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A STATED CHOICE EXPERIMENT TO MEASURE THE EFFECT OF INFORMATIONAL AND NORMATIVE CONFORMITY IN THE PREFERENCE FOR ELECTRIC VEHICLES.

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Abstract

This work aims to measure the effect of both informational and normative conformity in the preference for electric vehicles (EV) versus internal combustion vehicles (ICV). Differently from most of the literature in the field, measures of conformity are included as attributes inside a stated choice (SC) experiment, allowing a direct comparison of their effects with typical effects such as purchase price, range and fuel/electricity price. To measure informational conformity we set up an experiment where the same individual answers the choice tasks before and after he/she has received social information on three specific EV features: range, parking spaces reserved for EV and the need to change activity schedule if using an EV. Normative conformity was measured in terms of social adoption, social-signalling and injunctive norms. Social adoption and a pair of eyes to detect social-signalling were included as attributes in the stated choice experiment, while injunctive norms were measured using psychometric indicators. The SC experiment was also aimed at testing the effect of parking policy on the choice of EV. Hybrid choice models were estimated and a resampling technique was used to test the model sensitivity to the sample gathered. All social conformity effects tested are highly significant and their impact in the overall utility can be high enough to compensate also quite low driving range for EV (e.g. around 130 km) or significant differences in purchase price (for example 1/3 higher for EV than ICV). We also found that parking price and the number of slots reserved for EV can be effective in boosting the demand for EV, but a combination of parking policies is needed because each measure alone does not have a sufficient impact to compensate major difference in the characteristics between EV and ICV.

1. Introduction

People around us, friends, family, colleagues and peers but also people that we do not know and who do not know us, directly and indirectly influence our behaviours and decisions. According to Crutchfield (1955) individuals consciously or unconsciously tend to yield to group pressures and consequently to act in agreement to the majority position. This phenomenon, known as *social conformity*¹, has been studied since the first half of the nineteen century when Sherif (1935), Asch (1951) and Crutchfield (1955), using laboratory experiments, showed that people look to others as a guide to behaviour when they are unsure of themselves and, even further, that individuals can be influenced to give a wrong answer to a very simple task through the actions of others in the group, whether the individual is or is not in the physical presence of the group. Social conformity can occur because of the desire to be liked and accepted by the members of the group (*normative conformity*) or because of the desire to be correct; individuals then turn to the members of one's group to obtain and accept accurate information about reality (*informational conformity*)².

Conformity is a type of social influence involving a change in attitudes, beliefs, and behaviours in order to fit in with a group matching the group's norms belief (Cialdini and Goldenstein, 2004). According to Turner (1991, page 2) "social influence relates to the process whereby people agree or disagree about appropriate behaviour, form or maintain social norms and the social conditions that give rise to, and the effects of such norms", where social norms are "a generally accepted way of thinking, feeling or behaving that is endorsed and expected because it is perceived as the right and proper thing to do. It is a rule, value or standard shared by members of a social group that prescribes appropriate or desirable attitudes and conduct in matters relevant to the group". Social norms and social influence are then clearly bound up with each other and social norm is the key in understanding social influence.

However, as highlighted by Göckeritz et al. (2010), the main interest of psychologists is not focused on norms per se but on the normative beliefs that individuals hold. According to the Theory of planned behaviour³, in fact "human behaviour is guided by three kinds of considerations: beliefs about the likely consequences of the behavior (behavioral beliefs), beliefs about the normative expectations of others (normative beliefs), and beliefs about the presence of factors that may facilitate or impede performance of the behavior (control beliefs). In their respective aggregates, behavioral beliefs produce a favorable or unfavorable attitude toward the behavior; normative beliefs result in perceived social pressure or subjective norm; and control beliefs give rise to perceived behavioral control". Figure 1 illustrates the path that links social beliefs to social conformity.

Figure 1 Relation between beliefs, norms, social influence and social conformity.

¹ "The essence of conformity is yielding to group pressures but it may take different forms and be based on motives other than group pressure." (Mann, 1969)

² This distinction was proposed by Deutsch and Gerard (1955). Mann (1969) instead distinguished conformity into normative, informational and ingratiation while Kelman (1958) distinguished it into compliance, internalization and identification.

³ From Ajzen's website : <http://people.umass.edu/aizen/tpb.html>

Cialdini et al. (1990) differentiate between two categories of normative beliefs: *descriptive normative beliefs*, which refer to what an individual thinks others do in a particular situation, and *injunctive normative beliefs*, which reflect individuals' beliefs about what others approve or disapprove of. Göckeritz et al. (2010, page 515) highlight that “injunctive normative beliefs follow quite closely the normative social influence described by Deutsch and Gerard (1955)” while “descriptive norms can be both normative and informational”. Descriptive and injunctive social norms can be viewed as variations of normative conformity. But while both of these normative processes are driven by a desire to be accepted by the group (or at least, not to be too deviant), they work through distinct processes.

Social influence and social conformity can also be revealed by *social-signalling* behaviours, i.e. by behaviours that are driven by the image that individuals want other people to have of them (Grossman, 2010). Figure 2 illustrates the link between informational and normative conformity and different social norms and beliefs.

Figure 2: Relation between informational and normative conformity and social norms and beliefs.

Descriptive social norms can be further distinguished in *descriptive subjective norms* when social influence is exerted by individuals perceived to be affectively important to the individual (e.g., relatives and friends), and *descriptive local norms* when social influence is exerted by those who share the same social-physical context (e.g., neighbours or co-workers), regardless of their emotional connection to the individual (Carrus et al., 2009; Fornara et al., 2011). Some literature, as we will see below, makes use of this distinction.

1.1 Literature review

Social norms and social conformity have been extensively studied in psychological literature (see for example Cialdini and Trost, 1998; Kallgren et al., 2000; Cialdini, 2001, 2005, 2007; Cialdini and Goldstein, 2004; Goldstein and Cialdini, 2007; Schultz et al., 2007), but there are also several applications to transport studies. In the transport literature, social norms and different forms of social influence have been studied using field experiments, qualitative approaches or quantitative approaches where the effect of norms is modelled mainly using psychometric indicators or attributes that measure the level of adoption of each alternative.

For example Kormos et al. (2015) used a month-long field experiment to evaluate the impact of descriptive social norm information on self-reported reduction of private vehicle use. Goetzke and Rave (2015) studied the role of social identity (i.e. the perceived differences

between a person's choice and the choices of others) in automobile access on self-reported subjective well-being. Sunitiyoso et al. (2011) studied conformity using a laboratory experiment that exemplified a public goods game where the social interactions between participants occurred by sending and receiving text messages through their computer screens during the experiment. Wilton et al. (2011) adopted a qualitative approach (semi-structured interviews) to study the way social norms influence the decision to adopt telecommunication (i.e. flexible workplace arrangement). Axsen and Kurani (2012) used the personal network of each interviewed and the narrative of individuals' direct experience with a plug-in hybrid electric vehicle to study the effect of interpersonal influence in the adoption of plug-in hybrid electric vehicles from five perspectives including normative conformity. TyreeHageman et al. (2014) provided a description of early plug-in electric vehicle buyers and their relationships to and ideas about plug-in electric vehicle communities and use of social media to construct such communities. In particular they found that these early drivers used the forums to find more information about range and batteries, charging, charging infrastructure, and ways of accessing charging infrastructures among others.

Bamberg et al. (2007) used psychological constructs collected in a 3-wave questionnaire to prove the existence of a statistically significant and substantive relation between a personal norm and the actual use of public transport. Similarly, using structural equation models, Zhang et al. (2016) showed that descriptive and injunctive norms stimulate the intention to use public transport and increase actual public transport usage. Okushima (2015) using data on stated intention to shift mode, developed a multi-agent mobility shift simulation model that considers the influence of social conformity on the mobility shift intention of individual commuters. Polydoropoulou et al. (2015) used hybrid choice models to estimate the effect of social norms on the intention to switch from the current transport mode to green transport modes. In their model the latent variable "motivation to comply with social environment" works as a filter between the social environment's attitudes towards active transport and the decision makers' attitudes towards active transport. Using hybrid choice models, Thorhauge et al. (2015 and 2016) studied the effect of the intention to be on time as a mediator between the choice to shift departure time and several latent psychological aspects (including social norms) as implied in the extended Theory of Planned Behaviour.

