Factors related to the intention to buy an e-bike: A survey study from Norway

Özlem Simsekoglu[ab], Christian Klöckner[a]

[a] Norwegian University of Science and Technology, Department of Psychology

[b] Nord University Business School, Traffic Section

Abstract

The electric bicycle (e-bike) is a newly emerging transport option that brings several environmental and individual benefits. In order to promote e-bike use, it is important to understand which factors influence the intention to buy an e-bike among the non-users. The main aim of the present study is to examine the role of perceived benefits, barriers, social norms, familiarity with e-bikes and demographic variables for predicting the intention to buy an e-bike in a Norwegian sample. In addition, the study also aims to compare perceived benefits and barriers of e-bike use between e-bike users and non-users. A commercial panel (response rate 42.04%) and a Facebook post were used to collect data from 910 respondents (252 e-bike users, 658 non-users) via an online survey. A hierarchical multiple regression analysis was conducted to investigate the predictors of intentions to buy an e-bike. Results showed that increasing age, higher perceived benefits, both subjective and descriptive norm in favor of e-bikes, and familiarity with e-bikes were positively, whereas perceived barriers related to usability and safety were negatively related with the intention to buy an e-bike. In addition, compared to e-bike users, non-users had lower scores on the benefits related to mobility, symbolic and health aspects of e-bikes and higher scores on the barriers related to usability and safety of e-bikes. Environmental factors, such as poor weather and road conditions, appeared as the strongest barrier against e-bike use for both e-bike users and non-users.

Keywords: Intention to buy an e-bike; perceived benefits, perceived barriers; social norms; familiarity with e-bikes; Norway

1. Introduction

Environmental problems and energy use due to road transport can be reduced significantly by increasing the use of electric vehicles instead of traditional fuel-driven vehicles. Therefore, a shift towards electromobility (electrification of vehicles) is among the important transport policy goals among the European countries (European Commission, 2013). Electric vehicles, especially plug-in electric cars, provide clear environmental and economic benefits, thus there is an increase in electric vehicle use in many European countries (EEA, 2016). However, due to widespread barriers, such as lack of charging infrastructure and technical restrictions, market acceptance of electric vehicles in Europe is still quite low (Biresselioglu et al., 2018). In addition to electric cars, in recent years electric bicycles (e-bikes) have also appeared as a sustainable transport option, which offers several environmental, mobility and health benefits (Rose, 2012). Increasing the use of e-bikes has a potential to increase the share of cycling among other travel modes, and consequently to contribute the reduction of the problems related to the environment, health and traffic load. Despite the growing interest in e-bikes worldwide, there are considerable differences in e-bike use rates across different countries. E-bike use is especially high in Asian countries such as China, which is the leading country in terms of production and sales of e-bikes (Citron & Gartner, 2016). In Europe, the Netherlands, Germany, and Belgium are the leading countries in e-bike sales, whereas, despite a rapid growth, e-bike sales are relatively low in some other European countries, such as Norway (Statista, 2016). Various factors, including the geographical and cultural context, perceptions, social norms and familiarity related to e-bikes might account for the differences in e-bike use rates across different countries. The present study mainly focuses on examining the role of some psychological factors, such as perceived attributes of e-bikes and social norms, and individual factors, such as demographic characteristic and familiarity with e-bikes, for the intention to buy an e-bike in a Norwegian sample.

Norway is one of the leading countries in the world in terms of the rapid development of electromobility and use of electric vehicles. In 2016, 29 % of the new cars sold in Norway were electric and 11% were hybrid electric vehicles (ICCT, 2017). A strong climate policy, strong financial and societal incentives, and a clean and cheap way to generate electricity are among the reasons behind the successful development of electromobility in Norway (Feigenbaum et al., 2015). Compared to the electric cars, e-bike use is still in its infancy (Figenbaum & Kolbenstvedt, 2013; Fyhri & Fearnley, 2015; Fyhri et al., 2017). Increasing the share of use of active travel modes, such as bicycling and walking, is an important transport policy goal in Norway. Some previous studies point out that share of bicycling in Norway is less than desired and increased use of e-bikes, which makes cycling easier, has a potential to increase the number of bike trips in Norway (Fyhri & Fearnley, 2015; Fyhri et al., 2017).

1.1. Perceived benefits and barriers of e-bikes

E-bikes provide several benefits for individuals, the transport system, and the environment. Compared to conventional bikes, e-bikes allow riders to maintain a higher speed with less physical effort. Thus, being able to have more and longer bicycle trips with less physical effort is considered as a strong benefit of e-bikes (Fishman & Cherry, 2016; MacArthur et al., 2014; Popovich et al., 2014). E-bike use increases cycling activity especially for people who normally do not prefer using conventional bikes, such as old people with some physical limitations (MacArthur et al., 2014; Wolf & Seebauer, 2014). When replaced with cars, e-bikes allow people to engage in physical activity, which is considered as a health benefit. In addition, a shift from conventional cars to e-bikes is associated with a reduction of energy use in traffic, environmental problems caused by road traffic, such as air pollution, and traffic congestion (Berntsen et al., 2017; Cherry et al., 2009;

Fishman & Cherry, 2016; Gojanovic et al. 2011; Hiselius & Svensson, 2017; Pierce et al., 2013; Plazier et al., 2017).

