). However, the impact on driving might be greater in settings other than universities, where this program was implemented, or with privately owned e-bikes. To better understand how e-bikes might be used for transportation purposes, San Francisco is launching an e-bike sharing pilot program in 2014.

E-bikes provide significant increases in physical activity when they substitute for cars. From a public health standpoint, the largest relative health improvements are gained in the transition from inactivity to moderate physical activity (Gojanovic et al., 2011); thus, encouraging a substitution from cars to e-bikes could provide enormous public health benefits. In certain contexts, even riders of conventional bicycles can derive health benefits from switching to e-bikes. One study found that people using e-bikes exhibited lower levels of muscle strain and physiological stress compared to those using conventional bicycles (Theurel et al., 2012). Their results suggest that e-bikes might provide a safer and healthier alternative for individuals whose occupations frequently require biking for long periods of time, like postal workers or police officers. In another study, sedentary women experienced significantly lower levels of blood lactate concentration and reported higher levels of enjoyment after riding e-bikes than after riding conventional bikes (Sperlich et al., 2012). A controlled study conducted in the Netherlands found that under three different intensity levels of electric assistance, e-bike use was sufficiently high to meet physical activity guidelines for adults as prescribed by the American College of Sports Medicine (Simons et al., 2009). These health benefits help reaffirm the benefits of active commuting, whether on conventional or electric bikes.

However, some have expressed concern as to the safety of e-bikes on the road that could offset the health benefits of increased physical activity. A comprehensive study in China compared conflict incidents and risk-taking behavior by bicyclists and e-bike users at 14 intersections and found that e-bike user conflict rates were significantly higher than those of bicyclists for all types of intersection conflicts, regardless of who was at fault (Bai et al., 2013). E-bike users were 1.4 times more likely than bicyclists to exhibit risky behavior at intersections: 6.7% of e-bike users ran red lights, a figure the authors attributed to the relative confidence of e-bike users in being able to cross an intersection in a short period of time (Bai et al., 2013). In another Chinese study, 27% of e-bike users reported being involved in at least one at-fault accident in the past year (Yao and Wu, 2012). At this point, it is hard to know whether these same types of risky behavior apply in the U.S., where e-bike safety has not yet been studied.

Methodology and analysis

For this qualitative study, we recruited 27 e-bike owners to participate in in-depth interviews about their experiences in the fall of 2011. The interviews were intentionally open-ended and exploratory in nature. This approach, often used when little is yet known about a particular aspect of travel behavior (Clifton and Handy, 2003), allowed us to identify important themes that could serve as the basis for the design of policy-relevant questions in larger-scale quantitative studies. Furthermore, very few people currently ride e-bikes in the Sacramento region, making it difficult to recruit a sample large enough for quantitative analysis.

We employed three recruitment methods. First, we distributed fliers at local businesses that sell e-bikes. Second, we asked store-owners to email the research team's contact information to customers who had bought an e-bike from them. Third, using a snow-ball sampling approach, we asked each person who contacted us to refer other adult e-bike users who live or work in the Sacramento area. We offered a $20 gift card to Target to each participant as an incentive.

Socio-demographic characteristics of the interview participants are compared to the California population in Table 1. Only 10 out of the 27 participants were women, and this sample of e-bike users has average education and household income levels higher than the state average. As there are no available data on the population of e-bike users against which to compare this sample, it is not clear whether it is representative of all e-bike users or biased by the non-random sampling method and/or the demographics of the region from which the sample was drawn. About half of the participants live and/or work in Davis, a suburb of Sacramento well known for its bicycling infrastructure and culture (Buehler and Handy, 2008); Sacramento also has invested heavily in bicycle infrastructure (Handy and McCann, 2011).

We conducted 24 of the interviews in person and the remaining three by phone. We conducted the interviews in a variety of locations, including participants' offices and homes, university facilities, and coffee shops. The interviews took between 20 and 45 min and were recorded with an mp3 recorder. For most interviews, two members of the research team were present, though four were conducted by only one researcher. All interviews were based on the same set of guiding questions and included a mix of open-ended and close-ended questions.

Table 1
Socio-demographic characteristics of participants vs. California population.

	Participants	California	Source
Median age	54	35	1
Percent female	37%	50.3%	1
Education			
High school or higher	100%	80.5%	2
Bachelors or higher	78%	29.7%	1
Average household size	2.6	2.9	2
Average household income	$72,708	$58,935	3

Sources: (1) 2010 U.S. Census; (2) 2005–2009 American Community Survey; (3) 2009 American Community Survey. Retrieved from http://factfinder.census.gov/.