Paez and Scott (2007) used a simulated experiment to test the effect of social influence in the utility of telecommuting. In their model, social influence is an attribute added to the utility and defined as the number of adoptions or non-adoptions within the awareness range or personal network of each individual actor. In a related approach Dugunji and Walker (2005) estimated a mode choice model where interdependencies among decision-makers are captured including in the systematic utility variables that describe choices of others in the decision-maker's social and spatial network and by allowing for correlation across the disturbances of decision-makers within the same social and spatial network. In a similar work, Walker et al. (2011) captured social influences using a field effect variable calculated as the percentage of the population in the peer group that has chosen the specific alternative, and estimated a model that corrects for endogeneity. Since the peer group is defined based on socio-economic status and spatial proximity of residential location, it is likely that unobservable environment and preferences that impact the peer group also influence the decision-maker. Finally Abou-Zeid and Ben-Akiva (2011) explicitly modelled the behavioural process triggered by social comparisons and its effect on individual well-being. They measured social comparison by asking respondents to consider a person in their metropolitan area whose commute was familiar to them and to define their relationship with that person (e.g. friend, colleague,

neighbour, relative, family member, or other acquaintance). Maness et al. (2015) discussed the micro foundations of social influence and choice by separating the social influence mechanism from the source of its influence and provided a general framework for choice models of social influence. They highlighted that differences in social influence types, motivations, tactics, and sources have important implications when applying these models for policy analysis and gathering data is an important area to properly study these effects.

Kuwano et al. (2012), Rasouli and Timmermans (2013) and Araghi et al. (2014) are the only examples we are aware of, where the effect of social influence is measured directly as an attribute in a stated preference experiment. This has the advantage that the effect of social influence can be systematically varied as any other attribute. In particular Kuwano et al. (2012) included an attribute depicting the general market share of electric vehicles while Rasouli and Timmermans (2013) extended this approach by including four attributes that measure the market share of electric vehicles for different reference groups (friends, colleagues, peers and larger families). They also added an attribute that measures a general review about the product in terms of positive or negative reviews, but these do not refer to specific characteristics of the vehicles or their usage. Araghi et al. (2014) studied if the willingness to offset flight-related carbon emissions is a function of the collective participation rate, which can be regarded as a social norm, towards carbon offsetting. In their experiment individuals were divided into 3 random groups and each were presented with a different collective offsetting rate. This allowed them to estimate different preferences towards the environmental policies across the social norms, indicated by different collective carbon offsetting rates.

The objective of this work is to extend this research by measuring both informational and normative conformity inside a stated choice experiment. This paper contributes to the above literature in two ways: (1) it proposes a way to measure informational conformity inside a SC experiment and (2) it measures normative conformity in terms of social adoption, other signalling and injunctive norms. In particular to measure informational conformity we set up an experiment where, differently from Araghi et al. (2014), the same individual answers the choice tasks before and after he/she has received social information. Moreover, differently from both Araghi et al. (2014) and Rasouli and Timmermans (2013) the information provided does not refer to the share of individuals who adopted a given behaviour, but to the experience of other users regarding specific features of the alternative. In contrast with the three previous studies we measure normative conformity in terms of both descriptive and injunctive norms and we account also for the social-signalling effect. Descriptive norms are measured as attributes inside the SC experiment, while injunctive norms are measured using psychometric indicators.

The study is applied to the choice between electric vehicles (EV) and internal combustion vehicles (ICV). The stated choice experiment was also aimed at testing the effect of parking policy on the choice of electric vehicles, which is an important topic that has received much less attention in the literature compared to the car characteristics and recharging infrastructures. The only literature, we are aware of that tested the effect of parking policies on the adoption of EV, included the option “free parking” as one of the three levels (along with “access to bus lanes” and “no road/purchase taxes”) of an attribute “incentive” (Adler et

al., 2003; Potoglou and Kanaroglou, 2007; Hoen and Koetse, 2014; Hackbarth and Madlener, 2013⁴).

The rest of the paper is organized as follows. Section 2 reports a discussion on the different aspects of social conformity and describes how these were measured in our study. Section 3 describes the methodology followed to collect the data and to build the stated choice experiment. Section 4 reports the model structure, a discussion of the estimated results and a discussion of the policy implications of social conformity while Section 5 summarizes the main conclusions.

2. Measures of social conformity

The major problem in measuring social conformity inside a stated choice (SC) experiment resides in the fact that the attributes included in the SC define the alternative and its characteristics, while social conformity is not typically related to the characteristics of the alternatives but to the behaviour or opinion of others regarding that alternative. This is probably also the reason why social adoption is the only example of social influence tested so far inside a SC experiment, and why Araghi et al. (2014) presented the social information outside the SC experiment. In the following sections we will discuss each aspect of social conformity and the methodology followed to measure them inside the SC experiment.

2.1 Informational conformity

Informational conformity occurs when an individual is in an ambiguous (i.e. unclear) situation or lacks knowledge and hence turns to the members of one's group for guidance. This type of conformity usually involves internalization or private acceptance, i.e. a genuine belief that the information is right. Informational conformity is typically measured using sentences like *"Your friend/colleague/family tells you that she used an EV and she liked it. She will use it again"*. However, as discussed previously, this is a typical case of a sentence not linked to the characteristics of the alternatives presented in the SC and its inclusion among the attributes of the SC could be considered unrealistic. Analogously to Araghi et al. (2014) we decided then to present the social information outside the SC experiment; however to be able to measure the reaction of each respondent to the social information, instead of using control groups, we set up the experiment in a way that the same individual answered the SC experiment before and after she has received information. In particular the experiment was set up in the following way:

1. Individuals were asked to imagine they were at the car dealer choosing a car and they were presented with 3 different options (3 choice tasks), describing the characteristics of the cars, of the parking in public places and the current EV adoption.
2. Then individuals were asked to imagine that the car dealer leaves them for 5 minutes to bring more options of cars and in that moment a good friend of them, who has recently bought an EV, enters at the car dealer and they take the opportunity to ask the friend the following questions:
 - *What is your experience about the range of the EV?* (The answer was: *Very good, I never had any problem or Indeed not so good*)

⁴ In Hackbarth and Madlener (2013) the effects of "free parking" and "bus lines access" were not estimated separately.

- *Did you modify your activities now that you are using an EV?* (The answer was: *Never, I could do the same activities as before* or *Yes, I had to change or cancel some activities*)
 - *Did you feel the benefit of having parking spaces reserved for EV?* (The answer was: *Yes, it is so convenient to have parking spaces reserved* or *Not as much as I had thought it would have been*)
3. After the friend replies to the question, the car dealer comes back and presents other 3 options (3 choice tasks) to the respondent.

The choice of a good friend as the person who provides information was carefully discussed. The reference group chosen has an effect on the type of social norm we measure. The best way would have been to define the reference group relevant for each respondent and use it to measure information conformity. However, eliciting this information is complex and requires a specifically dedicated study, such as e.g. in Abou-Zeid and Ben-Akiva (2011). We then opted for using as reference “a good friend”: almost everybody has a good friend and he/she is someone who people typically rely on.

2.2 Normative conformity

Normative conformity (or normative social influence) refers to the tendency to conform to others in order to be liked and accepted by them. Normative conformity can be driven by descriptive norms, injunctive norms and social-signalling.

