# Socio-demographic characteristics, psychological factors and knowledge related to electric car use: A comparison between electric and conventional car drivers

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**Abstract**

Increasing number of drivers are using electric cars either as their main or additional car. It is important to make a distinction between sole electric car drivers and drivers of both an electric and a conventional car to understand whether determinants of electric car use differ across these sub-groups. The main aim of the present study was to make comparisons among owners of sole electric car, both electric and conventional cars, and sole conventional car for demographic characteristics, travel mode use, psychological factors and knowledge related to electric car use in a Norwegian sample of car drivers. In addition, factors that predict type of car/s (electric, conventional or both electric and conventional) owned by the drivers were investigated. An online survey, with a response rate of 11%, was used to collect data from 663 Norwegian car drivers including both electric and conventional car drivers. The MANCOVA results showed that the most substantial differences in the measured constructs were between the sole electric car owners and the sole conventional car owners, whereas there were fewer differences between those who only own an electric car and those who own both an electric and a conventional car. Compared to the conventional car owners, electric car owners were younger and had a higher education and income level, and they reported more car use and higher level of knowledge about electric cars. In addition, electric car owners agreed with the positive attributes of electric cars more and reported higher level of personal norm, ascription of responsibility and awareness of consequences related to effects of car use to the environment. Finally, multinomial logistic regression results showed that attributes of electric cars were the strongest group of variables that increased probability of electric car ownership.

Key words: electric car drivers; conventional car drivers; socio-demographic characteristics; attributes; the VBN theory; knowledge; Norway

## 1. Introduction

In many countries, an increasing number of people prefer to use a battery electric car due to its economic and environmental benefits, such as lower operational costs and reduced $CO_2$ emissions. Norway has the highest electric car market share in the world with 69.100 registered battery electric vehicles at the end of 2015 (Statistisk sentralbyrå, 2016). Big governmental incentives, such as exemption of electric cars from purchase and road taxes and parking fees, have an important role for the rapid increase in electric car use in Norway (Bjerkan et al., 2016). It should be noted that, many Norwegians buy an electric car in addition to their conventional car instead of replacing their conventional car with an electric car (Hjorthol, 2013; Klöckner et al., 2013; Nayum et al., 2016). Therefore, there is a need for making a distinction between these two sub-groups of electric car drivers, such as sole electric car drivers and drivers of both an electric and a conventional car, when examining factors related to electric car use. Previous studies comparing electric car drivers with conventional car drivers in Norway (e.g. Klöckner et al., 2013; Nayum et al., 2016) showed that these two groups of drivers show some differences in terms of their socio-psychological profile related to car use. It is also likely that sole electric car drivers and drivers of both an electric and a conventional car show differences in terms of their socio-demographic characteristics, and reasons for electric car use. Therefore, the focus of the present study is to differentiate electric car drivers (sole electric car drivers and drivers of both an electric and a conventional car) and compare them with conventional car drivers to see whether they differ in terms of socio-demographic profile, travel mode use and psychological factors related to electric car use, such as attitudes and norms.

Previous research has found socio-demographic characteristics, and attitudinal and normative factors as related to electric car use. In terms of demographic characteristics male gender, being middle-aged (30-50 years), being married or cohabitating, having a higher education and high income level have been found to be positively associated with electric car use (Hjorthol, 2013; Nayum et al., 2016; Plötz et al., 2014). In addition, most of the electric car drivers have a larger household size with more children and they tend to buy an electric car as an addition to their household's car fleet (e.g. Hjorthol, 2013; Klöckner et al., 2013; Nayum et al., 2016).

Attitudes towards both environmental (e.g. reduced $CO_2$ emissions) and non-environmental aspects of electric cars (e.g. technical features) are important for adoption of electric cars (Graham-Rowe et al., 2012; Hjorthol, 2013; Nayum & Klöckner, 2014; Schuitema et al., 2013; Tiel et al., 2012). Being environmentally friendly and lower operational costs are among the two most frequently reported positive aspects of electric cars, while limited driving range and charging infrastructure are among the most frequently reported negative aspects (Graham-Rowe et al., 2012; Hjorthol, 2013; Tiel et al., 2012). There are instrumental (i.e. related with functionality and utility), symbolic (i.e. related with social and self-identity reflected by driving an electric car) and hedonic attributes (i.e. related with the emotional experience derived from using an electric car) that influence adoption of electric cars (Dittmar, 1992; Voss et al., 2003). Studies focusing on the perceived attributes of electric car use showed that especially perceived instrumental (e.g. performance, purchase price) and symbolic attributes (e.g. status enhancement, differentiating from others) have an important role in adoption of electric cars (Nayum & Klöckner, 2014; Noppers et al., 2015; Schuitema et al., 2013).

