Exploring the inclusion of social influence in a hybrid choice model of electric vehicle (EV) purchase preferences

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Over the past 30-40 years, travel demand models have evolved significantly to develop more sophisticated formulations that overcome the limitations of classic discrete choice models. More recently, transport research has begun to focus on the inclusion of social influence in models of travel demand. Social influence is generated by people interacting face-to-face (direct influence) or can be the result of unconscious cognitive processes which are stimulated by other people or other sources of information such as TVs or websites (indirect influence). Social influence can be very powerful when analysing issues related to transport demand and travel behaviour. It is clear from previous studies that to understand the dynamics behind daily choices, analyses of consumer behaviours should not be considered at an individual level but rather at a social level e.g. family and friends (see, for instance, Dugundji and Walker (2005); Páez et al. (2008)).

However, transport researchers in this field face several challenges because of the complexity of the problem. Indeed, social influence analysis requires the application of methods used in other disciplines, such as social psychology and social economics, to understand many psychological aspects. A precise model has not yet been defined, thus, sometimes those presented in the literature are not able to reproduce what is under investigation, at other times they can lead to wrong results. In fact, only a handful of papers in the transport literature have estimated discrete choice models of travel demand with an inclusion of social influence in the utility function (e.g. Dugundji and Walker (2005) and Páez et al. (2008), who draw on the pioneering study by Brock and Durlauf (2001)). In these models, the attention is generally focused on the choice of the peers and this is the factor considered to define social influence. The underlying hypothesis is that people in a social network are affected by their peers' behaviours, and therefore the choices of various individuals in the social network have been included as an exogenous variable. On the other hand, an important avenue of research in terms of modelling social influence was undertaken by Leenders (2002) who has explored various ways to consider the weight matrix. This matrix is a result of the interactions among the nodes of the social network and gives information about the type of relationship between the individuals, hence, the strength of the tie between them. There have also been some methodological advances, for example Kamargianni et al. (2014) have developed a hybrid choice model to take into account the social environment. By asking children about their parents' attitudes during a questionnaire, they have explored the unobserved effect of the social environment in the household, and in particular, they have focused their attention towards the influence of parents on children regarding the intention to walk.

In this paper, we estimate new model formulations including the social influence variable and the weight matrix of the social network in order to investigate the electric vehicle purchase preferences of interviewees; these formulations are an extension of previous work by Manca et al. (2017). The data used to estimate these models was collected during the extension of the 'Battery Electric Vehicles (BEV)' project, which had previously involved 57 of 500 employees of a UK

company. Afterwards, Axsen et al. (2013) built a screening survey for 191 participants with information on their travel patterns and BEV experience, employee social network and demographic characteristics. 105 employees answered a semi-structured interview regarding their attitudes towards green technologies and lifestyle preferences. The attitudes were measured on a 5-point Likert scale. The survey included a stated preference design with nine different exercises which compare different attributes of conventional vehicles and electric vehicles (EV).

We investigate different hybrid choice model structures to include social influence within the context of choice behaviour. The individual latent constructs are explored with an explanatory factor analysis by which an 'open to innovation' latent factor is identified. The social influence variable is built by a cluster analysis of the attitudinal statements of the individual's social network to be able to define the number of contacts for each individual who are open to innovation. As an extension to the hybrid choice formulation discussed in Manca et al. (2017), we make the social influence variable interact with the relationship matrix among co-workers. Early results show that accounting for the interaction matrix is crucial to be able to get a significant coefficient of the social influence variable. The social influence variable generally seems to affect the attitudes of the individuals rather than directly affecting the utility function of the alternative. More results with different specifications of the interaction matrix (e.g. symmetric or not, normalized or not) and further interactions between the social influence variable and the stated choices of the peers will be presented at the conference.

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