Despite the clear benefits of e-bikes, there are also some aspects of e-bikes that are perceived as negative. There is research evidence showing that traffic accidents involving e-bikes result in more serious injuries, compared to accidents involving conventional bikes (Hu et al., 2014; Schepers et al., 2014; Yao &Wu, 2012). This is mostly explained by the higher speed maintained by the e-bikes. Fear of being seriously injured in case of an accident and worrying that other road users do not anticipate the speed of e-bikes are reported as safety concerns related to e-bike use (Haustein & Møller, 2016; Jones et al., 2016; Popovich et al., 2014). Security risks (e.g. risk of theft), higher purchase price, the higher weight of e-bikes and lack of bicycling infrastructure, such as lack of dedicated bicycling roads, have also been reported as some negative aspects related to e-bikes (Jones et al., 2016; MacArthur et al., 2014; Popovich et al., 2014). In addition to these factors, there are also some barriers arising from social perception and stigmatization related to e-bikes. Some people think that compared with riding a conventional bike, riding an e-bike is “cheating” because it requires less physical activity and it is something that should only be used by people with physical limitations (Jones et al., 2016). Also, it should be noted that, although e-bikes mitigate most of the barriers related to conventional bicycle use (e.g. difficult to ride in hilly areas), there are still some factors, such as heavy winter conditions, that might reduce bicycle use regardless of bike type. Adverse weather and road conditions during winter period are reported as common reasons reducing cycling in different countries including Norway (e.g. Heinen et al., 2010; Fyhri et al., 2017; Miranda-Moreno & Nosal, 2011).

1.2. Social norms

Social norms, which include both injunctive and descriptive norms, have an important role in shaping the behaviors of road users. While injunctive norms capture the perception of what feels morally right and wrong to do, descriptive norms capture how other people, in fact, behave (Cialdini et al., 1990). According to the Theory of Planned Behavior (TPB) (Ajzen, 1991), subjective norms, which refer to the opinions of significant others about engaging in a certain behavior, is a determinant of behavioral intention. Subjective norm as defined in the TPB is an example of an injunctive norm. Although the role of social norms for e-bike use is rarely examined previously; there are several previous studies showing the significant role of social norms for predicting different transport behaviors, such as public transportation use (e.g. Bamberg et al., 2003; Heath & Gifford, 2002) and conventional bicycle use (e.g. de Bruijn et al., 2005; Heinen & Handy, 2012; Heinen et al., 2010; Sherwin et al., 2014). Overall these studies show that presence of others using a certain travel mode (positive descriptive norms) and significant others' positive opinions about using this travel mode (positive injunctive norms) leads to increased use (e.g. de Bamber et al., 2003; Bruijn et al., 2005; Heath & Gifford, 2002; Heinen & Handy, 2012; Heinen et al., 2010; Sherwin et al., 2014). Hence, positive descriptive and injunctive norms are also likely to increase e-bike use especially since it is a relatively new transport option and people might need more guidance from others.

1.3. Knowledge and familiarity related to e-bikes

Since e-bikes are a relatively new transport mode, there is limited knowledge about and familiarity with e-bikes compared to other commonly used transport options. Previous research examining the role of knowledge for the adoption of new technology cars, such as electric cars has shown that lack of knowledge and experience might constitute a barrier against adoption of these vehicles (e.g. Egbue & Long, 2012; Krause et al., 2013). There is a lack of studies focusing on the role of knowledge for the adoption of e-bikes; however, it is likely that a low level of knowledge and familiarity related to e-bikes is a potential barrier against adoption of this new transport mode.

1.4. The present study

Most of the e-bike research is from Asian countries, such as China and Japan, where the market growth for the e-bike use is the largest. However, there are relatively fewer e-bike studies from European countries, although there is an increasing research attention to this newly emerging transport option. In their review about e-bike research, Fishman & Cherry (2016) indicates that focus of the e-bike research shows some geographical differences: research from the Eastern countries, such as China, focus on the market growth, safety and operational aspects of e-bike use more, whereas research from the Western countries focus more on behavioral and health aspects of the newly emerging e-bike use market.