The value-belief-norm theory (VBN) (Stern, 1999; Stern, 2000) provides a useful theoretical framework for examining the role of normative factors and environmental beliefs

for choosing pro-environmental behaviors. According to the VBN theory, the ultimate-predictor of behavior is personal norm (i.e. a person's sense of environmental obligation), which is considered as a function of three core beliefs: (1) one's ecological worldview determined by values, which leads to (2) awareness of consequences of a behavior (AC), which leads to 3) ascription of responsibility for taking action (AR). Previous studies showed that the VBN theory was successful in explaining sustainable transport mode choices, such as public transportation use and reduced car use, and they supported the causal order of the variables in the theory (Lind et al., 2015; Norlund & Gravill, 2003; Steg et al., 2005). In addition, some recent studies have shown that the VBN theory provides a relevant theoretical framework for explaining use of pro-environmental cars, such as electric cars (Klöckner et al., 2013; Nayum & Klöckner, 2014; Norlund and Gravill, 2003) and alternative fuel vehicles (Jansson et al., 2011).

In addition to attitudinal and normative factors, level of knowledge and familiarity with electric cars are also important for adoption of electric cars. Level of familiarity with electric cars was found to be relatively low especially among older European car drivers in a previous study (Tiel et al., 2012). Although there are a few previous studies measuring level of knowledge and familiarity related to electric cars (Graham-Rowe et al., 2012; Tiel et al. 2012), there is little known about the role of knowledge about electric cars in predicting electric car ownership (Hjorthol, 2013).

### 1.2 Aims of the study

The main aim of the present study is to compare three groups of car owners (sole electric, sole conventional, both electric and conventional) for socio-demographic characteristics, travel mode use, attitudinal and normative factors, and knowledge about electric cars in a Norwegian sample. An additional aim is to investigate role of demographic factors, psychological factors (e.g. environmental beliefs, evaluation of attributes of electric cars) and

level of knowledge for predicting the type of car/s owned by the drivers. By comparing sole electric, sole conventional and both electric and conventional car drivers the present study is expected to contribute to a better understanding of similarities and differences in socio-demographic and psychological profile of these three different driver groups.

The largest differences in the measured constructs are expected between the sole electric and conventional car owners since they own two different types of cars. On the other hand, drivers who both own an electric and a conventional car are expected to show similarities with both electric and conventional car drivers. However, it is more likely that they will have a more similar profile with the electric car drivers than the conventional car drivers since owning an electric car is a more distinctive feature reflecting drivers' attitudes, norms and preferences related to car use.

## 2. Material and methods

### 2.1 Sampling and procedure

A web-survey, which was developed using a survey platform internally used at the Norwegian University of Science and Technology, was used to collect data from the electric and conventional car owners in Norway. Data was collected during the period between May and September, 2016. An invitation letter for the survey was sent out 6000 randomly selected addresses (3000 electric car owners, 3000 conventional car owners) of car owners who lived in different parts of Norway. The Norwegian Public Roads Administration database was used to obtain the addresses of the car owners. Out of the 3000 electric car owners 457 of them responded (response rate 15.2%), and out of 3000 conventional car owners 205 of them responded (response rate 6.8%). General response rate to the survey was 11%.

The sample included three groups: 231 (34.9%) drivers who solely owned an electric car, 205 (31.1%) drivers who solely owned a conventional car and 226 (34.1%) drivers who

owned both an electric and a conventional car. One hundred sixty-six respondents (25.5%) were female and 485 were male (75.5%), and their age ranged from 19 to 80 years old (*M*=50.9, *SD*=12.3). The majority of the respondents (76.3%) had a high education (university education until 3 years or more), while 22.2 % had completed a secondary education and 1.5% only had completed a basic education.

