Habitual behaviour versus reasoned trade-off of mode characteristics in the choice to commute to work by bike

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FULL ABSTRACT hEART2018

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The intensive use of cars and the several problems caused to the environment, the urban accessibility and in general urban life has prompted in many countries, in Europe and around the world, a new interest in active mobility, such as walking and cycling (Buehler and Pucher, 2012; Pooley *et al.*, 2013; Handy *et al.*, 2014). In particular, cycling, which is the most sustainable mode of transport, has become the key travel mode in the strategies to promote low-carbon cities (Braun *et al.*, 2016). The number of researches that have studied what affects the propensity to use the bike as commute mode is extremely vast. As typical in transport studies, several objective as well as psycho-social factors, associated with the personal sphere of each individual, have been studies and found significant in explaining individual decision or intention to bike. However, the number of papers that have studied the propensity (or probability) to bike comparing it to the other modes available to do the same trip, i.e. within a mode choice context, is surprisingly low. Some works (Goetzke and Rave, 2011; Börjesson and Eliasson, 2012; Buehler and Pucher, 2012; Muñoz *et al.,* 2016) analysed the choice of biking versus non-biking, i.e. more a propensity to bike than a mode choice. Few other works estimated a proper mode choices with more than two modes (Wardman *et al.*, 2008; Akar and Clifton, 2009; Yi *et al.*, 2011; Kamargianni and Polydoropoulou, 2013; Maldonado-Hinarejos *et al.*, 2014) but they used few aggregate level-of-service characteristics (*e.g.* total travel time, without distinguishing among different time components). Hamre and Buehler (2014) used a richer specification but mainly in terms of socio-economic and urban characteristics and they did not include psychosocial factors.

Although a vast literature on biking as a mean of transport have emphasized the importance of psychosocial factors to understand what contributes to shape individual preferences, there are almost no works that include these factors in a mode choice model with the focus specifically on biking. The only exceptions are Akar and Clifton (2009), Kamargianni and Polydoropoulou (2013) and Maldonado-Hinarejos *et al.* (2014) who studied the effect of attitudes and perceptions. Interestingly, especially compared with the vast literature on mode choice, there are no studies on the impact of habit in the propensity to choose bike. Stinson and Bhat (2004) found that the number of years of cycling experience to work and the use of bike for no work trip purposes increases the frequency to commute by bicycle to and from work. However, there are no evidence on mode choice. Moreover, while frequency of usage (*i.e.* a repeated behaviour) is probably the best indicator of habit, it is only an indicator of the tendency to repeat the same course of action. Until a behaviour is habitual, individuals still look at the characteristics of the alternatives and adopt compensatory rules as well (Aarts *et al.*, 1998). Then it is crucial to account for the effect of both possible habitual behaviour and trade-off among objective characteristics.

The aim of this work is to study specifically the impact of habitual behaviour in the choice of biking to work. In doing that, we estimate a mode choice model where biking is one of four alternative modes and we used a rich specification for all the modes in order to understand the relation between habit and compensatory evaluation of objective characteristics of the alternative modes. We also postulated that there might be a relation between habit and the latent perception of the objective characteristics, so we estimate a hybrid choice model that includes explicitly a relation between these two latent effects.

Following Cherchi *et al.* (2013) habitual behaviour is measured as a latent variable, where three indicators reveal past behaviour related to the bike use for different purposes. The perception of the objective characteristics is measured as latent variables where the indicators are statements about the importance of bike infrastructure and network, measured in a 5 points Likert scale. The discrete choice part of the model includes disaggregate level of services attributes for all modes, systematic heterogeneity, non-linear effects as well as other land attributes such as topography characteristics.

The data used in this study come from a survey conducted by the Regional Government of Sardinia and the Research Centre for Mobility Models (CRiMM) at the University of Cagliari (Italy) in two mid-size urban areas. The survey, called "BIKE I LIKE YOU", was carried out between 2014 and 2016 and targeted local authority employees. A total of 2,128 observations with prerequisites useful for the study at hand were used in our analyses. The sample is equally divided between males and females with a slight preponderance of the latter. As the sample is composed predominantly by public sector employees, the majority of the respondents has medium to high level education and are aged between 41 and 60. The majority is married/live with partner in household with on average 3 members. Car is the mode used the most (67.5%), followed by walking (14.7%), public transport (9.9%) and cycling (7.9%). But 50% of the sample reported using the bicycle for some purpose and having access to a bicycle for the home-work trip, but only 168 individuals use regularly bike to commute to work.

Our initial results confirm a significant and positive effect of latent habit in the choice of cycling to work, suggesting that, like other transport modes, using bike regularly for any purpose could positively affect the likelihood to commute to work by bike. Frequency was tested both as indicator of the latent habitual behaviour and directly in the utility function of biking, and both effects are significant. The number of bicycles per member of the family affects positively the probability to bike, but indirectly as it has a positive impact on the habitual behaviour toward biking, indicating probably also a social normative effect. As expected, the number of cars in the family affects habit to bike negatively, though this effect was not highly significant. The perception of cycle deterrents (risk of traffic accidents, difficulties in carrying on heavy objects) decreases the more frequently people bike, while the perception of the positive aspects of biking (fast mean of transport, economic and healthy) increases with frequency. Interesting, frequent users perceived also as more important having bike infrastructures on the route (reserved bike lanes) and at destination (parking spaces) while less frequent users perceived more important having bike and ride facilities that allow them to combine biking with public transport. These results are very interesting from a policy point of view. Finally, all the level-of-services attributes included in the discrete part of the hybrid choice model are highly significant and many of them shows non-linear effects. The slope has a negative impact in the choice of bike: we tested different specifications, the mean slope of uphill stretches was the most significant.

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