Similar to conventional bike use, e-bike use is also likely to vary according to the geographical and cultural factors in different regions of the world. Compared to the countries with a flatter landscape and milder winter conditions, in countries with heavy winter conditions and hilly landscape, such as Norway, e-bike use might be more beneficial for increasing cycling. In addition to the geographical factors, cultural factors, more specifically cycling culture in a country, are also likely to influence people's acceptance towards e-bikes. For example, cycling is strongly associated with physical exercise in Norwegian cycling culture, therefore, some people in Norway are reluctant to use an e-bike use as it requires less physical effort compared to the conventional bike use. Therefore, it is important to conduct e-bike use studies in different countries with different geographical and cultural profile. The present study focuses on examining the predictors of the intention to buy an e-bike in a

Norway, where increasing the e-bike use might be an effective tool to boost the number of bike trips. The aim of the study is two-fold. The first aim is to examine the role of perceived benefits and barriers of e-bikes, subjective and descriptive norms, familiarity with e-bikes and demographic variables (age and gender) for the intention to buy an e-bike among non-users. The second aim is to compare perceived benefits and barriers of e-bikes between the e-bike users and non-users to investigate if these differences might account for ownership / non-ownership.

Based on the previous studies showing the importance of perceived benefits for the adoption of e-bikes (e.g. Fishman & Cherry, 2016; Simsekoglu & Klöckner, 2018[1]; Wolf & Seebauer, 2014) perceived benefits of e-bikes, especially mobility benefits, are expected to be a strong predictor of the intention to buy an e-bike in the present study. Also, in line with the previous findings showing the important role of social norms for bicycle use (e.g. de Bruijn et al., 2005; Heinen & Handy, 2012; Heinen et al., 2010; Sherwin et al., 2014) and of familiarity for adoption of new vehicle technology (e.g. Egbue & Long, 2012; Krause et al., 2013), it is expected that both social norms and familiarity with e-bikes will be positively related with the intention to buy an e-bike. In addition, it is expected that compared to e-bike users, non-users will give higher scores on barriers and lower scores on benefits related to e-bike use.

2. Method

[1]This previous study focused on the predictors of e-bike use using the same sample used in the present study. Although both studies are mainly related to psychological factors related to e-bike use, the aims and the variables they focused on are different. The previous study focused on the role of attitudes, normative beliefs, innovativeness and demographic variables for predicting e-bike use in the sample including both e-bike users and non-users, whereas the present study mainly focuses on the role of perceived benefit, barriers, social norms, familiarity and demographic variables for intention to buy an e-bike only among the non-users.

2.1. Sampling and procedure

A commercial panel was used to contact 1903 persons for inviting them to participate in an online survey about e-bike use. Eight hundred of them responded to the survey (154 e-bike users and 646 non-users) resulting in a response rate of 42.04%. Since the number of e-bike users was less than targeted, a Facebook post inviting people to the survey was used additionally. One hundred ten people (98 e-bike users and 12 non-users) were recruited to the survey via the Facebook post, thus the total number of respondents was 910 (252 e-bike users and 658 non-users). Although the sample obtained from the commercial panel is highly representative of the Norwegian population, the Facebook sample is likely to be less representative of the general population. The demographic characteristics of the e-bike users and non-users both for the panel and Facebook samples are displayed in Table 1. Overall males and highly educated people are overrepresented in the Facebook sample compared to the panel sample. Despite its possible negative impact on the representativeness of the study, the two samples were mixed to reach a high enough number of e-bike users and thus gain more power to make comparisons between the two groups. The data collection was completed between November 2016 and January 2017.

2.2. Measures

The online survey included several parts that are described below. Only the respondents who do not use an e-bike rated the items related to familiarity with e-bikes, social norms and the intention to buy an e-bike.

2.2.1. E-bike use

The respondents were asked whether they used an e-bike (1 = yes, 0 = no), which means whether they had any experience with e-bike use either as an owner or a person who have access to an e-bike.

2.2.2. Perceived benefits and barriers

Based on the previous studies examining the positive and negative experiences with e-bike use (e.g., Fishman & Cherry, 2006; Jones et al., 2016; Popovich et al., 2014), two different scales for measuring the benefits and barriers of e-bike use were developed. The benefits scale included 19 items related to health (e.g., "Use of an e-bike is good for my health"), usability (e.g., "I can reach my destinations faster using an e-bike than a conventional bicycle") and symbolic aspects of e-bikes (e.g., "Using an e-bike says something positive about me"). The items were rated using a 7-point Likert-type scale (1 = completely disagree, 7 = completely agree). The barriers related to e-bike use were measured using 13 items, which cover barriers related to usability (e.g. "E-bike is heavy"), safety (e.g. "In case of an accident, there is a higher chance of getting severely injured with an e-bike than a conventional bike") and environmental factors (e.g. "poor weather conditions"). The respondents were asked to report to what extent these barriers prevent/would prevent them from using an e-bike (1=not at all, 5=very much).

2.2.3. Social norms

In line with the previous studies measuring social norms related to different transport behaviors (e.g. Bamberg et al., 2003; Fyhri et al., 2017; Heath & Gifford, 2002), subjective norm was measured by three items related to opinions of significant others about purchasing an e-bike (e.g. "People who are important to me would support my intention to buy an e-bike") and the descriptive norm was measured only by one item ("I see many people using an e-bike"). Items were rated using a 7-point Likert-type scale (1 = completely disagree, 7 = completely agree).