2.2 Measures

An online questionnaire was used to collect the data. The first section included items about type of owned car (electric, conventional or both), total km driven with the car, and use frequency of different travel modes (train, metro, tram, bus, personal car, bicycle, walking) in a typical week. In the second section, a newly developed scale was used to measure knowledge about electric cars. There were 11 items including true (e.g. Electric cars do not emit exhaust gas) or false statements (e.g. Electric cars can only be charged at special charging stations) about the electric cars. The participants responded to the items using three response options (1=correct, 2=wrong, 3=I do not know). The number of correct answers was calculated based on the responses to the knowledge scale.

In the third section, attributes related to different aspects of electric cars (e.g. environmental, economic, technical, safety) were measured by 25 items, which were developed based on previous studies measuring different attributes of electric cars (e.g. Graham-Rowe et al., 2012; Schuitema et al., 2013). The items reflected both positive (e.g. "Electric car is a more environmental friendly transport mode than conventional car") and negative attributes (e.g. It is not/would not be practical to drive an electric car due to few charging stations) related to electric cars. Symbolic attributes related to electric car use were measured separately by 5 items (e.g. "Driving an electric car gives me status"), which were adapted from a previous study measuring symbolic attributes of car use (Noppers et al., 2014). The respondents rated the attribute items using a 5-point Likert type scale (1=Completely

disagree, 5=Completely agree), and negative items were reversed to make higher scores indicate more positive evaluations about electric cars.

The VBN theory components were measured in the next section of the questionnaire. The value orientation scale (De Groot and Steg, 2007, 2008; Steg et al., 2014) included four items measuring altruistic values (e.g. helpfulness), four items measuring biospheric values (e.g. care for the environment), three items measuring hedonic values (e.g. comfort) and five items measuring egoistic values (e.g. social power). The respondents were asked to rate the importance of each value item on a 9-point scale ranging from "extremely important" (7) to "opposed to my principles" (-1). The New environmental paradigm (NEP) scale (Dunlap, 2008; Dunlap et al., 2000) included 13 items measuring general environmental beliefs (e.g. The balance of nature is very vulnerable and easy to disturb). Items for measuring awareness of consequences (AC), ascription of responsibility (AR) and personal norm (PN) were adapted from a previous Norwegian study applying the VBN theory to sustainable travel mode choice (Lind et al., 2015). Awareness of consequences (AC) was measured by 4 items (e.g. We run out of limited natural sources, such as oil, by using conventional cars); ascription of responsibility (AR) was measured by 9 items (e.g. It is not my responsibility to protect the environment); and personal norm (PN) was measured by 2 items (e.g. I would feel myself a better person if I choose to use an electric car instead of a conventional car). Both NEP scale and AC, AR and PN items were rated using a 5-point Likert type scale (1=Completely agree, 5=Completely disagree). Negative items were reversed so higher scores indicated more positive environmental beliefs and norms related to electric car use. Finally, the questionnaire included items regarding demographic characteristics of the respondents, such as age, gender and income.

2.3 Statistical analysis

First, one-way ANOVA and chi-square tests were conducted to examine differences in demographic characteristics between the three driver groups. In the second step, a principal component analysis (PCA) using iteration and Varimax rotation was conducted to identify the dimensional structure of the scale measuring attributes related to electric car use. Kaiser's ''eigenvalue >1" criterion was used to decide the number of dimensions. Cronbach's alpha coefficients were calculated to examine the reliability of the scales and the scale dimensions. In order to examine differences between the groups across the measured constructs a Multivariate Analysis of Covariance (MANCOVA) was conducted entering the type of car owned (electric, conventional, both) as the fixed factor and composite scores of the VBN theory components, attributes related to electric car use and knowledge as dependent variables. Gender, age, income, working/under education status and annual km driven were included as covariates. Bonferroni post hoc corrections were conducted to examine the specific differences in the measured constructs across the three drivers groups. Finally, to examine the predictors of type of car/s owned by the drivers, a multinomial logistic regression analysis was carried out. Type of car/s owned (electric, conventional, both) was entered as the dependent variable, and demographic variables (age, gender, education, income), attributes of electric-car use, normative variables (awareness of consequences, ascription of responsibility and personal norm) and knowledge about electric cars were entered as independent variables. The reference category for the outcome variable included sole conventional car owners.

