What role do safety-related factors play in determining user preferences towards new bicycle technologies enhancing cycling safety?

1 Introduction

Worldwide, e-bike users are facing many crashes, and many countries are developing or adjusting bicycle infrastructure to address this issue. Despite the improvements in the infrastructure, countries such as the Netherlands, with the best and well-designed bicycle network, still experience many e-bike crashes.

Recent years have witnessed a growing academic interest in addressing cycling safety issues by adopting new technologies, such as bicycle sensors and the Internet of Things (IoT), to prevent and reduce e-bike crashes. However, research to date has not yet determined users' intention to adopt new bicycle technologies that increase safety and comfort. To address this gap, the aim of this study is twofold: 1) to investigate users' opinion of new technologies on e-bikes by collecting data from e-bike users and people interested in buying an e-bike across Europe and 2) to examine the role of different safety-related factors such as available cycling infrastructure, perceived safety and shared road with motor vehicles on people's perception towards smart features on e-bikes that enhance cycling safety.

2 Approach

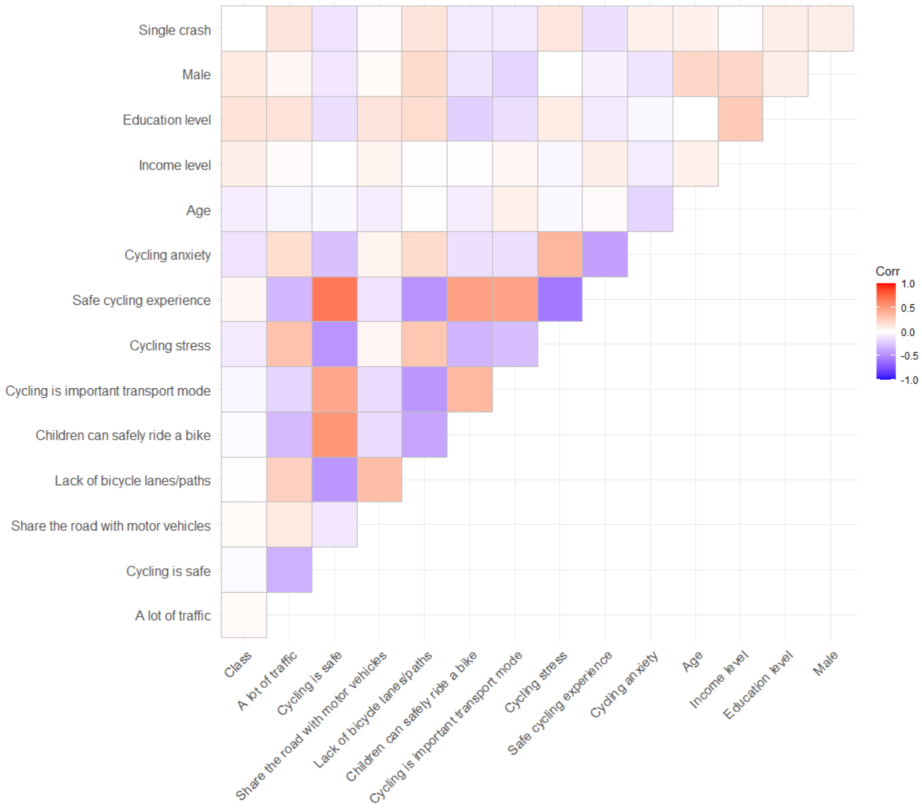
A survey was administrated in January 2022. The survey provided quantitative data from 1354 cyclist participants from six European countries. 54% of the respondents were male, 56% were highly educated (university degree and higher), and 33% earned more than 3000€ per/month net. A Multinomial Logit model (MNL) was applied to the collected data estimating to what extent sociodemographic characteristics, safety-related factors (i.e. perceived safety, traffic volume, cycling infrastructure), and cycling culture affect respondents' opinion towards smart features on e-bikes.

3 Results

This section presents the model estimated regarding the usefulness of new smart features on e-bikes to increase cycling safety and a correlation matrix of the variables can be found in Figure 1. Before we conducted the analysis, we clustered the respondents using k-means into three groups; based on respondents' perception toward bicycle technologies: 1) not useful, 2) moderately useful and 3) very useful. The estimation of the MNL model for the groups mentioned above is presented in Table 1.

The class "not useful" used as a reference group. The results of the second category, "moderately useful", indicate that age, education and cycling anxiety are the only significant variables with $\beta = 0.021$, $\beta = -0.241$ and $\beta = 0.181$, respectively. Indicating that elderly perceived that new technologies could positively affect their safety while cycling. Also, people who feel anxious when cycling have a positive opinion towards new bicycle technologies. In contrast, highly educated people have a negative opinion of smart bicycle technologies. Considering the results from the third category, "very useful", males believe that smart bicycle technologies could positively affect their safety than females with $\beta = 0.382$. Furthermore, people who live in areas with high traffic have a positive view of these technologies, while people who live in areas with few bicycle paths do not think the smart bicycle technologies will affect their safety. Lastly, in a question related to cycling stress people who stated neutral stress when cycling believe that smart cycling technologies will not affect their safety β = 0.421. The remaining variables are not significant in both categories.

Figure 1: Correlation matrix



Conclusions

This study provides novel results for the user acceptance of new technologies on e-bikes as a potential solution to improve e-bike safety and comfort. Despite the fact that this is the first survey investigating smart bicycle technologies, there is evidence that such technologies are perceived positively by an important portion of respondents.

Table 1: MNL model results for users' perception towards bicycle technologies

Reference Class: Technology is not very useful	Moderately Useful			Very Useful		
Variables	Beta	St.Error	p-value	Beta	St.Error	p-value
(Intercept)	- 0.319	0.762	0.675	0.309	0.843	0.714
Age	0.021	0.005	0.0	0.002	0.005	0.727
Income	- 0.001	0.028	0.985	0.024	0.03	0.427
Education	- 0.241	0.059	0.0	0.079	0.065	0.229
Male	- 0.265	0.139	0.057	0.382	0.157	0.015
Single crash	- 0.105	0.134	0.432	- 0.196	0.149	0.189
Cycling stress	0.13	0.144	0.366	- 0.421	0.164	0.01
Cycling anxiety	0.181	0.076	0.017	- 0.081	0.088	0.363
Cycling experience	- 0.1	0.102	0.326	- 0.06	0.113	0.595
There is a lot of traffic in my town	0.038	0.064	0.56	0.145	0.073	0.048
Cycling is safe in my town	0.115	0.088	0.189	- 0.104	0.097	0.284
Cyclists share the road with motor vehicles in my town	- 0.046	0.061	0.451	- 0.028	0.069	0.679
There is a lack of bicycle lanes/paths in my town	- 0.092	0.065	0.156	- 0.159	0.072	0.028
Children can safely ride a bike to their school in my town	- 0.091	0.064	0.154	- 0.095	0.071	0.182
Cycling is an important transport mode in my country	- 0.031	0.058	0.596	0.024	0.065	0.708