2.2.4. Familiarity with e-bikes

Familiarity with e-bikes was measured by one question asking about how familiar the respondents were with e-bikes (1=not familiar at all, 5=very familiar).

2.2.5. Intention

The intention to buy an e-bike was measured by three items (e.g. "I am planning to buy an e-bike", "If I would buy a bike in near future that will be an e-bike"). Items were rated using a 7-point Likert-type scale (1 = completely disagree, 7 = completely agree).

2.2.5. Demographics

Finally, several questions related to demographic characteristics of the respondents (age, gender, income, and education) were asked.

2.3. Statistical analyses

In the first step, a joint principal component analysis (PCA) using Varimax rotation was conducted including all the perceived benefits and barriers items. Only two general factors, labeled as benefits and barriers of e-bike use, were obtained in this analysis (can be seen Table 1 in Online Appendix). It is possible that different response options used for the benefits and barriers items dominated the factor structure. Hence, to identify the dimensional structure of the perceived benefits and barriers more specifically, two separate principal component analyses (PCA) using Varimax rotation were conducted for the perceived benefits and barriers items in the second step Kaiser's ''eigenvalue >1" criterion was used to decide the number of dimensions. Next, a hierarchical multiple regression analysis was conducted to investigate the predictors of intentions to buy an e-bike among the non-users. Demographics (gender and age), perceived benefits, perceived barriers, social norms, and familiarity were entered into the model as the predictor variables in separate steps and the intention to buy an e-bike was entered as the dependent variable. Additionally, a series of independent sample ttests were conducted to compare the mean scores for the perceived benefits and barriers of e-bike use between the e-bike users and non-users.

3. Results

3.1. Dimensional structure and reliability of the scales

For the perceived benefits, PCA yielded three dimensions labeled as “mobility benefits” “symbolic benefits” and “health and other benefits”. Two dimensions emerged for perceived barriers of e-bike use, which were labeled as “barriers related to usability and safety of e-bikes” and “barriers related to environment and other factors”. Items, factor loadings and reliability coefficients for each dimension of perceived benefits and barriers are displayed in Table 2 and Table 3, respectively. All dimensions of perceived benefits and barriers had a good reliability. In addition, the three-item scales measuring the intention to buy an e-bike (Cronbach’s α= 0.82) and the subjective norm (Cronbach’s α= 0.70) had a good reliability score.

3.2. Predictors of intention to buy an e-bike

Results of the hierarchical multiple regression analysis (see Table 4) showed that age, all the benefits, barriers related to the environment and other factors, both the subjective and descriptive norm, and familiarity with the e-bikes were significantly and positively related with the intention to buy an e-bike. On the other hand, barriers related usability and safety was negatively related to the intention. Compared to perceived barriers, perceived benefits were stronger predictors of the intention to buy an e-bike. Also, among all variables, the symbolic benefits, followed by the subjective norm and the mobility benefits were the strongest predictors of intention to buy an e-bike.

3.3. Comparison of perceived benefits and barriers between e-bike users and non-users

Compared to the e-bike users, non-users reported lower mobility, symbolic, and health and other benefits, and higher usability and safety barriers; however, there was no significant difference in barriers related to environment and other factors between the two groups (see Table 5). Mobility benefits were the most agreed benefit among e-bike users, whereas health and other benefits were the most agreed benefit among the non-users. On the other hand, symbolic benefits were the least agreed benefits for both e-bike users and non-users. Regarding perceived barriers, for both e-bike users and non-users barriers related to environment and other factors appeared as the strongest barrier against e-bike use.

4. Discussion

Increasing the share of cycling among other transport modes is an important transport policy goal in many countries including in Norway. Considering the hilly landscape and heavy winter conditions and in Norway, increasing e-bike use has a great potential to increase cycling especially among those who do not prefer using conventional bikes. Little is known about determinants of the intention to use an e-bike, compared to other commonly used transport modes. The focus of the present study is to focus on the role of psychological variables (perceived attributes and social norms), familiarity with e-bikes and demographic variables for predicting intention to buy an e-bike among non-users. In addition, perceived benefits and barriers of e-bike use are compared between the e-bike users and the non-users.

The predictive role of perceived benefits, barriers, social norms, familiarity with e-bikes and demographic variables for explaining the intention to buy an e-bike were examined by conducting a multiple regression analysis. Among the demographic variables, age had a significant effect whereas gender had no significant effect on the intention to buy an e-bike. Age was positively and significantly related with the intention to buy an e-bike, which is line with the previous findings showing a positive association between older age and e-bike use

(MacArthur et al., 2014; Wolf & Seebauer, 2014). Being able to ride a bike with less physical effort might explain the stronger intention to buy an e-bike among older people who are likely to have increased physical limitations due to aging.