## 3. Results

### 3.1 Comparison of socio-demographic characteristics between the driver groups

Demographic characteristics and annual km driven for the three driver groups are shown in Table 1. There were significant differences between the driver groups in age, income, number of children in the household, occupational/educational activity and annual km driven. Electric car drivers were on average younger than the other driver groups. Drivers

using both an electric and conventional car reported higher annual km driven, had more children and had a higher yearly income than the other driver groups. Further, the number of drivers who were currently in an occupational activity or undergoing education was much higher among the electric car drivers than among the conventional car drivers.

Insert Table 1 here

3.2 Dimensional structure and reliability of the scales

PCA showed that the attributes scale had a two-dimensional structure. The dimensions were labelled as "environmental-economic attributes" (e.g. "Use of electric cars contributes to reduction air pollution", "one can save money in the long run by driving an electric car") and "instrumental attributes" (e.g. "It is not practical to drive an electric car because of limited charging stations"), and they explained a total of 42.6% of the variance. For the VBN theory constructs the dimensional structure that was established and used in previous studies (De Groot & Steg, 2007, 2008; Dunlap, 2008; Dunlap et al., 2000; Lind et al., 2015) was also used in the present study. The number of items, an example item, reliability, and average corrected inter-item correlation are shown in Table 2. All dimensions had an α value around 0.70 or above and corrected inter-tem correlation above 0.40, which can be considered as satisfactory (Nunnally, 1978). Composite scores were established for each dimension by calculating the mean of the items under each dimension.

Insert Table 2 here

3.3 Frequency of travel mode use in the driver groups

The proportion (%) of drivers using different travel modes in a typical week are shown in Table 3. There were only significant differences in use of personal car and walking frequency across the three driver groups. Drivers owning an electric car used their car more frequently and tended to walk less for traveling compared to the conventional car drivers.

Although the differences were not significant, electric car drivers, including both electric and conventional car drivers, tended to use bicycle and bus less than the conventional car drivers did.

Insert Table 3 here

3.4 Differences in the study constructs across the driver groups

MANCOVA results showed a significant main effect of car type [$F(24, 1238)= 16.38$, $p< .001$, Wilk's $\Lambda = 0.57$, partial $\eta^2 =0.24$], gender [$F (12, 619)= 6.48$, $p < .001$, Wilk's $\Lambda = 0.89$, partial $\eta^2 =0.11$], income [$F (12, 619)= 5.53$, $p < .001$, Wilk's $\lambda= 0.90$, partial $\eta^2 =0.10$], education [$F (12, 619)= 4.52$, $p < .001$, Wilk's $\Lambda = 0.92$, partial $\eta^2 =0.08$] and age [$F (12, 619)= 12.08$, $p < .001$, Wilk's $\Lambda =0.81$, partial $\eta^2 =0.19$]. Means of the measured constructs for the three groups and Bonferroni corrected post-hoc comparisons between the groups means are shown in Table 4. The largest differences in the measured constructs were observed between the sole electric car and sole conventional car owners. However, the differences in most of the measured constructs between the owners of sole electric cars and owners of both electric and conventional cars were not significant.

Insert Table 4 here

The driver groups showed significant differences in the VBN theory constructs. The sole electric car owners reported higher personal norm, awareness of consequences and ascription of responsibility related to electric car use than the other driver groups, while the sole conventional car owners reported the weakest personal norm, awareness of consequences and ascription of responsibility related to electric car. However, there were no significant differences in environmental worldview and values across the three driver groups.

Regarding attributes of electric cars, the sole electric car drivers reported a significantly higher level of agreement with the all positive attributes of electric car use than the other driver groups. In particular, all driver groups reported a significantly higher level of agreement with the environmental-economic attributes compared to the other attributes, whereas they reported a significantly lower level of agreement with the symbolic attributes related to electric car use.