2.2.1 Descriptive norms

Descriptive norms define when the individual’s behaviour is affected by what other people do. Since social-behavioural responses might be activated automatically by the perception of others enacting a given behaviour (Bargh et al., 1996), the typical way to measure descriptive norms is by communicating “how most people behave in a given situation”. This is the easiest social influence effect to measure inside a SC experiment. In the specific context of EV preferences, a typical sentence can be like “*EV is expected to be used by the majority (73%) /minority (27%) of commuters*”. However this sentence can be vague, especially when included in a stated choice experiment and it cannot be directly linked to a policy. An alternative can be to use the exact number of people that behave in a certain way, like “*The EV is used by 100 people every day*”. This is for example the definition of social adoption used in Rasouli and Timmermans (2013), who also indicated the several reference group that behaves in that way. While adding the reference group makes the sentence less vague, there is the risk that it might not correspond to the knowledge that the person has about the group (a person might know that none of her colleagues has or intends to buy an EV and she might not believe the information provided in the SC). We then decided to define the descriptive norm in terms of “*Number of EV recently bought in Denmark*” that indirectly informs about how many individuals will use it, and it is more directly linked to a policy, even though it is not linked to a reference group (no distinction is made between subjective and local norms). An explanation of what “recently bought” means was also added to the above sentence, “*(i.e. bought but they will arrive in the next couple of months)*”, to ensure that each respondent have the same interpretation of “recently” and to prevent the problem that respondents can make their own judgement whether the number of EV bought is true or not, based on the number of EV currently circulating.

2.2.2 Injunctive norms

Injunctive norms define when the individual's behaviour is affected by what other people think of her doing something. A typical sentence that could capture injunctive norm in an EV context is something like *"Your friends/colleagues/family would approve of your use of the EV."* However, this is another example of a sentence not linked to the characteristics of the alternatives presented in the SC. Moreover, given the specific content of the sentence ("approve using EV") we also felt that its inclusion as an attribute in the SC could have been perceived as an attempt to manipulate individuals' answers and could have jeopardized the results of the SC experiment itself. After a couple of tests we then decided to measure injunctive norms in a more traditional way, using psychometric indicators. In particular we measured injunctive norms asking people about the level of agreement (strongly disagree – strongly agree) in a 7-point Likert scale, to the following statements:

- *People who are important to me (friends, family) would approve of me using an electric vehicle instead of my conventional car.*
- *People who are important to me (friends, family) think that using an EV instead of my conventional car is appropriate.*
- *People who are important to me (friends, family) think that more people should use EV instead of their conventional car.*

2.2.3 Social-signalling

Social-signalling defines when the individual's behaviour is affected by the image the individual wants other people to have of her, opposite to self-signalling that defines when the individual's behaviour is affected by the image she wants to have of herself. This is another social effect difficult to include as attributes in a SC. A possible way to measure it in a SC consists of using, as attributes, images that represent the concept of the group each person feels she belongs to or wishes to belong to. However this requires a previous study to define, for each individual, the images that best represent the group the individual feels (or does not feel) belonging to and the type of message that the image conveys to the person (the same image can convey different input). As discussed before we needed to keep the survey within a feasible size. We then decided to adopt a different strategy and use the image of a pair of eyes that is linked to social-signalling by the fact that being watched tends to trigger status/social-signalling concerns. This may influence how people respond eliciting pro-social or other-regarding behaviours versus maximisation of individual self-interest (Haley and Fessler, 2005; Bateson et al., 2006; Camerer and Fehr 2006).

The image of a pair of eyes represents a priming effect. A purely symbolic reminder of being watched prods, without any awareness, to improved behaviour (Kahneman, 2011). The reason of this effect relies on the fact that the "human perceptual system contains neurons that respond selectively to stimuli involving faces and eyes"; then even if a person is not actually observed, the simple image of the eyes "exerted an automatic and unconscious effect on the participants' perception that they were being watched" (Bateson et al. 2006, page 413). Several studies have tested the effect of the presence of eye images both in field experiment and in laboratory tests on the background of a computer. Results seem to confirm that the presence of eye images increase cooperation levels and norm-compliance, and in general affect individuals' behaviour or responses in computer experiments. However, results are mixed. Brudermann et al. (2015) recall in fact that non-neuroscientific experimental studies failed to confirm the effectiveness of eye cues. Based on this literature, we have an

expectation that the effect of the image of eyes should affect individuals' stated choice responses, but empirical results need to confirm it.

In this study we followed the work of Bateson et al. (2006) who tested the effect of 5 types of eyes. Figure 3 reports the two images that were the most effective. Case B was also more effective than case A, but we chose to include the image in case A because it was more neutral⁵. The image of the eyes was included in the SC experiment as a dummy attribute (present/no present), as described in the SC experiment section.

Figure 3: Images of eyes in Bateson et al. (2006) study.

3. Data collection methodology

The data used in this study was specifically collected to study the effect of parking policies on the choice of EV versus conventional cars (gasoline or diesel car) and the role played by social conformity on this choice. The population of interest was then individuals who had recently driven a car to a destination where it was difficult to find a parking space. The survey consisted of five sections:

- (1) The first section aimed at collecting detailed information about the last parking activity where the respondent encountered parking problems (location, time to find a slot, duration of the parking, walking distance to the final destination, motivation to choose that slot, activities performed after parking, car driven, and frequency of that trip) and information on household vehicle ownership and use, definitions on the most likely future vehicle purchase and information on whether this new car would replace an existing one or if it would be an additional one in the household. As in the previous surveys (Jensen et al., 2014) it was also asked to indicate the degree of influence the person had in the decision about the type of car.
- (2) The second section consisted of a SC experiment, pivoted around the values collected in the first section. The SC included attributes related to the car characteristics and to the parking options, plus attributes that allow us to measure the effect of conformity. A description of the SC experiment is reported in the next section.
- (3) The third section was dedicated to gathering standard socioeconomic information (such as age, gender, level of education, type of work etc.) and residential information (mainly type of accommodation and parking facilities).
- (4) The fourth section was dedicated to collecting information about individuals' attitudes and perception towards several aspects related to EV (environment, technology etc.),

⁵ We became aware of Brudermann et al.'s (2015) work only recently, after our survey study was completed. It is interesting to note that they used the same image of eyes that we used in our study, i.e. the eyes that scored second best, for the same reasons we pointed out.

injunctive social norms, affects and values in life. In this paper we only focus on the injunctive norms as described in the previous section. A discussion on attitudes, affects and values can be found in Cherchi (2015).

- (5) In the last section, information about personal and family income was asked.

The survey was administered via internet in the period between December 2014 and January 2015. Given the novelty of some information tested, a major effort was dedicated to the pilot phase. Four pilot tests, of approximately 50 individuals each, were performed between March and October 2014 to make sure that respondents understood the information provided, to define the levels of the attributes and to check the SC experiment.

The sample was gathered from a list of individuals who had signed up to participate in a real life experiment with EV that was launched in Denmark in 2010. This is the same list of contacts used in Jensen et al. (2014), but because the target population is different and respondents were randomly selected, only 39% of the sample gathered in this survey had also participated in the previous survey described in Jensen et al. (2014)⁶. The overall list consists of 17,299 contacts, all living in Denmark (of which approximately 30% in cities with more than 25,000 inhabitants). 31% of the people contacted replied to the invitation (i.e. either they at least entered the survey or sent us an email), which is quite high considering that approximately four years had passed since they had signed up for the experiment, and that probably several contact emails were not active any more. Up to 2 reminders were sent to respondents, though the majority (72% of the individuals who filled in the survey) replied without a reminder.

The survey started with some initial screening questions to select only individuals who had driven a car in the last 2 months. The introduction of the survey also explained that the objective of the study was to investigate the effect of parking policies, so some individuals then sent an email informing us that they have driven a car in the last 2 months but only in rural areas or places where parking policies would not make sense. Considering then only the individuals who were eligible, the response rate was around 50%. This is again quite high for an internet survey. We need also to consider that the questionnaire proposed was not related (though on the same topic, the EV) to the experiment for which these people had originally signed up. Table 1 reports a summary of the information about the recruitment process.

For the purpose of this paper, the useful sample consists of all individuals who have replied up to the attitudinal statements (2595 individuals). Of these 232 individuals were excluded for several reasons, such as they already had an EV or a hybrid car, or because they wrote in the comments that they participated even if for some reasons they did not fulfil the pre-requisites, like for example they described a trip to a destination where parking was not a problem at all or similar comments. Table 2 illustrates some socio-economic characteristics of the respondents and of their trips. As can be seen the majority of the respondents is male (73%) and employed (78%), while only half of them (42%) have a job with a fixed amount of hours. On average respondents are 47 years old and live in households with 3.12 members and 1.52 cars.