In terms of the perceived benefits of e-bikes, all three benefits (mobility, symbolic and health & other) were positively related with the intention; however, symbolic and mobility benefits were stronger predictors of the intention compared to the health & other benefits. The relatively weaker role of health & other benefits for predicting the intention might be related with the perception that an e-bike is associated with the less physical activity, compared to a conventional bike. Symbolic benefits were the strongest perceived benefit predicting the intention to buy an e-bike, which points out that in addition to social perceptions about e-bike use (i.e. how e-bike use is perceived by others), whether e-bike use fits the self-image of the respondents is also a critical factor for e-bike use intention. Regarding perceived barriers of e-bikes, as expected barriers related to the usability and safety were negatively related with the intention to buy an e-bike; however, unexpectedly barriers related to environment and other factors were positively related with the intention. This could be related to the fact that some of the environmental barriers, such as weather conditions, cannot be changed, hence it is likely that although people perceive them as a challenge they do not perceive them as a barrier against their intention to use an e-bike.

In line with the previous findings showing the importance of social norms for bicycle use (e.g. de Bruijn et al., 2005; Heinen & Handy, 2012; Heinen et al., 2010; Sherwin et al., 2014), both subjective and descriptive norm were significantly and positively related to the intention to buy an e-bike. Compared to the descriptive norm, subjective norm was a stronger predictor of the intention, which indicates that rather than the example of others using an e-bike, significant others' opinions about e-bike use were more critical for the respondents' intention to buy an e-bike. Fewer people using an e-bike since e-bike is a new transport mean could explain the relatively weaker role of the descriptive norm for the e-bike use intention.

Finally, as expected, familiarity with e-bikes was positively related with the intention to buy an e-bike. Although there is little known about the role of familiarity and knowledge for the adoption of e-bikes, previous studies have shown that lack of knowledge and familiarity related to new vehicle technology, such as electric cars, constitutes a barrier against their use (Egbue and Long, 2012; Krause et al., 2013). It is likely that lack of familiarity with e-bikes is positively associated with perceived risks related to safety and usability of e-bikes.

The comparison of the perceived benefits between the e-bike users and non-users showed as expected that e-bike users agreed with the benefits, especially the mobility benefits, more than the non-users. It is very likely that those who perceived more benefits related to e-bikes choose to use an e-bike; also perceived benefits of e-bikes are likely to increase with use. For both e-bike users and non-users, barriers related to environment and other factors appeared as a stronger barrier as compared to the barriers related to usability and safety. Also, although e-bike users agreed with the barriers related to usability and safety less as compared to the non-users; there was no significant difference in barriers related to environment and other factors between the two groups. It is likely that some of the perceived barriers related to e-bike use, especially those regarding usability and safety, tend to decrease when using an e-bike; however, barriers related to the environment, such as bad weather and road conditions and lack of bicycle routes, remain the same for both the users and the non-users.

4.1. Implications of the study

The present findings have some practical implications that could be useful for interventions aiming to increase e-bike use. Environmental factors appeared as the strongest barrier against e-bike use for both e-bike users and non-users. Some of the environmental factors, such as poor weather conditions cannot be changed; however, some of them are adjustable. For example, it is possible to reduce the negative consequences of the winter weather on bicycle use by providing more road maintenance, such as cleaning the snow on the roads more frequently. Thus, improving the adjustable environmental factors, for example by building more bicycling routes and improving the road conditions in wintertime, might increase cycling in general and e-bike use in specific. Subjective norm and mobility benefits of e-bikes are strong predictors of the intention to use an e-bike. Therefore, campaigns aiming to promote e-bike use might benefit from emphasizing the benefits of e-bikes especially for increasing mobility and what significant others think about e-bike use. In addition, familiarity with e-bikes was a strong predictor of the intention to buy an e-bike, thus, increasing familiarity with e-bikes by providing more information about them and making them visible as an available transport option in different contexts, such as workplaces, might be helpful to increase e-bike use.

4.2. Limitations of the study

In addition to providing results that can be useful for interventions aiming to increase e-bike use, there are also some limitations of the present study. In order to reach more e-bike users, a Facebook post was used in addition to panel data, which could have resulted in a biased sample. The sample recruited from the commercial panel was fairly representative of the general population in terms of demographic characteristics; however, the sample recruited via the Facebook ad included a higher number of male and highly educated respondents. Adding gender as a control variable in the regression analysis might have helped to control for the discrepancies between the two samples. In order to do robustness check, some additional analyses were conducted for comparing the Panel and Facebook samples on the measured constructs to see if there are some differences (can be seen Table 2 in online Appendix). This was done only for the e-bike user group as almost all the respondents not using an e-bike were recruited from the Panel data. It appears that e-bike users in the Facebook sample were more in favor of the e-bikes and they perceived less barriers compared to the e-bike users in the Panel sample. It is possible that those who participated to the study via the Facebook post by their own initiation were initially more positive towards e-bike use. These differences in recruitment methods and samples should be taken into account when interpreting the results. Also, transferring the present findings to other cultural contexts should be done with caution as factors influencing bicycling, such as physical environment and bicycling culture and infrastructure, show considerable variations across different countries. The present findings though might be applicable in countries with similar geographic characteristics and e-bike use level as Norway. An interesting research question for further studies is how the effect of descriptive social norms might change in countries with a more mature market situation. Our hypothesis would be that the importance of knowledge and familiarity decreases in markets where e-bikes are more visible in the fleet, but the role of descriptive norms increases. The symbolic benefits might change in their importance since new technology becomes less interesting for early adopters once the majority starts adopting it (Rogers, 2010). In addition, since the perceived benefits and barriers of e-bike use are likely to change according to the trip type (e.g. work-related vs leisure time trips), in future studies measuring the benefits and barriers separately for different trip types would give a clearer picture about determinants of e-bike use. Finally, using a single item for measuring some of the constructs, such as descriptive norm and familiarity with e-bikes, might be considered as another limitation of the present study. It should be noted that, using multi-item scales instead of single-item scales for measuring the constructs would give more reliable results in general.