Owners of both electric and conventional cars had the highest number of correct answers in the knowledge test, whereas the sole conventional car owners had the lowest number of correct answers. However, it should be noted that, although there were differences in the number of correct answers between the groups, all driver groups had a mean of correct answer above 8 out of 11 questions, which indicates an overall good level of knowledge about electric cars among all drivers. Examination of the responses to individual knowledge items indicates that especially the knowledge related to technical aspects of electric cars is lower among the sole conventional drivers.

### 3.5. Predictors of car type owned by the drivers

In order to examine the relationships between demographic variables, normative variables, attributes of electric cars, knowledge about electric cars and type of car owned by the drivers (electric, conventional, both electric and conventional) a multinomial logistic regression analysis was carried out (see Table 5). The reference category for the outcome variable included sole conventional car owners. The model had a satisfactory fit to the data (-2 log likelihood=956.45, $\chi^2$=442, 87, $p<0.001$).

Being female, reporting higher level of agreement with the positive environmental, instrumental and symbolic attributes of electric car use, and having higher level of knowledge related to electric cars significantly increase the probability of owning only an electric car. Whereas, increasing age, ascription of responsibility and having an income between 350 000-

500 000 NOK or 500 000-900 000 NOK significantly decrease the probability of owning only an electric car. Similarly, reporting higher level of agreement with environmental, instrumental and symbolic attributes of electric car use, and having higher level of knowledge related to electric cars significantly increase the probability of owning both an electric and a conventional car. Whereas, increasing age, and having an income between 350 000-500 000 NOK or 500 000-900 000 NOK significantly decrease the probability of owning both an electric and a conventional car.

Insert Table 5 here

## 4. Discussion and conclusions

Number of drivers purchasing electric cars as their main or additional car is increasing rapidly in many countries including Norway. Majority of the previous studies focusing on electric car use approach electric car drivers as one group without differentiating sub-groups, such as sole electric car drivers and drivers of both electric and conventional cars. However, to have a better understanding of determinants of electric car use for different groups, it is important to differentiate electric car drivers. In the current study sole electric car drivers, drivers of both an electric and a conventional car, and sole conventional car drivers were compared for socio-demographic characteristics, travel mode use, attitudinal and normative factors and knowledge related to electric car use in a Norwegian sample. Additionally, demographic and psychological predictors of type of car/s owned by the drivers were investigated.

Socio-demographic characteristics of the drivers differed across the driver groups. Electric car owners were younger, had a higher income and more children than the conventional car drivers had. In addition, multinomial logistic regression results showed that increasing age and having an income category between 350 000 – 500 000 NOK, which can be considered as middle-income in Norway, decreased the probability of owning an electric

car. These findings are in line with the previous findings showing young age, higher income and a higher number of children in the household as positively associated with electric car use (e.g. Hjorthol, 2013; Nayum et al., 2016). It is very likely that younger people who are still active in work life and who have a larger household prefer to use electric cars more due to their increased mobility needs and benefits of electric cars for mobility. Examination of the differences between the sub-groups of electric car owners showed that those who own both an electric and a conventional car had older age, higher income and higher number of children than the sole electric car drivers did. It seems that as the household size and income increase purchasing an electric car as an additional car becomes more preferable.

Comparing the three driver groups for their travel mode use in a typical week showed that those who owned an electric car used their car significantly more frequently and walked significantly less frequently when traveling compared to the conventional car owners. Also, although the differences were not significant, electric car drivers tended to use bicycle and bus as a travel mode less frequently than the conventional car drivers. These findings suggest that owning an electric car, both as a main and an additional car is associated with increased car use. Big governmental incentives for electric car use in Norway, such as exemption from road taxes, and more facilities offered to electric cars might explain why drivers owning an electric car prefer using their electric cars to travel many places instead of using public transportation or walking. Differences in demographic profile of the electric and conventional car drivers should also be taken into consideration when interpreting the differences in travel mode use among the three driver groups. For instance, bigger proportion of people working/studying and higher number of children in household among the electric car drivers than the conventional car drivers might be contributing to more car use among the electric car drivers.

