

An analysis of the joint dynamics of attitudes, intentions and behaviour in e-cycling

EXTENDED ABSTRACT

1. Introduction

This study analyses the co-evolution of adoption intentions and use behaviour of electrically assisted bikes (e-bikes), and the associated changes in *attitudes, social norms and perceived behavioural controls* (ANC, hereafter) relevant to urban travel behaviour. The nature of this co-evolution has to date been largely ignored in the literature. Yet, it potentially holds the key to effective policies encouraging the uptake of e-bikes amongst those urban travellers that are generally little inclined towards active modes.

Thus, the general aim of this study is to understand the relation between ANC, e-bike adoption and use behaviour and their co-evolution. The specific objectives are:

- To quantify the strength of the association between ANC and: a) adoption intentions, and b) use expectation of e-bikes;
- To quantify the strength of the association between pre-experience ANC and the effective use of the e-bikes, as well as the evolution of such association with experience;
- To quantify possible changes in ANC, after a month of e-bike experience, as well as changes in future adoption intentions.

In the rest of this extended abstract, we describe the data collection, the analytical methods, and report preliminary results on the first objective. The complete set of results will be presented at the conference.

2. Methodology

We address the research objectives outlined in the introduction analysing data from an ongoing e-bike trial in London. In this section, we first introduce the data background and, subsequently, we detail the analytical methods.

2.1. Data background

The data source for this study is an e-bike trial currently taking place in Greenwich (southeast London). The trial investigates the potential local impact of e-bike use.

Recruited local residents are given an e-bike for 4 weeks upon acceptance of a data collection protocol consisting of:

- A pre-trial questionnaire with 7-day pen-and-paper travel diary;
- GPS monitoring of e-bikes over the 4-week period;
- A 7-day travel diary for the third week of the 4-week period or, alternatively, google timeline to passively record travel activities for the 4-week period;
- A post-trial questionnaire.

The questionnaires collect information about socio-economic characteristics, users current travel behaviour and Likert scale indicators gauging attitudes towards cycling, e-bikes and their connection with health and environment, subjective norms and perceived difficulties with cycling and riding an e-bike.

The indicators are designed in line Theory of Planned Behaviour¹ (TPB). TPB identifies intentions as crucial precursors of behaviour. In turn, intentions, according to the theory, are determined by attitudes, subjective norms and perceived behavioural control. Attitudes indicate proclivity for a behaviour. Subjective norms account for the social factors influencing an individual. The perceived behavioural control reflects to the effort in performing that behaviour.

2.2. Analytical methods

Our first research objective requires the analysis of pre-trial data. First, we use exploratory factor analysis (EFA) to identify latent ANC underlying the Likert scale items. We subsequently use the identified factors as explanatory variables in regression models in order to investigate the trial participants' intentions of e-bike adoption before the trial as well as their expectation regarding e-bike use (e.g. e-bike trips purposes). Initially, to explore the relations between intentions/expectations and ANC, we adopt a two-stage approach consisting of using the factors scores output from the factor analysis above as explanatory variables in a separate estimation of regression models, where the dependent variables are the eliciting intentions and expectations. We refer to this as a two-stage approach as the measurement model of the latent variables, and the intention/expectation regressions are estimated separately. After this preliminary exploration of the relations between the intention/expectations and ANC, we specify structural equation models (SEMs) and hybrid choice models (HCMs) to associate pre-trial e-bike adoption intentions and use expectations to latent ANC, while simultaneously estimating structural models for the latter.

We adopt an analogous approach to address our second research objective. In this case, our dependent variables in regression and choice models are not anymore expectations of use but measured behavioural variables, expressing revealed preferences of e-bike use.

For the third objective, we first test for significant differences in central tendency and dispersion for ANC indicators collected before and after the trial, i.e. in the pre-trial survey and in the post-trial survey respectively. This analysis gives an indication of the aggregate effect of the trial on ANC. Secondly, we estimate HCMs for e-bike adoption intentions using both pre and post-trial intention statements, testing for scale variation and preference parameter variations, and ANC changes across trial phases.

3. Preliminary results

We present here preliminary results focusing on the first research objective related to quantification of the association of intentions and expectations with ANC. We carried out an EFA on Likert-scale statements designed as ANC indicators from the pre-trial questionnaire. We identified 6 latent factors that reflect perception and attitudes towards e-bikes, cycling and car use. Table 1 shows the rotated factor matrix and present our interpretation of the factors based on the factor loadings.

Factor scores for the 6 identified latent variables in the EFA are used as explanatory variables in regression models. We found that before the trial the intention to purchase an e-bike or to subscribe to an e-bike sharing scheme is positively correlated with the

¹ Ajzen, I. (1991) The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50, 179-211.

individual perception of how positively e-bikes are viewed within one's close social network. Additionally we found that the number of activities prospective e-bike users expect to use their e-bike for is correlated with the strength of their "car affection". While these results are purely exploratory, they provide an initial indication of the type of relation we are uncovering addressing the first objective.

At the conference we will provide empirical results on the effect of ANC on adoption intention and use expectation, and, more importantly on evolution of ANC, e-bike adoption and use, resulting from experience. Such deeper insights will be possible thanks to the availability of a larger sample that will enable the full methodological toolbox described above. With stronger evidence, we will also be able to draw implications for a targeted design of policies to promote e-bike adoption and improve cycling and e-cycling in urban areas.

Table 1: Explanatory factor analysis of ANC indicators

Indicators ^a	E-bikes		Cycling			Car
	Perceived reduction in physical effort	Cycling convenience	Cycling Activism	Personal health and wellbeing	Perceived positivity of cycling in close social networks	Car affection
P1: I would like to cycle and enjoy nature				0.858		
P2: Travel by car is faster				-0.304		0.727
P3: I would not like to wait for public transport				0.412		0.589
P4: I prefer to cycle to save money	0.368 ^b	0.780				
P5: I prefer to cycle to save time (less travel time, no need for parking space)	0.312	0.758				
P6: I prefer to cycle to avoid the crowds in buses and tubes	0.372	0.726				
P7: I would like to cycle to keep fit				0.796		
P8: Riding an electric bike is faster	0.697					
P9: Riding an electric bike makes it easier to cycle longer distances	0.890					
P10: Riding an electric bike makes it easier to cycle an uphill route	0.867					
P11: Public transport in London is expensive	0.498					-0.510
P12: I feel safer in a car during the night		-0.554			0.374	0.333
S1: They think the e-bike facilitates cycling over longer distances	0.500		0.402		0.425	
S2: I generally encourage them to be respectful of the nature			0.764			
S3: I generally encourage them to play sports			0.852			
S4: I generally encourage them to cycle		0.428	0.622			
S5: I love arranging meetings with my friends		0.600				-0.334
S6: They like cycling during their spare time					0.862	
S7: Among them cycling is considered to be cool					0.654	

Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO): 0.705; Cronbach's alpha: 0.754

^aThe items with a P indicator reflect personal attitudes and perceptions, following the question: "How much do you agree with the following statements". The items with an S indicator reflect social attitudes and subjective beliefs on close social network attitudes and perceptions. They follow the question: "How much do you agree with the following statements regarding your family and friends?"

^bCoefficients with absolute value below 0.3 are suppressed and not displayed in the table