Conclusions

E-bike is a sustainable transport option which contributes to reduction of environmental problems and brings mobility and health benefits to the individuals. In order to increase e-bike use, it is important to understand the perceived benefits and barriers related to e-bike use among the non-users. The present study focused on examining the role of some psychological factors and familiarity with e-bikes for predicting the intention to buy an e-bike in a Norwegian sample. Compared to the perceived barriers, perceived benefits, especially the symbolic benefits (e.g. positive self-image gained by using an e-bike) and mobility benefits (e.g. reaching many places faster and with less effort), had a stronger role in predicting the intention to buy an e-bike. Also, positive social norms and familiarity with e-bikes had a significant positive influence on the intention. Hence, interventions aiming to increase e-bike use might benefit from emphasizing the benefits, especially the mobility benefits, of e-bike use and increasing the knowledge and familiarity related to e-bikes. Environmental factors, including poor weather and road conditions, appeared as the strongest barrier against e-bike use or both e-bike users and non-users, which indicates that adverse weather and road conditions constitute a common barrier against cycling regardless of the bike type (conventional bike vs. e-bike). Therefore, there is a need for increasing the measures to reduce the negative effects of the physical environment on bicycle use (e.g. improving the bicycling infrastructure and road maintenance) especially in countries like Norway, where there are heavy winter conditions

Acknowledgment

This study was funded by the Department of Psychology, Norwegian University of Science and Technology.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes*, *50*(2), 179-211.

Bamberg, S., Ajzen, I., & Schmidt, P. (2003). Choice of travel mode in the theory of planned behavior: The roles of past behavior, habit, and reasoned action. *Basic and applied social psychology*, *25*(3), 175-187.

Berntsen, S., Malnes, L., Langåker, A., & Bere, E. (2017). Physical activity when riding an electric assisted bicycle. *International Journal of Behavioral Nutrition and Physical Activity*, 14(55).

Biresselioglu, M. E., Kaplan, M. D., & Yilmaz, B. K. (2018). Electric mobility in Europe: A comprehensive review of motivators and barriers in decision making processes. *Transportation Research Part A: Policy and Practice*, *109*, 1-13.

Cherry,C. R., Weinert, J. X., & Xinmiao, Y. (2009). Comparative environmental impacts of electric bikes in China. *Transportation Research Part D, Transport and Environment, 14* (5), 281–290.

Cialdini, R. B., Reno, R. R., & Kallgren, C. A. (1990). A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places. *Journal of Personality and Social Psychology, 58*, 1015–1026.

Citron, R., Gartner, J. (2016). Executive Summary: Electric Bicycles. Retrieved from the web February, 2018: https://www.pedegoelectricbikes.com/wp-content/uploads/2016/07/MF-EBIKE-16-Executive-Summary-w-Pedego.pdf

de Bruijn, G. J., Kremers, S. P., Schaalma, H., Van Mechelen, W., & Brug, J. (2005). Determinants of adolescent bicycle use for transportation and snacking behavior. *Preventive medicine*, *40*(6), 658-667.

European Commission (2013). Promotion of clean and energy efficient road transport vehicles : Report from the commission to the European parliament, the council, the European economic and social committee and the committee of the regions. Brussels.

European Environment Agency, EEA, 2016. Electric Vehicles in Europe. Retrieved from the web September, 2018: https://www.eea.europa.eu/publications/electric-vehicles-in-europe

Egbue O., Long S. (2012). Barriers to widespread adoption of electric vehicles: An analysis of consumer attitudes and perceptions. *Energy Policy, 48*, 717-729.

Figenbaum, E., Assum, T., & Kolbenstvedt, M. (2015). Electromobility in Norway: experiences and opportunities. *Research in Transportation Economics*, *50*, 29-38.

Figenbaum, E., & Kolbenstvedt, M. (2013). *Electromobility in Norway-experiences and opportunities with Electric Vehicles*(No. 1281/2013).

Fishman E., Cherry, C. (2016). E-bikes in the Mainstream: Reviewing a Decade of Research. *Transport Reviews*, *36*, 72-91.