⁶ Jensen et al. (2014) used a panel survey where individuals answered a SC experiments twice, before and after they tried an EV for 3 months. We know that 39% of the individuals in our sample participated to the before survey described in Jensen et al., but we do not know how many participated to the after.

According to Statistics Denmark, in 2012, 60% of the Danish households owned a car, of which 24% are multivehicle households. In our sample all households possess a car and 46% have more than one car. The majority of the respondents declared that they would like to replace an existing car and mostly they are also the ones whose opinion is more influential on the decision (on average respondents have 86% influence on the decision). Respondents could choose among a predefined set of seven car classes: Mini, Small, Medium 1, Medium 2, Large, MPV and a final class called “other” if none of the previous six car classes fully describes the relevant car class.

Table 1: Recruitment process

	TOTAL	% with respect to		
		Contacts	Replied	Eligible
Contacted	17299	100%		
Replied (i.e. at least entered the survey or sent an email)	5369	31.04%	100%	
Asked explicitly to be removed	68	0.39%	1.27%	
Have changed email or do not live in Denmark anymore	48	0.28%	0.89%	
Already have an EV	3	0.02%	0.06%	
Do not have a car, have not driven or did not experience parking problems in the last 2months	108	0.62%	2.01%	
Eligible	5142	29.72%	95.77%	100%
Only entered the survey	2270	13.12%	42.28%	44.15%
Dropped after parking information (section 1)	216	1.25%	4.02%	4.20%
Dropped after the SC experiment (section2)	37	0.21%	0.69%	0.72%
Dropped after SE characteristics (section3)	24	0.14%	0.45%	0.47%
Dropped after Attitudes statement (section 4)	10	0.06%	0.19%	0.19%
Dropped after Affects statement (section 4)	100	0.58%	1.86%	1.94%
Dropped after Values statement (section 4)	82	0.47%	1.53%	1.59%
Completed the full survey	2403	13.89%	44.76%	46.73%
Completed the SC experiment	2656	15.35%	49.47%	51.65%

Regarding the parking activities, 1/3 of the respondents parked in the street, 2/3 in multi-storey car parks, which are mainly private. Finding a parking space takes on average 10 minutes, but with a large variation between zero and 30 minutes (with 95% of the sample within this range). 2/3 of the respondents parked in the first parking slot available, but no correlation was found between the time used to find a parking space and the choice to take the first slot available. To the question “how frequent is the parking activity described in the survey”, 78% of the respondents answered “not frequent” (less than once every 2 weeks) and 10% “very frequent” (every day). This question measures the number of times the respondent parked in exactly the same location declared in the survey, i.e. in the location where she has last encountered parking problems. In this sense, it is not exactly a measure of the overall frequency of parking activities. The respondent might have parked only once in the specific location described in the survey, but still have frequently experienced parking problems in nearby zones and still being able to appreciate the effect of parking policies.

Finally, as reported in Table 2, we analysed the distribution of the sample separately for those individuals who had already taken part in the survey conducted by Jensen et al. (2014) and we did not find any significant difference from the overall sample. The only difference between these two groups is the knowledge and/or the experience they have with EV. This is important later to explain why these two groups have different preferences.

Table 2: Sample characteristics

	All sample		Individuals who participated also in the previous survey	
	Total	%	Total	%
Number of individuals	2363		933	
Gender: <i>Female</i>	628	27%	248	27%
<i>Male</i>	1735	73%	685	73%
Profession: <i>Employed</i>	1847	78%	715	77%
<i>Freelance</i>	187	8%	80	9%
<i>Pensioners, early retirement</i>	211	9%	93	10%
<i>Other</i>	118	5%	45	4%
Job with fixed hours	998	42%	381	41%
Age (average)	47		48	
N. of members in the household (average)	3.12		3.08	
N. of cars available in your household (average)	1.52		1.52	
Daily km travelled (average)	54.62km		54.54km	
N. of families with: <i>One car</i>	1228	52%	481	52%
<i>More than one car</i>	1087	46%	440	47%
<i>Missed information</i>	48	2%	12	1%
Type of replacement: <i>Replace an old car</i>	1803	76%	734	79%
<i>Acquire additional one</i>	265	11%	87	9%
<i>Not considering acquiring any car</i>	295	12%	112	12%
Car class in the intended purchase: <i>Mini</i>	294	12%	106	11%
<i>Small</i>	532	23%	212	23%
<i>Medium 1</i>	613	26%	254	27%
<i>Medium 2</i>	426	18%	180	19%
<i>Large</i>	132	6%	51	5%
<i>MPV</i>	268	11%	94	10%
<i>Other</i>	98	4%	36	4%
% of influence in the decision	86%		83%	
Parking location: <i>On the street</i>	836	35%	324	35%
<i>Other (e.g. multi-storey car park)</i>	1527	65%	609	65%
Time to find a parking space (average)	10min		9.8min	
Strategy for parking choice: <i>The first one available</i>	1455	62%	582	62%
<i>The one closest to destination</i>	785	33%	307	33%
<i>Reserved</i>	19,1,8		9,1,4	
<i>Other</i>	95	4%	30	3%
N. of activities performed after parking: <i>All purposes</i>	1.52		1.42	
<i>Work related</i>	0.27		0.25	
<i>Business</i>	0.24		0.24	
<i>Shopping</i>	0.65		0.63	
<i>Leisure</i>	0.19		0.18	
<i>Other</i>	0.18		0.17	
Walking time from the parking space to the first destination (average)	5.7min		5.7min	
Duration of the parking (average)	2h35min		2h32min	
Frequency of the parking in the same zone and same time of the day: <i>Every day</i>	240	10%	80	9%
<i>Between 2 and 4 times a week</i>	193	8%	76	8%
<i>Once a week</i>	324	14%	149	16%
<i>Once every 2 weeks</i>	288	12%	107	11%
<i>Less than twice a month</i>	1318	56%	521	56%

3.1 Stated choice experiment

The SC experiment built in this study consists of binary choices between a conventional car (gasoline or diesel) and an electric vehicle⁷, including the option of choosing none of them. The experimental design includes 7 attributes: 3 attributes that measure the characteristics of the vehicles and their performance (purchase price, driving cost and operational range); 2 attributes that define the parking policies (cost of parking and the number of parking spaces reserved to EV); and 2 attributes that measure descriptive normative conformity (the number of EV recently bought in Denmark and an image of eyes).

The choice of the attributes that describe the characteristics of the vehicles and their performance was based on the extensive literature available on the subject and our own experience from previous SC surveys conducted in the Danish context. Among all the characteristics of the vehicles, purchase prices (which includes also operational price), driving cost and range are the most important attributes in the choice of EV versus ICV. These attributes were included with 3 levels, and their values were customised based on the type of car that was the most likely next car purchase, as declared in the first section of the survey. The levels of the purchase price were based on the current prices of the vehicles' standard version in each car class. The values were then set higher for the EV than for the ICV, but cases where the EV was cheaper than the conventional car were also included to reflect the realistic scenario that the price of EV is decreasing. The information regarding the fuel/electricity price was given per kilometre; but for each respondent the estimated monthly cost, based on the number of kilometres driven as declared in the first part of the survey, was also calculated and showed for each choice task. The driving range was defined as the maximum distance that could be covered with a full tank or a fully charged battery, however, differently from Jensen et al. (2014), we allowed the range of the EV to reach up to 270 km (instead of only 200 km) because, due to the recent development, this was considered a more realistic value.

To test the effect of parking policies, we included two attributes: cost of parking and number of spaces reserved for EV. These are the most typical parking policies implemented in the urban areas, and those currently implemented in Danish cities. Differently from previous SC studies, instead of a dummy variable "free parking for EV", the parking cost in our experiment has 3 levels: 30⁸, 60 and 90 DKK/hour for the ICV and free, 15 and 30 DKK/hour for the EV. The estimated monthly parking cost, based on the number of times a year the respondent declared to park in that area, was also showed below the hourly cost. The number of parking spaces reserved only for EV was set equal to 0, 20 and 100, and the description of the attribute was customized indicating that those were parking spaces available nearby the exact location where the respondents declared to have parked their car in the trip described as reference⁹. Other attributes such as time to find a parking space and distance from the parking space to the destination were considered but not included because we preferred to test attributes that could be directly controlled by specific policies. Walking and searching time also depend on the individual's strategy in searching for parking space and specific values presented in the scenarios can be considered unrealistic by the respondents.