In line with the previous findings showing stronger personal norm, awareness of consequences and ascription of responsibility associated with the use of pro-environmental

cars (Jansson et al., 2011; Klöckner et al., 2013; Nayum & Klöckner, 2014), electric car owners reported higher level of personal norm, awareness of consequences and ascription of responsibility compared to conventional car owners. However, multinomial logistic regression results showed that personal norm and awareness of consequences were not significant predictors of electric car ownership. Also, unexpectedly ascription of responsibility was negatively associated with owning only an electric car, which is a rather contradicting finding. It is possible that for electric car owners feeling responsible for the negative consequences of car use is not so relevant because they already behaved in an environmentally responsible way by purchasing an electric car. Similarly, in a previous study (Lind et al., 2015) the negative association found between ascription of responsibility and public transportation use was explained by arguing that public transportation users might not feel so responsible for negative effects of car use because they already take responsibility by using public transportation.

There were significant differences in values and general environmental beliefs among the three driver groups. This could be explained by the general measurement level of the constructs. Unlike the awareness of consequences, ascription of responsibility and personal norm, which were adapted to electric car use, both the general environmental beliefs and the values were measured at a general level. Although the differences were not significant, examination of the scores for the values showed that altruistic and especially the biospheric values were more important for the sole electric car drivers than the other driver groups. This is in line with previous findings showing biospheric and altruistic values as positively associated with pro-environmental acts (e.g. Lind et al., 2015; Steg et al., 2005).

Not surprisingly, the sole electric car owners agreed with the positive attributes of electric cars significantly more than the other groups, while the sole conventional car owners agreed with the positive attributes significantly less than the other groups. In addition,

attributes of electric car use were found to be the strongest group of variables that increased the probability of owning an electric car both as the main or second car. In particular, perceived instrumental attributes of electric cars (e.g. technical characteristics, performance, and safety) were the strongest variable that increased the probability of owning an electric car, which is in line with the previous studies (Nayum & Klöckner, 2014; Noppers et al., 2015; Schuitema et al., 2013) showing instrumental attributes as strong predictor of electric vehicle use. This finding indicates that what people think about attributes of electric cars, especially instrumental attributes related to utility, is very critical for their electric car ownership.

Although the overall knowledge level about the electric cars was high in all driver groups, those who own both an electric and a conventional car had the highest number of correct answers, which could be explained by their familiarity with the characteristics of both types of cars. The sole conventional car drivers had the lowest number of correct answers in the knowledge test, especially to the questions related to technical aspects of electric cars, which indicates the need to increase knowledge about electric cars especially among conventional car drivers.

As expected, the overall results showed that the most substantial differences in the measured constructs are between the sole electric and the sole conventional car owners, whereas the differences between the sub-groups of electric car owners (sole electric car owners and both electric and conventional car owners) were the least. In addition, multinomial logistic regression results showed that variables that increase the probability of owning an electric car are mostly similar for sole electric car owners and owners of both electric and conventional cars. It could be concluded that owners of both an electric and a conventional car have a more similar profile with the sole electric car owners than with the sole conventional car owners. It is likely that for drivers owning both types of car, owning an electric car is a

more distinctive feature, which is more closely connected with attitudes, beliefs and norms related to car use.

## 4.1 Implications of the study

The current study has several implications. The drivers owning both an electric and conventional car constitute almost an equally large group as the drivers owning only electric cars. This reflects the growing amount of Norwegians who prefer to buy an electric car in addition to their conventional car, which results in increased car use. This undesired development might have some negative consequences for the traffic system, such as increase in traffic load. Therefore, when implementing governmental incentives and interventions to increase electric car use in Norway, the potential negative spillover effects of increasing electric cars should be taken into consideration. Although owners of sole electric cars and both electric and conventional cars did not show substantial differences for most of the measured constructs, they are still two different groups of drivers with different socio-demographic characteristics and mobility preferences. Therefore, instead of approaching potential electric car owners as a homogeneous consumer group, taking them as a heterogeneous consumer group including sub-groups with different socio-demographic profile, mobility needs and preferences might be beneficial for understanding various consumer motivations. The current findings indicate that how people evaluate the attributes related to electric car use, especially the instrumental attributes (e.g. performance, usability), has a very strong role in determining electric car ownership. Thus, transport policy interventions aiming to promote electric car use could benefit from emphasizing positive attributes of electric cars especially the ones related to usability and utility of electric cars.

