Travel Characteristics of E-bike Users: Survey and Analysis in Shanghai

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Abstract

In response to the rapid increase of electric bicycle (e-bike) usage, a questionnaire survey on e-bike users was conducted in Shanghai. Travel characteristics and traffic mode transferring features of e-bike users were analyzed. The main results are as follows: e-bike users are mostly in middle and low level income brackets; users of different ages or genders have no significant differences in terms of trip characteristics; e-bikes are mostly used for commuting, during which the travel time is generally less than 40 minutes; “more labor-saving than bike and more convenient and faster than bus” are the main reasons why users choose e-bikes; if the use of e-bike was prohibited, 55% of users would transfer their commuting mode to bus and 33% would choose bike as commuting mode. Findings in this survey are of good value for the function orientation of e-bike and policy-making.

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1. Introduction

With the expansion of the city, development of motorization and increase of residents’ income, people require for faster and more comfortable daily travel. However, regular bike cannot meet these requirements; motorcycles are prohibited in the Inner City of Shanghai; and private cars cannot be popularized due to the high cost and traffic congestion. In this case, the low price and convenience of e-bike make it a kind of ideal transportation means.

E-bikes in Shanghai have experienced 20 years of development. The first e-bike was invented by Shanghai Forever Co., Ltd in 1983. (Huang Xuanjun, 2005) In the 1990s, new technology brings vitality and vigor into the development of e-bike. However, the emerging fuel scooters quickly seized the market, and e-bike had not yet
been developed. 1990s is the initial stage of the development of e-bikes. (Dong Binjie, 2008) Although the ownership of e-bike in Shanghai fluctuated, the overall trend was upward. From 2002, Shanghai issued a document to prohibit the use of motorcycle in the Inner City of Shanghai. This document brings e-bikes into a stage of rapid development. From 2003 to 2012, registrations of e-bikes increased from 408 thousand to 2.8 million. (Shanghai City Transportation Planning Institute, 2004) Unsoundness of legal regulations and weakness of users’ legal consciousness have led to a lot of unlicensed e-bikes, which is more than the registered e-bikes.

E-bikes partly meet the travel need of Shanghai residents, and they have experienced great popularization and development. Meanwhile, e-bikes have brought many safety problems to urban traffic. The e-bikes face serious exceeding the standards (Weight no exceeding 40kg, speed no exceeding 20km/h (GB17761-1999, 1999)) and motorized trends problems. Users of e-bikes have weak awareness of safety driving, thus speeding behavior and other illegal driving behavior are common, and management of e-bike is very difficult. The e-bikes meet the "embarrassing travel demand" between bicycles and buses, and possess advantages and adaptabilities that bus cannot replace within a certain time range. If long-distance travel of e-bikes continued growing, it would bring great pressure to the urban traffic. Sprawl of e-bike may lead to worsen of traffic environment, weak advantages of public transportation, destruction of urban traffic sustainable development, and strong competition with other traffic modes, especially with bus.

This paper is organized as follows: firstly, the development of e-bikes was reviewed; then using the data obtained by questionnaire survey conducted at typical non-motorized bicycle parking spots, user group features, analyze the travel demand of e-bike users, to determine the function orientation of e-bike and to make policies.

2. Survey Methodology

2.1. Survey overview

Investigation on e-bike users group features, travel characteristics and traffic mode transfer characteristics is an important reference for understanding the current e-bike users group features and travel characteristics, making policies on the management of e-bike and guiding the development of urban transportation structure.

2.2. Survey content

The questionnaire includes three parts. The first part is about the e-bike users’ personal information, including gender, age, income, household size, etc. This part of the survey can help to get a preliminary understanding of user group features. The second part includes trip purpose, time, distance, and frequency of transfer to public transport using e-bikes, etc. This part of survey can help get travel characteristics. The third part includes traffic mode before e-bike, mode choice assuming that e-bike use was forbidden, reason of using e-bike, etc. This part of survey can be used to analyze the possibility of e-bike users transferring to another mode of transportation from the electric bike.