⁷ We have considered including other types of alternative fuel vehicles other than the EV. However, we preferred to build a SC that was comparable with the other ones carried out in Denmark.

⁸ 30 DKK/hour is the highest parking cost charged in 2012 in the most central area of Copenhagen.

⁹ The exact parking location of each respondent was not known beforehand. The attributes levels for the number of parking spaces were chosen such as to be realistic wherever the respondent had parked.

Much effort was put into defining the attributes that measured social conformity. As discussed in the previous section, two attributes were included directly in the experimental design: the market share, expressed in terms of total numbers of EV sold, and an image of eyes. The market share attribute was varied according to 3 levels and several pilot surveys were carried out to define the values of the levels. The best results were obtained for the levels: 10, 100 and 500, respectively, though this attribute was never highly significant in none of the tests performed. But the sign was positive as expected, because the attribute was included in the EV alternative. The image of the eyes was included in the SC experiment as a dummy variable (present/no present). The image was also positioned on top of the columns describing the alternatives, and centrally with respect to both alternatives in order not to influence the effect on a particular alternative.

A D-optimum efficient design was generated, with 8 segments. Bayesian priors were used. For the car attributes these were initially based on previous SC studies in Denmark (Jensen et al., 2014) and then adjusted based on the results from the pilots; the coefficients of parking and social influence were initially assumed (after some tests with simulated data) and then adjusted based on the results from the pilots. Since the experiment was customised based on the car class, the final design optimised included 21 utility functions: 3 alternatives for each of the 7 car classes. 24 choice tasks for each segment were generated and randomly divided into 4 blocks, so that each interviewed was presented with 6 choice tasks. The Ngene software was used to generate the design (ChoiceMetrics, 2011).

Before the SC experiment, respondents were given information about the choice scenarios and some general information about EVs. Differently from Jensen et al. (2014) we only informed respondents that more information was available and provided a link, which they could click on, if they would read more about: (1) a map with the location of 100 battery stations in Denmark (100 is the highest level used in Jensen et al. (2014) SC experiment); (2) the characteristics and models of EV available (6 pictures of EV from a small Smart car to the luxury Tesla were provided); (3) the charging options and (4) the environmental impact (the same pictures as in Jensen et al. (2014) were used, which illustrate the EV charging options and the source of pollution of EV versus ICV). Surprisingly, very few people looked at the information provided. 16% of the respondents looked at the description of the car models, while only 2% at the other three sources of information.

Immediately after the SC experiment respondents were asked to indicate if they had considered all the attributes when answering the SC tasks and if no to tick (from a list provided) the attributes that they had not considered. 46% of the respondents declared to have considered all the attributes presented in the experiment. Only 8% did not consider price, fuel cost and/or range, while around 20% did not consider one of the other attributes, with a pick of 36% for the number of EV sold.

4. Model structure and results

4.1. Model structure

The model structure used in this paper is a typical hybrid choice model where a mixed logit model is used to model the discrete choice, while the latent variable model allows accounting

for the effect of the injunctive norm. The utility U_{qjt} that individual q associates to alternative j in the choice task t takes the following form:

$$U_{qjt} = ASC_j + \theta_j X_{qjt} + \lambda_j LV_q(A_{qj}, \omega_q) + \beta_j SE_q + X_{qjt}' (\beta_j' SE_q' + \lambda_j' LV_q(A_{qj}, \omega_q)) + \eta_{qj} + \varepsilon_{qjt} \quad (1)$$

Where X is a vector that includes all the attributes presented in the SC experiment, SE is a vector of socioeconomic characteristics and θ, β are the respective vectors of coefficients; LV is the latent variable that measures the injunctive norm and λ is its effect on the utility. The latent variable depends on a vector (A) of socioeconomic and parking characteristics and an error term ω_q distributed Normal with zero mean and standard deviation σ_ω . The model specification also allows for the marginal utility of the attributes included in the SC experiment to depend on the socio-economic characteristics and on the effect of the injunctive norm, being β and λ' the respective coefficients. Finally ASC is the alternative specific constant, η an error term distributed Normal (0, σ_w) that accounts for correlation among observations of the same individual and ε an error term identically and independently distributed extreme value type 1. The discrete choice model in equation (1) is then an error component model with systematic heterogeneity in the preferences.

The statements reported in Section 2.2.2 were used as indicators of the latent variable and are linked to it with the following measurement equations:

$$I_{qk} = \gamma_k + \zeta_k LV_q(A_{qj}) + v_{qk} \quad k = 1, \dots, K \quad (2)$$

Where I_{qk} is the k -th indicator for the latent variable, γ_k is the intercept, ζ_k is the coefficient associated to the latent variable (γ and ζ are normalised to zero and one for the first indicator, for identification purpose), and v_{qk} is an error term distributed Normal with zero mean and standard deviation σ_v .

The conditional probability to choose the sequence of choices j_t , is then given by the product over the SC choice tasks of multinomial logit probabilities conditional on the realisation of the LV: $P_{qj}(LV_q(\omega_q)) = \prod_{t=1, \dots, T} P_{qjt}(LV_q(\omega_q))$; while the distributions of the latent variable and the indicators are respectively:

$$f_{LV}(LV_q) = \frac{1}{\sigma_\omega} \phi\left(\frac{LV_q - \alpha A_q}{\sigma_\omega}\right) \quad ; \quad f_I(I_{qk}) = \frac{1}{\sigma_{v_k}} \phi\left(\frac{I_{qk} - \gamma_k - \zeta_k LV_q}{\sigma_{v_k}}\right) \quad (3)$$

The unconditional choice probabilities are given by:

$$P_{qj} = \int_{\omega} P_{qj}(LV_q(\omega_q)) f_{LV}(\omega_q) f_I(LV_q(\omega_q)) f(\omega) d\omega \quad (4)$$

Models are estimated by maximum likelihood estimation, using PythonBiogeme (Bierlaire and Fetharison, 2009).

4.2 Model results

Before estimating the models, the data were carefully analysed to check for completeness and consistency. 48 individuals were eliminated because they declared that the family did not own a

car and 28 because they parked in reserved parking spaces. Since each individual answered 6 choice tasks, this leads to 13,727 observations. 34 observations were then eliminated because of inconsistency, so a final dataset of 13,693 observations was used to estimate the models. The first two columns of Table 3 report the results of the best hybrid choice model estimated.

Characteristics of the vehicles

Firstly we note that the driving range and all the attributes related to monetary costs are statistically highly significant at 1%. In line with Jensen et al. (2014) we found that the marginal utility of one extra kilometre is clearly much higher for EV than for the ICV, which indicates that the marginal utility decreases as the range increases, because the EV range is lower than the ICV range. Several non-linear specifications were tested, but the linear utility with coefficients specific for EV and ICV was the best. In particular we found that the marginal utility of one extra kilometre for the EV is almost 20 times higher than for the ICV. This corresponds to the ratio found in Jensen et al. (2014) before individuals get direct experience with an EV (after the experience the ratio was 40 times higher). It is worth noting that the majority of our sample had not tried an EV and we did not find any difference between new respondents and those who had already participated in the survey in Jensen et al. (2014).