## 4.2 Limitations

There are also some limitations of the study to mention. Relatively low response rate, especially from the sole conventional car owners, is one of the major limitations of the study. It is likely that sole conventional car drivers found the survey less relevant since it was focusing on electric cars. Some similar previous web-surveys related to electric car use in Norway also had low repose rates especially from the conventional car drivers (e.g. Nayum et al., 2016; Klöckner et al., 2013). Also, it should be noted that, it is generally common to achieve a lower response rate to online surveys compared to paper-based surveys (Nulty, 2008). The present study focused on drivers of battery electric cars since they are the most commonly used electric vehicle in Norway. However, in future research it might be useful to include drivers of other types of electric vehicles as well, such as full hybrid and plug-in hybrid, to see if there are differences in profile of drivers using different types of electric vehicles.

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**TABLES**

Table 1. Demographic characteristics of the driver groups

| | **Mean (*SD*)** | | | **F** | **$\chi 2$** |
|---|---|---|---|---|---|
| | Electric car owners (n=231) | Conventional car owners (n=205) | Electric and conventional car owners (n=226) | | |
| Age | 48.13 (11.77) | 55.52 (13.39) | 49.82 (10.44) | 22.60*** | |
| Number of children | 0.88 (1.13) | 0.50 (0.90) | 1.20 (1.18) | 22.50*** | |
| Annual km driven | 15847.66 (9194.07) | 16316.09 (8442.35) | 23980.53 (10285.76) | 53.27*** | |
| | **n (%)** | | | | |
| Gender | | | | | 24.96 |
| *Male* | 145 (64%) | 153 (76%) | 187 (84%) | | |
| *Female* | 83 (36%) | 47 (24%) | 36 (16%) | | |
| Education | | | | | 6.64 |
| *Basic education* | 4 (1.7%) | 4 (2%) | 2 (1%) | | |
| *Vocational secondary education* | 29 (12.6%) | 34 (16.7%) | 29 (12.9%) | | |
| *General secondary education* | 20 (8.7%) | 18 (8.8%) | 16 (7.1%) | | |
| *Bachelor degree or equivalent* | 60 (26.1%) | 54 (26.5%) | 49 (21.9%) | | |
| *Master's degree or equivalent* | 117 (50.9%) | 94 (46.1%) | 128 (57.1%) | | |
| Income | | | | | 28.86*** |
| *Under 250 000 kr*[a] | 4 (1.7%) | 4 (2%) | 2 (1%) | | |
| *250000-350 000 kr* | 14 (6.1%) | 13 (6.4%) | 3 (1.3%) | | |
| *350000-500 000 kr* | 46 (19.9%) | 53 (26.1%) | 28 (12.4%) | | |
| *500000-900 000 kr* | 110 (47.6%) | 95 (46.8%) | 117 (52%) | | |
| *Over 900 000 kr* | 57 (24.7%) | 38 (18.7%) | 75 (33.3%) | | |
| Working/student | | | | | 44.19*** |
| *Yes* | 211 (91%) | 147 (72%) | 207 (92%) | | |
| *No* | 20 (9%) | 58 (28%) | 19 (8%) | | |

***p<0.001

[a]= 1 NOK (Norwegian Kroone) ≈ 0.11 Euro

Table 2. Dimension characteristics

| **Dimensions** | **Example Item** | **Number of items** | **α** | **Average corrected inter-item correlation** |
|---|---|---|---|---|
| Environmental-economic attributes | Use of electric cars reduces air pollution in residential areas caused by traffic | 8 | 0.84 | 0.57 |
| Instrumental attributes | It is not practical to drive an electric car because of the infrequent charging points | 8 | 0.79 | 0.49 |
| Symbolic attributes | Driving an electric car gives/would give me status | 5 | 0.84 | 0.66 |
| Egoistic values | Social power - controlling others and dominance | 5 | 0.76 | 0.57 |
| Altruistic values | Helpfulness – working for others well-being | 4 | 0.82 | 0.64 |
| Biospheric values | Environmental protection – preserving nature | 4 | 0.88 | 0.76 |
| Hedonic values | Pleasure – satisfaction of needs | 3 | 0.81 | 0.66 |
| General environmental beliefs | The balance of nature is very vulnerable and easy to disturb | 13 | 0.79 | 0.52 |
| Awareness of consequences | We run out of limited natural sources, such as oil, by using conventional cars | 4 | 0.66 | 0.45 |
| Ascription of responsibility | It is not my responsibility to protect the environment | 9 | 0.82 | 0.42 |
| Personal Norm | I would feel myself a better person if I choose to use an electric car instead of a conventional car | 2 | 0. 67 | 0.51 |