Fyhri, A., & Fearnley, N. (2015). Effects of e-bikes on bicycle use and mode share. *Transportation Research Part D: Transport and Environment*, *36*, 45-52.

Fyhri, A., Heinen, E., Fearnley, N., & Sundfør, H. B. (2017). A push to cycling—exploring the e-bike's role in overcoming barriers to bicycle use with a survey and an intervention study. *International Journal of Sustainable Transportation 11(9)*, 681-695.

Gojanovic, B., Welker, J., Iglesias, K., Daucourt, C., & Gremion, G. (2011). Electric bicycles as a new active transportation modality to promote health. *Medicine & Science in Sports & Exercise, 43(11)*, 2204–2210.

Haustein, S., & Møller, M. (2016). E-bike safety: individual-level factors and incident characteristics. *Journal of Transport & Health*, *3*(3), 386-394.

Heath, Y., & Gifford, R. (2002). Extending the theory of planned behavior: Predicting the use of public transportation 1. *Journal of Applied Social Psychology*, *32*(10), 2154-2189.

Heinen, E., & Handy, S. (2012). Similarities in attitudes and norms and the effect on bicycle commuting: Evidence from the bicycle cities Davis and Delft. *International Journal of Sustainable Transportation*, *6*(5), 257-281.

Heinen, E., Van Wee, B., & Maat, K. (2010). Commuting by bicycle: an overview of the literature. *Transport reviews*, *30*(1), 59-96.Hiselius, L. W., & Svensson, Å. (2017). E-bike use in Sweden e CO2 effects due to modal change and municipal promotion strategies, *Journal of Cleaner Production*, *141*, 818-824.

Hu, F., Lv, D., Zhu, J., & Fang, J. (2014). Related risk factors for injury severity of e-bike and bicycle crashes in Hefei. *Traffic injury prevention*, *15*(3), 319-323.

ICCT (International Council on Clean Transportation) (2017). European vehicle market statistics. Pocketbook 2017/2018.

Jones, T., Harms, L., & Heinen, E. (2016). Motives, perceptions and experiences of electric bicycle owners and implications for health, wellbeing and mobility. *Journal of transport geography*, *53*, 41-49.

MacArthur, J., Dill, J., & Person, M. (2014). Electric Bikes in North America: Results from an online survey. Transportation Research Record. *Journal of the Transportation Research Board, 2468*, 123–130.

Miranda-Moreno, L., & Nosal, T. (2011). Weather or not to cycle: Temporal trends and impact of weather on cycling in an urban environment. *Transportation Research Record: Journal of the Transportation Research Board*, (2247), 42-52.

Krause R.M., Carley, S.R., Lane B. W., Graham, J. D. (2013). Perception and reality: Public knowledge of plug-in electric vehicles in 21 U.S. cities. *Energy Policy*, *63*, 433-440.

Pierce, J.M.T., Nash, A.B., & Clouter, C.A. (2013). The in-use annual energy and carbon saving by switching from a car to an electric bicycle in an urban UK general medical practice: the implication for NHS commuters. *Environment, Development and Sustainability, 15 (6)*, 1645–1651.

Plazier, P.A., & Weitkamp, G., van den Berg, A. E. (2017). Cycling was never so easy!" An analysis of e-bike commuters' motives, travel behaviour and experiences using GPS-tracking and interviews. *Journal of Transport Geography*, *65*, 25-34.

Popovich, N., Gordon, E., Shao, Z., Xing, Y., Wang, Y., & Handy, S. (2014). Experiences of electric bicycle users in the Sacramento, California area. *Travel Behaviour and Society, 1(2), 37-44.*

Rose, G. (2012). E-bikes and urban transportation: emerging issues and unresolved questions. *Transportation*, *39*(1), 81-96.

Rogers, E. M. (2010). *Diffusion of innovations*. New York: Simon and Schuster.

Schepers, J. P., Fishman, E., Den Hertog, P., Wolt, K. K., & Schwab, A. L. (2014). The safety of electrically assisted bicycles compared to classic bicycles. *Accident Analysis & Prevention*, *73*, 174-180.

Sherwin, H., Chatterjee, K., & Jain, J. (2014). An exploration of the importance of social influence in the decision to start bicycling in England. *Transportation Research Part A: Policy and Practice*, *68*, 32-45.

Simsekoglu, Ö., Klöckner, C. (2018). The role of psychological and socio-demographical factors for electric bike use in Norway. International Journal of Sustainable Transportation, 1-9.

Statista (2016). Electric bicycle usage in Europe – Statistics and Facts. Retrieved from the web February, 2018. https://www.statista.com/topics/3883/electric-bicycle-usage-in-europe/

Yao, L., & Wu, C. (2012). Traffic safety for electric bike riders in China: attitudes, risk perception, and aberrant riding behaviors. *Transportation Research Record: Journal of the Transportation Research Board*, (2314), 49-56.