As in Jensen et al. (2014) we found that the marginal utility of the purchase price depends on the car classes and on the type of propulsion. In particular, it is higher (more negative) for small than large car classes and it is higher for EV than for ICV. For example a unit change in the purchase price of a small or mini car is valued on average 1.8 times higher than a unit change in that of a car of size medium 1 (exactly 1.5 times higher for EV and twice as much for ICV). It is worth noting that the effect of the car classes in the marginal utility of the purchase price is not capturing income effect but only a specific effect of type of car. We found instead possible income effect in the fuel/electricity cost where, according to Jara-Díaz and Videla (1989), we found a highly significant and positive fuel/electricity cost squared coefficient, clearly indicating that the marginal disutility for fuel/electricity cost decreases as the fuel/electricity cost increases. The microeconomic conditions are satisfied for values of fuel/electricity costs less than 0.98 DKK/km (0.13 Euro/km), i.e. for 96% of our sample. A specification was also tested with the annual fuel/electricity cost (i.e. where the fuel/electricity cost per kilometre was multiplied by the number of kilometre driven per year). Coefficients were significant but the overall model was not superior to the model estimated with the fuel/electricity cost per kilometre.

Parking policies

The attributes that measure parking policies were also highly significant. In particular the preference for parking cost is statistically highly significant (at 1%) clearly indicating that parking policies can be effective in boosting the demand for EV. This result is different from previous studies that found a positive effect of the “free parking” option for EV, but relatively unimportant or not significant (Potoglou and Kanaroglou, 2007; Hoen and Koetse, 2012). Several specifications were estimated to test whether the preference for parking cost depended on the characteristics of the parking (duration, frequency, location etc.), of the individuals (age, gender etc.), and on the parking cost (income effect). We also tested for non-linear effect between “free parking” and no-zero parking costs. None of these effects was significant. Some of these results are unexpected and might seem counterintuitive. For example, it is typically expected that the frequency of parking use is influential on the preference of people

about parking price. However, as described in Section 3, the frequency recorded in the survey measures only the number of times the respondents parked in exactly the same location declared in the survey. Moreover, respondents were asked to think about the last time they experienced parking problems, and “retrospective assessments are insensitive to duration and weight two singular moments: the pick and the end” (Kahneman, 2011, page 380).

We found instead an interesting interaction with the image of the pair of eyes. When respondents are reminded that they are watched the preference for parking cost for the ICV option reduces significantly and the effect is much more marked for the respondents who had participated in the EV survey in Jensen et al. (2014); we called them “old respondents”. In particular, among old respondents, the preference for parking cost drops from -1.42 to -0.10 (more than 14 times lower) due to the effect of social-signalling, while among the new respondents, it drops from -1.42 to -0.88. The effect of being watched prods respondents into giving much more relevance to EV than ICV. This suggests that markedly increasing the gap in the parking costs (much lower for EV than for ICV) can be an effective policy in increasing the EV demand.

The other attribute related to parking policy is the number of parking spaces reserved only for EV, whose effect is positive, as expected, and statistically significant at 1%. This attribute was also tested in interaction with socio-economic and parking characteristics. We did not find any significant systematic heterogeneity in the preference for parking spaces reserved for EV. Women’s preference for reserved parking spaces is 30% higher than that of men, but this difference is not statistically different (t-test for generic coefficients equals 0.73). On the other hand, the type of activity performed after parking seems to be important. In particular, the preference for reserved parking spaces almost double if the individual has to realise business related activities, and the preference increases with the number of activities performed. We also tested the interaction between the time to search for parking space (for the current trip described in the survey) and the number of parking slots reserved for EV. This interaction was positive indicating that the longer the time spent searching for a parking space the higher the preference for slots reserved for EV, but it was not significant; it was then not included in the final specification.

Measures of conformity

As discussed previously, social-signalling has a strong impact on the preference for parking cost for the ICV option reducing significantly its effect. It is also interesting to note that the effect of eyes is highly significant and negative when simply added to the ICV utilities. Since the ICV is the type of propulsion currently owned by the respondents, this effect reveals that being watched triggers a propensity to change reducing the inertia to stick with the current type of vehicle.

Regarding the effect of the information provided, firstly it is interesting to note that its effect is significant at 5% when the experience reported is negative. This is due to the so-called *negativity bias* effect, which refers to the notion that “negative information tends to influence evaluation more strongly than comparably extreme positive information” (Ito et al., 1998). People tend to be affected more by unpleasant events than happy ones because “negative emotions generally involve more thinking, and the information is then processed more thoroughly than positive ones” (Nass, 2010). Interestingly, we found that the information about negative experience with driving range was not highly significant. On the other hand,

we found that what people care more about is the fact that with an EV they have to change activity schedule. This result is interesting because it reveals that it is not the range in itself that is relevant (i.e. how far I can drive) but the reduced flexibility in the activity plan and, probably more important, the fact that this also requires a change in the habitual activity schedule. This interpretation is in line with the negative effect of the “additional detour time due to limited charging/refuelling locations” that was found in Train (2008) and Hoen and Koetse (2012). Interestingly, in our sample, we found that this effect is particularly relevant especially among old respondents. It seems then that the more respondents get to know EVs the more they are concerned about the ability to maintain their present mobility. This is in line with what found in Jensen et al. (2014) that, after the 3 months trial with an EV, respondents expressed significantly more concern about being able to maintain their current mobility.

Our results also clearly show that a negative experience with more than one aspect (in our study with all the three pieces of information provided) clearly has a strong negative and significant impact on the choice of EV. Women are much more negatively affected by negative information received by people they trust than men, indicating that women are more likely to conform to norms when they receive accurate information about reality. In the literature the role of gender in the adoption of norms is not unanimous. There is a general idea that women are more persuadable than men, but Eagly and Carli (1981), using a meta-analysis across dozens of studies with thousands of participants, found very little difference between men and women. They argued that, instead, gender differences can be indirectly explained by status inequality: men are more likely than women to have high-status (leading) roles (Eagly, 1983), or a bias in the experimental materials used, which are more familiar to those of their own sex (and researchers were more often men).

The number of EV sold was highly significant only for the new respondents and for those who have declared that they have considered this attribute. As mentioned in Section 3.1 we asked respondents if they have considered each and one of the attributes presented and for each attribute we tested if this information has an effect on the preference for that attribute. We found a significant effect only for the number of EV sold, which was also by far the attribute least considered. It is also interesting to note that the effect is much more marked for the new respondents (for the old respondents it was positive but insignificant), though the percentage of respondents who did not consider this attribute is slightly lower (35%) among the new respondents than among the old ones (37%). This can be explained by the fact that the respondents who had already taken part in the previous survey are probably more familiar with EV and hence less affected by descriptive norms.

Finally, as expected the injunctive norm is positive and significant only in the EV alternative, indicating that if those who are important for the respondent believe it is correct to use an EV, the respondent shows a higher preference for EV versus ICV. Employees with fixed work hours are negatively affected by injunctive norms about EV, probably because they are not flexible or more habitual in their trips, and hence less influenced by others. It also makes sense that the less the respondents have a say in the choice of the type of car and the more cars are available at home, the less prone these individuals are to adopt injunctive norms. In line with the result about fixed work time, we also found that if respondents parked their car in Copenhagen in order to realise business or work related activities they tend to conform more to socially accepted behaviours. Finally we note that our results also indicate that women seem to conform to norms driven by the desire to get the right information more than by the desire to behave right. The effect of female in the injunctive norm is in fact negative

and highly significant (at 1%). This effect can be related to the topic, i.e. when it comes to the choice of a car men are typically much more interested than women and probably also more informed.

As a way to test to which extent the model is sensitive to the sample gathered, we used a resampling technique, where 50 random subsamples of approximately 2/3 of the original sample were randomly generated and hybrid choice models estimated with each subsample. The last two columns in Table 3 report the mean and standard deviation of the coefficients estimated across the 50 repetitions. As can be seen, the resampling mean is very close to the mean values estimated with the full sample and has a very small standard deviation (i.e. for each coefficient the distribution of the estimates across the 50 subsamples is very close to the mean value). For each subsample we also computed the t-test to compare each coefficient estimated with the full dataset with the values estimated in each subsample. The hypothesis that the coefficient estimated with the subsample was equal to the coefficient estimated with the full set was never rejected at less than 20%, with the only exception of the latent injunctive norms where the test was rejected at 5% in 2 out of 50 repetitions. This result refers to the injunctive norms included in the EV alternative, because it is the only one highly significant, and indicates that the estimation of the latent variable is indeed less precise than the other variables in the model.