2.3. Site selection

The survey consists of two parts. The first part was conducted at the Nanjing East Road Metro Station and Zhongshan Park Metro Station. Nanjing East Road is located at the center of Shanghai, and Zhongshan Park is located in the west part of Shanghai Center Area. The two districts have a large number of working staff, many of whom use the e-bikes for commuter travel. The second part was conducted at 10 residential areas located between the inner ring and outer ring in Yangpu district, Shanghai. The 10 residential areas are different from
each other in complete time, construction area, number of households, floor area ratio and so on. In general, 500 questionnaires were distributed and 470 valid questionnaires were obtained.

3. Group Features

3.1. Household registration

For e-bike users, the local household registration is 47% versus 53% of them from other places in the country. Since the survey was conducted in downtown of Shanghai, and local household registration is lower than that of the suburbs, considered from the entire city, the proportion of foreign household registration maybe higher than the survey result of 53%.

3.2. Income

Monthly income of 79% of the respondents is lower than 4,000 yuan/month, among which, 38% have a monthly income of 2000-3000 yuan. According to the National Bureau of Statistics, The Shanghai average wage was 4,331 yuan/month, and per capita disposable income was 3,019 yuan/month in 2011. (Shanghai Statistical Bureau, 2012) E-bike users are mostly in low- and middle-income groups. The low cost of electric bicycles and, advantage on punctuality are the reasons why they choose e-bikes as their main traffic mode. It is worth noting that 20% of the e-bike users have a high income of more than 4,000 yuan/month. This indicates that the public choose the e-bikes not only because of their low cost, as well as but also their convenience.

![Figure 1 Users’ monthly income distribution (CNY)](image-url)
3.3. Household e-bike ownership

90% of the respondents possess 1 or 2 e-bikes, and the average household number of e-bikes owned by respondents is 1.54. 92% of the respondents who own more than 1 e-bike use the second e-bike for commuter trips. Different from those family that have cars, 45% of the e-bike users have more than 1 e-bike.

Figure 2 Distribution of household e-bike ownership
4. Travel Characteristics

4.1. Trip purpose

The trip purposes of the respondents for e-bike uses are mainly commuting and shopping, the percentage of which are 42.7% and 36.5% respectively. Respondents generally use e-bikes for commuting and shopping trips. 42.7% of user trips are for commuting, and 36.5% of them are for shopping. Compared with the survey results from the Fourth Comprehensive Transportation Survey in Shanghai (Shanghai City Transportation Planning Institute, 2009), the proportion of commuting trips is lower, and the proportion of shopping trips is higher. Since the e-bikes are the only traffic mode of the respondents, and e-bike is more convenient than other modes for shopping, this result is reasonable.

Figure 3 E-bike users’ trip purpose
4.2. Commuting length

The proportions of users with commuting length longer than 10km, between 5km and 10km and shorter than 5km are 30%, 37% and 33%, respectively. This result indicates that e-bike has strong adaptability in a large travel length range, and e-bike has become a strong competitor to bus in the middle- and short-length commuter trip service. The average commuter length of e-bike users is 9.54km, which is almost the same with the result of 10km obtained by the Fourth Comprehensive Transportation Survey (Shanghai City Transportation Planning Institute, 2009) in Shanghai.

Figure 4 Distribution of commuting length
4.3. Trip time

The trip time survey consisted of two parts, including commuter trip time and non-commuter trip time. The results are showed as Figure 5. Most of the trip time distributed between 10 and 40 minutes, which accounts for more than 70%. The average commuter trip time is 27.3 minutes, basically the same with the result (28.6 minutes) from the Fourth Comprehensive Transportation Survey (Shanghai City Transportation Planning Institute, 2009) in Shanghai. The average trip time of non-commuter trips is 25.0 minutes, since people tend to choose a closer shopping mall or entertainment place.