Wolf, A., & Seebauer, S. (2014). Technology adoption of electric bicycles: A survey among early adopters. *Transportation Research Part A: Policy and Practice, 69*, 196–211.

TABLES

Table 1. Sample characteristics

	E-bike users (n=252)		*Non-users (n=658)*	
	Panel sample	Facebook sample	Panel sample	Facebook sample
Age mean (SD)	56.03 (13.79)	51.00 (14.01)	50.76 (16.35)	58.00 (13.97)
Gender (%)				
Male	43.5	72.4	49.7	75.0
Female	56.5	26.5	50.3	25.0
Education (%)				
Elementary school	4.5	5.1	5.3	0.0
Secondary school (vocational)	22.1	16.3	20.3	8.3
Secondary school (general)	12.3	15.3	12.8	8.3
University/college (≤ 3 years)	31.2	19.4	38.1	33.3
University/college (>3 years)	29.9	43.9	23.5	50.0

Table 2. Factor loadings and reliability scores for dimensions of perceived benefits

Items	Dimensions		
	Mobility benefits	*Symbolic benefits*	*Health and other benefits*
It is easy to reach many places with an e-bike	0.68		
Using an e-bike is useful for everyday mobility	0.75		
It is possible to reach your destinations faster with an e-bike than a conventional bike	0.61		
I can have more trips with an e-bike than a conventional bike	0.52		
One can save time by using an e-bike instead of a car, especially on short trips	0.75		
E-bike is a more practical transportation mode than public transportation	0.74		
It is simple to use an e-bike	0.60		
Using an e-bike enables me to distinguish myself from others		0.85	
I can show who I am by using an e-bike		0.86	
Using an e-bike fits me		0.71	
Using an e-bike says something positive about me		0.79	
Using an e-bike is good for health			0.81
Using an e-bike promotes physical activity			0.79
It is safe to use an e-bike			0.71
E-bike is an environmental-friendly transport mode			0.52
It is easy to charge an e-bike			0.61
Explained variance (%)	24.5	19.8	21.7
Reliability (α)	0.86	0.89	0.85

Note: Factor loadings less than 0.10 were suppressed.

Table 3. Factor loadings and reliability scores for dimensions of perceived barriers

Items	*Barriers related to usability and safety of e-bikes*	*Barriers related to the environment and other factors*
It is uncomfortable to use an e-bike in dark	0.52	
E-bike is heavy	0.75	
One cannot ride an e-bike longer than 70-120 km without recharging	0.72	
There are too few charging stations for e-bikes	0.67	
There is a lack of safe parking facilities for e-bikes	0.69	
An e-bike enables less physical exercise than a conventional bike	0.52	
In case of an accident, there is a higher chance of getting severely injured with an e-bike than a conventional bike	0.68	
Poor weather conditions (e.g. rain and snow)		0.82
Poor road conditions (e.g. slippery roads)		0.82
There is a lack of bicycle roads/routes		0.66
It is expensive to buy an e-bike		0.54
I am afraid that my e-bike can be stolen		0.46
Explained variance (%)	28.7	22.8
Reliability (α)	0.79	0.68

Note: Factor loadings less than 0.10 were suppressed.

Table 4. Predictors of intention to buy an e-bike[2]

Step	*Variable*	*Beta*	R^2	R^2 *change*	*F*
1			0.022	0.022	6.38**
	Gender (male)	-0.02			
	Age	0.08*			
2			0.325	0.304	55.47***
	Mobility benefits	0.18***			
	Symbolic benefits	0.22***			
	Health & other benefits	0.09*			
3			0.338	0.013	41.88***
	Barriers related to usability and safety	-0.09*			
	Barriers related to the environment and other factors	0.11**			
4			0.394	0.055	41.24***
	Subjective norm	0.19***			
	Descriptive norm	0.10**			
5			0.419	0.025	41.17***
	Familiarity with e-bikes	0.17***			

*p<0.05, **p<0.01, ***p<0.001

The dependent variable is the intention to buy an e-bike (1=completely disagree, 7=completely agree)

[2] Only the data from the respondents who did not use an e-bike (n=658) were used in this analysis.

Table 5. Mean scores for the perceived benefits and barriers for the e-bike users and non-users

Dimension	*Mean (SD)*		*t-value*	*df*	*CI 95%*
	E-bike users (n=252)	Non-users (n=658)			
Perceived benefits					
Mobility benefits	5.86 (1.07)	4.53 (1.41)	13.51***	890	1.14-1.52
Symbolic benefits	3.84 (1.72)	2.85 (1.52)	8.28***	866	0.75-1.22
Health and other benefits	5.78 (1.10)	4.74 (1.42)	10.43***	888	0.84-1.23
Perceived barriers					
Usability and safety barriers	2.52 (0.90)	2.88 (0.99)	-5.08***	879	-0.51-0.22
Environmental and other barriers	3.52 (0.98)	3.58 (0.88)	-0.94	890	-0.20-0.07

***p<0.001