Table 3 Model estimation results

	Value	Robust t-test	Resampling mean	st.dev.
DISCRETE CHOICE MODEL				
ASC (EV)	-2.920	-7.22	-2.559	0.515
ASC (ICV)	-10.100	-16.23	-9.946	0.883
SIGMA (EV)	3.070	24.89	3.010	0.075
SIGMA (ICV)	4.770	26.81	4.715	0.178
RHO (ICV)	3.250	14.80	3.212	0.200
Characteristics of the vehicles				
Purchase price [100,000DKK]	-4.430	-17.09	-4.320	0.124
» * Car class Medium 1 (EV)	1.520	8.07	1.490	0.094
» * Car class Medium 1 (ICV)	2.310	11.09	2.200	0.122
» * Car class Medium 2 & MPV (EV)	2.250	11.19	2.195	0.097
» * Car class Medium 2 & MPV (ICV)	2.940	13.70	2.840	0.122
» * Car class large & Others (EV)	2.810	12.73	2.725	0.101
» * Car class large & Others (ICV)	3.400	14.56	3.271	0.120
Fuel costs [DKK/km]	-7.460	-10.32	-7.314	0.435
Fuel costs squared [DKK/km]	3.820	6.04	3.717	0.366
Driving range (EV) [100km]	1.510	10.87	1.480	0.090
Driving range (ICV) [100km]	0.076	6.13	0.075	0.009
Parking Policies and measures of conformity				
Parking cost [100DKK/hour]	-1.420	-11.30	-1.392	0.092
» * Eyes watching / old respondents (ICV)	1.320	4.20	1.294	0.229
» * Eyes watching / new respondents (ICV)	0.542	4.03	0.549	0.064
Eyes watching / old respondents (ICV)	-0.612	-2.82	-0.610	0.154
# of parking spaces reserved for EV (EV) [×100]	0.346	4.42	0.351	0.039
» * # work related activities after parking	0.202	2.04	0.213	0.048
# of EV sold * attendance / new respondents (EV) [×100]	0.067	2.92	0.064	0.014
Negative info on the need to change activities / old resp. (EV)	-0.339	-1.99	-0.327	0.104
Negative info on range, parking options and activities (EV)	-0.437	-2.02	-0.440	0.135
» * Female	-0.807	-1.70	-0.758	0.231
Latent Injunctive norm (EV)	0.410	2.25	0.321	0.245
Latent Injunctive norm (ICV)	-0.170	-0.94	-0.106	0.282
LATENT MODEL				
Coefficient Latent Injunctive norm in indicator N2	1.010	47.04	1.012	0.011
Coefficient Latent Injunctive norm in indicator N3	0.808	36.98	0.808	0.014
Constant in indicator N2	0.125	1.91	0.130	0.032
Constant in indicator N2	1.270	16.29	1.270	0.050
Standard Deviation Indicator N1	-0.305	-7.08	-0.306	0.022
Standard Deviation Indicator N2	-0.357	-7.45	-0.354	0.027
Standard Deviation Indicator N3	0.084	3.97	0.083	0.013
Structural equation Latent Injunctive norm				
Constant	3.580	21.87	3.435	0.159
Age between 30 and 45	0.491	2.93	0.479	0.125
# work related activities after parking in Copenhagen	0.258	2.60	0.246	0.112
# business activities after parking in Copenhagen	0.251	1.84	0.255	0.056
Fixed work hours	-0.186	-2.96	-0.179	0.038
Female	-0.223	-3.01	-0.233	0.023
% of influence in the choice of the type of car	-0.322	-2.04	-0.304	0.095
Number of car in family	-0.079	-1.59	-0.090	0.032
Standard deviation	0.320	17.99	0.317	0.009
Overall statistics				
Number of draws		500		
Number of observations		13693		
Log-likelihood at the maximum		-20399		
RHO2 adjusted		0.284		

4.3 Policy implication

Results from the model estimation showed that social conformity significantly affects individual preferences for EV versus ICV. However, in terms of policy implication, it is important to understand the impact of these measures compared to the typical characteristics of the vehicles (price, range etc.). According to a meta-analysis of 185 studies the Theory of planned behaviour accounts for 27% and 39% of the variance in behaviour and intention, respectively (Armitage and Conner, 2001). However, this result does not refer to EV and does not specifically compare the psychological effects with the microeconomic effects, which also requires that specific scenarios are defined.

With the aim to understand to which extent social conformity can affect the preferences between EV and ICV, compared to the characteristics of the vehicles, for the observations in our sample we computed the difference between the EV and ICV utility (Overall Utility) and the specific contribution of the attributes that measure social conformity, the characteristics of the vehicles and the interaction between parking cost and social signalling. The specific contribution of the attributes is reported separately depending on whether the difference EV-ICV is positive or negative. Differences are computed for the 6 different scenarios described in Table 4. These refer to small cars. The scenarios are all plausible and realistic, as they have been defined based on the levels used in the SP experiment. Since the utility of EV and ICV depends on individual's characteristics, the information on the socio-economic characteristics in Table 4 indicates whether the scenario affects or not a specific socio-economic group. Results are reported in Figure 4. The overall utility is computed without considering the random part of the latent injunctive norm, while the probabilities reported in the last 3 rows in Table 4 are computed integrating the conditional probabilities over the latent variable and using sample enumeration. The panel effect is also not included in prediction. Results in Figure 4 show that the impact of social conformity on the overall preference for EV with respect to ICV can be high and also compensate the negative impact of a much higher purchase price (5000 Euros higher, which is approximately 1/3 of the price of a small car) or much lower driving range.

Table 4 Description of the scenarios used to compute the utility difference between EV and ICV in Figure 4 (small cars)

Characteristics of the vehicles	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Purchase Price [€]	6040	6040	6040	6711	5369	5369
Fuel/Electricity [<i>cent/km</i>]	-1.21	-1.21	-1.21	-2.68	-3.62	-3.62
Driving range ¹⁰ [<i>km</i>]	-571	-571	-571	-293	-381	-381
Parking Policies						
Parking cost [€/hour]	-2.01	-2.01	-2.01	-10.07	-4.03	-4.03
Number of parking spaces reserved for EVs	20	20	20	100	100	100
Measures of conformity						
Number of EVs sold	500	500	500	10	500	500
Negative info only on the need to change activities	no	no	yes	no	no	no
Negative info on range, parking options and activities	yes	yes	no	no	no	no
Effect of being watched	yes	yes	yes	yes	no	no
Individual's characteristics						
Work related activities after parking	no	yes	no	no	no	no
Business activities after parking	no	no	no	no	no	no
Parking in Copenhagen	no	no	no	no	no	no
Female	no	yes	yes	yes	yes	yes
New Respondent	no	no	no	yes	yes	no
Probabilities						
Probability of choosing EV	19.8%	35.0%	48.5%	74.9%	66.2%	69.7%
Probability of choosing ICV	78.4%	63.5%	50.3%	16.1%	22.3%	19.2%
Probability of choosing none of them	1.8%	1.5%	1.2%	9.0%	11.5%	11.0%

¹⁰ In computing the D values, i.e. the difference between the range EV and the range ICV, the ICV range was assumed equal to 700 km.