Figure 5 Distribution of trip time
4.4. Transfer characteristics

The survey found that about 12% of the e-bike users will use e-bike to transfer to metro, and the transfer frequency is 2.71 times/week.

Non-motorized vehicle transfer rate is defined as the ratio of number of passengers using non-motorized vehicles to transfer to metro to total number of passengers. Bike transfer rate at Anting Station, Nanxiang Station and Zhongshan Park Station is 2.5%, 6.5%, and 5%, respectively. The survey conducted at the same time finds that, the e-bike transfer rate at Anting Station, Nanxiang Station and Zhongshan Park Station is 10%, 11%, and 15%, respectively. E-bike has become the major mode for metro and two-wheeler transfer.

Figure 6 Non-motorized vehicle transfer rate

Transfer distance distribution is shown as Figure 7. 60% of the users’ transfer distance is shorter than 2km, and 15% of the users’ transfer distance is longer than 5km. The average transfer distance is 2.33km, which is basically the same with the result (2.4km) of the Fourth Comprehensive Transportation Survey in Shanghai.

Figure 7 Distribution of transfer distance
5. User Attitude And Behavior

5.1. Reasons to choose e-bike

Punctuality, time-saving, economic, labor-saving and convenience are the main reasons why the respondents choose e-bikes as their main travel mode. Due to the long travel distance, it is too laborious to ride a bike. If they take the bus, it is too crowded and expensive, and due to the congested roads during peak time, bus takes too long, and punctuality cannot be guaranteed. Taking all these factors, many people choose the time-saving, economic, labor-saving and convenient e-bikes as their main travel mode.

Figure 8 Distribution of reasons to choose e-bike
5.2. Attitude towards electric bicycles

10.1% of the respondents believe that e-bikes should be limited mainly due to safety and environmental concerns. 82.5% of them hold the opinion that e-bikes should not be restricted, and e-bike is time-saving, economic and environmentally friendly. 7.5% of the respondents do not care about this issue. They still have other travel modes to meet their travel need even if the use of e-bikes is limited.

5.3. Main travel mode before e-bike

56% of the respondents used bike as their main travel mode before they buy e-bikes and 33% of them used to take bus. As the living conditions improve, people who used to ride a bike to travel now can afford e-bikes to take the advantage of labor-saving and high speed. For people who used to take bus, e-bike can offer them a cheaper, faster, and more punctual travel mode.

Figure 9 Main travel modes before e-bike
5.4. Travel mode transfer assuming e-bike banned

By comparing the travel modes distributions before and after e-bike and travel mode choice when assuming that e-bike use was banned, the followings can be concluded: when e-bike use is banned, most e-bike users will choose bicycle and bus (86%, Figure 10), their travel modes before e-bike (89%, Figure 9). As can be seen, about 9% of these respondents will turn to travel by car, including those who already own cars (2%) and who will buy cars to meet their travel need (7%).

![Figure 10 Travel mode transfer assuming e-bike banned](image)

6. Conclusions

E-bikes account for 80% of the total number of non-motorized vehicles on the roads and play an important role in urban transportation system. E-bike users are mostly in middle and low income brackets; users of different ages or genders have no significant differences in terms of travel characteristics; and e-bike is suitable for men and women, the olds and children. The main reasons why users choose e-bike as their main travel mode are as follows: convenient, punctual, labor-saving, fast, cheap, etc. The prosperity of e-bike is the result of residents’ natural selection. E-bikes are mostly used for commuter travels, and its one-way travel time is generally less than 40 minutes, and the longest one-way travel time can be up to 2 hours. If use of e-bikes was banned, about 55% of the e-bike users would transfer their travel mode to bus, 31% of them would transfer to bike, and 9% of them would transfer to private car, including 7% of e-bike users buying cars to meet their travel need.

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