Table 5 Contribution of each effect to the utility difference between EV and ICV (small/mini cars)

Characteristics of the vehicles	Δ values	Δ utility	Δ values	Δ utility	Δ values	Δ utility
Purchase Price [€]	1.500	-0.50	5.000	-1.65	10.000	-3.30
Fuel/Electricity [€cent/km]	-0.80	+0.50	-2.47	+1.65	-4.64	+3.30
Driving range ¹¹ [km]	-68	-0.50	-144	-1.65	-254	-3.30
Parking Policies						
Parking cost [€/hour]						
Without the effect of being watched	-4.70	+0.50	-15.60	+1.65	-31.20	+3.30
With the effect of being watched / old respondents ¹²	-41.00	+0.50				
With the effect of being watched / new respondents	-6.40	+0.50	-24.0	+1.65		-
Number of parking spaces reserved for EVs						
To perform activities non-work related after parking	91	+0.50	512	+1.65		
To perform 1 work related activity after parking	80	+0.50	323	+1.65		
Number of EVs sold * attendance / new respondents	755	+0.50	2470	+1.65	4940	+3.30
Measures of conformity						Δ utility
Effect of being watched / old respondents						+0.61
Negative info on the need to change activities /old respondents						-0.34
Negative info on range, parking options and activities						
For Male						-0.78
For Female						-1.58
Latent Injunctive norm (EV)						
for <u>fixed</u> work hours, 100% influence in the choice, 1 car a family ^(*) , female, not parking in CPH or not for business or work related activities						+0.66
for <u>flexible</u> work hours, 100% influence in the choice, 1 car a family ^(*) , female, not parking in CPH or not for business or work related act.						
for flexible work hours, 0% influence in the choice, 0 car a family, male, <u>parking in CPH for business or work related activities</u>						+0.98
for flexible work hours, 0% influence in the choice, 0 car a family, male, <u>not parking in CPH or not for business or work related activities</u>						

(*) The coefficient of the number of cars a family is not highly significant (only 10%), this specific effect is then subject to a certain degree of variation.

¹¹ In computing the Δ values, i.e. the difference between the range EV and the range ICV, the ICV range was assumed equal to 700 km.

¹² For policy analysis, in order to identify “old respondents” in the population, a specific information needs to be asked about whether individuals have ever participated in a trial or survey related to EVs.

To make it easier to compare the relative impact of these effects, we fixed 3 levels of differences in the systematic utilities (± 0.50 , ± 1.65 , ± 3.30) and we computed the difference in the attributes between EV and ICV that gives that level of utility. So, for example, if the difference in the purchase price between EV and ICV is $\Delta \text{ values} = 1500\text{€}$, this contributes to the difference in the utility between EV and ICV ($\Delta \text{ utility}$) by -0.50 . The 3 levels of differences in utility were arbitrarily set, but they were also chosen ad hoc in order to cover realistic ranges of differences in the purchase price. Table 5 reports the contribution of each attribute to the difference in the utility between EV and ICV. All values refer to the characteristics of a small car.

As can be seen in Table 5, the effect of 91 parking slots reserved to EV compensates (in terms of utility) the effect of a purchase price for EV of 1.500 Euros higher than an equivalent ICV. To compensate a difference in the purchase price of 5000 Euros, 323 parking slots would instead be needed (which can be not realistic in some situation) or a parking cost per hour for ICV 15.60 Euros higher than for EV (which is definitely quite high). A more feasible policy (not reported in Table 5) that would compensate a difference in purchase price of 5000 Euros, is a combination of interventions such as 91 slots reserved and a parking price per hour for ICV 4.70 Euros higher than for EV. The effect of negative information on women can be equivalent to the effect of a difference in purchase price of around 4500 €, but it is important to note that less than 30% of the sample are women, which indicates that this policy, though very effective will target only a small proportion of the population. Parking policies seem to be quite effective, both as direct (i.e. parking costs) and indirect measure (i.e. through normative conformity), but a combination of parking policies is needed because each measure alone does not have a sufficient impact to compensate the difference in range or purchase price. For example if an ICV has a range of 700km and an EV has a range of 556 km, to compensate this difference of 144 km, the parking cost has to be extremely high: 15.60 €/h higher for ICV than for EV, which is probably unrealistic.

5. Conclusions

This paper presented a stated choice experiment designed to measure the effect of informational and normative conformity in the choice of electric vehicles versus conventional cars. This work extended previous studies in the field in several ways: (1) it measured informational conformity based on the experience of other users regarding specific features of the alternative; (2) it used a more realistic design where individuals are asked to answer the same stated choice experiment before and after they received the information; (3) it tested the effect of social-signalling other than social adoption and (4) it accounted also for the effect of injunctive norms. The study is applied to the choice between EV and ICV and (5) it also tested the effect of parking price and parking spaces reserved for EV, shedding some light on the effect of parking policies on boosting the EV market: an important topic that has received less attention in the literature compared to the car characteristics and recharging infrastructures.

Results show that all the social conformity effects tested are highly significant and can contribute to boost the demand for EV and to explain the difference between the current demand for EV and what would be expected based only on the characteristics of the EV. Although it is difficult to measure the exact extent of the impact of social conformity in the overall utility, our experiment show that the effect can be high enough to compensate also

significant differences in purchase price (for example 1/3 higher for EV than ICV) or the so called “range anxiety” effect, i.e. a quite low driving range for EV (e.g. around 130 km).

Among the social conformity effects, the effect of adoption is almost the only conformity measure tested in the literature. Interestingly in our study this is the least relevant conformity measure, not only in terms of relative contribution to the utility but also because of the small proportion of respondents who considered it. This result can be due to the specific way we measured social adoption in our experiment. As we discussed in the paper, a better measure would have been to manipulate the descriptive norm specifying the reference group who perform a given action or the person who gives you the information. However, we note that Rasouli and Timmermans (2013) found small effects of social influence, though they used a different (and more disaggregate) definition of the social adoption and also distinguished it by four reference groups. Nevertheless, social adoption plays an important role and its contribution to utility increases as the EV market grows, which is particularly relevant for the diffusion process, such as that discussed for example in Jensen et al. (2016).

Informational conformity seems to have quite high an impact on the EV utility but interestingly only when the experience reported is negative. This is an interesting result that indicates that information about poor performance constitutes a strong obstacle to the growth of the EV market. This is probably what happened all these years where the EV models available on the market were not good enough and generated negative information that slowed down the market. While it is of course important to provide correct information (even if they are not positive) it is on the other hand important to avoid misinformation and correctly inform users about all the positive (or no-negative) experiences with EV. This is important also because the effect of informational conformity increases significantly with the number of aspects for which individuals got negative experiences. Studies on informational conformity are particularly relevant for the driving range, that is perhaps the EV feature with the worst “reputation”. Our results show that it is not the range in itself that is relevant (i.e. how far I can drive) but the reduced flexibility in the activity plan and, probably more important, the fact that this also requires a change in the habitual activity schedule. An effective policy would be then to show individuals that their plans would not change or support them in adapting their plans to the EV, or enlarging trial tests with EV of new generation that have better range performances. One direction where the current study can be extended can be to build up an experiment (using state choices and/or real trials) to test the effectiveness of these policies.

Our results also show that injunctive norms can play an important role in boosting the demand for EV. In line with the previous discussion about informational conformity and habitual activity plans, also the effect of injunctive norms suggests that habitual individuals are less influenced by others and more prone to stick with the current choice of their conventional car. There seems to be then a link between habitual behaviour and (lack of) adoption of EV that has been neglected so far in the studies on EV. The effect of habitual behaviours in the demand for EV is an important area for research.

Social-signalling is another effect that can be used as social policy to induce individuals to adopt more sustainable transport modes. In this study we tested the effect of social-signalling triggered by a pair of eyes, but other more precise methods can be used, such as for example using images to represent the concept of the group each person feels or wishes to belong to. This is another interesting area where further research is needed. Responses in SC experiments are affected by the frame of the questionnaire, more research is also needed to

ascertain if the effect of the eyes is revealing social-signalling or it is just a frame effect. It seems also that a pair of eyes can be used as a way to make the stated choice experiment more realistic, reducing the inertia to stick with the current type of vehicle, which is a typical effect present in the stated choice experiment. Since in our application the current type of vehicle is the typical gasoline/diesel cars, reducing inertia to stick with the current ICV in favour of sustainable modes is then a key policy.

Finally, our experiment also shows that parking policies (both parking price and slots reserved for EV) can be effective in boosting the demand for EV, but a combination of parking policies is needed because each measure alone does not have a sufficient impact to compensate major difference in range or purchase price. Analogously a combination of social policies is also needed to significantly shape individuals' preferences. However, "for information campaigns to be successful, their creators must recognise the distinct power of descriptive and injunctive norms and must focus the target audience only on the type of norm that is consistent with the goal" (Cialdini et al., 2006, page 4). The way in which one communicates the descriptive or injunctive information can also influence recipients' responses to the message and produce opposite results than intended.

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