Table 3. Frequency (%) of different travel mode use in a week for the driver groups

| | **Train** | | | **Bus** | | | **Car** | | | **Metro** | | | **Tram** | | | **Bicycle** | | | **Walking** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *E* | *C* | *B* | *E* | *C* | *B* | *E* | *C* | *B* | *E* | *C* | *B* | *E* | *C* | *B* | *E* | *C* | *B* | *E* | *C* | *B* |
| **Never** | 89.5 | 86 | 86.3 | 83.4 | 76.8 | 85.4 | 3.1 | 4.0 | 1.4 | 89.2 | 89.1 | 93.2 | 91.2 | 91.5 | 92.9 | 67.6 | 62.0 | 70.9 | 55.7 | 35.9 | 55.1 |
| **1 day** | 6.2 | 9.7 | 6.3 | 13.3 | 14.1 | 9.8 | 3.6 | 7.5 | 4.5 | 5.9 | 6.0 | 4.7 | 6.9 | 5.1 | 5.6 | 13.3 | 14.7 | 11.6 | 8.4 | 10.3 | 9.1 |
| **2 days** | 1.9 | 0.5 | 1 | 1.9 | 4.3 | 1.0 | 3.1 | 7.5 | 5.4 | 1.5 | 2.2 | 1.0 | 1.5 | 1.7 | 0.5 | 5.7 | 12.5 | 4.5 | 10.3 | 10.9 | 5.6 |
| **3 days** | 0.5 | 0.5 | 1.5 | 0 | 0.5 | 0.0 | 4.9 | 10.1 | 6.3 | 2.0 | 0.5 | 0.5 | 0.5 | 0.6 | 0.5 | 5.7 | 3.3 | 4.5 | 8.4 | 8.2 | 4.5 |
| **4 days** | 0.5 | 0 | 1.5 | 0 | 0.5 | 1.5 | 12.5 | 13.6 | 6.3 | 0.0 | 1.1 | 0.0 | 0.0 | 0.0 | 0.5 | 3.3 | 2.2 | 4.0 | 3.0 | 5.4 | 1.5 |
| **5 days or more** | 1.4 | 3.2 | 3.4 | 1.4 | 3.8 | 2.4 | 72.8 | 57.3 | 76.0 | 1.5 | 1.1 | 0.5 | 0.0 | 1.1 | 0.0 | 4.3 | 5.4 | 4.5 | 14.3 | 29.3 | 24.2 |
| **Total (%)** | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| **$\chi$2(df)** | 10.6 (10) | | | 15.5 (10) | | | 26.5 (10)** | | | 9.10 (10) | | | 8.3 (10) | | | 13.9 (10) | | | 31.3 (10)** | | |

** $p<0.01$

E – Electric car owners
C – Conventional car owners
B – Both electric and conventional car owners

Table 4. Comparison of the means for the measured constructs among the three driver groups

| | Electric car drivers (E) | Conventional car drivers (C) | Drivers of both (B) | E-C | E-B | B-C | F | df | Partial eta squared |
|---|---|---|---|---|---|---|---|---|---|
| Personal norm | 3.21 | 2.66 | 3.03 | 0.55*** | 0.18 | 0.38** | 17.85*** | 2 | 0.04 |
| Awareness of consequences | 4.04 | 3.52 | 3.85 | 0.52*** | 0.19** | 0.33*** | 35.15*** | 2 | 0.05 |
| Ascription of responsibility | 3.72 | 3.45 | 3.65 | 0.26*** | 0.07 | 0.20** | 11.28*** | 2 | 0.10 |
| General environmental beliefs | 3.50 | 3.47 | 3.44 | -0.03 | 0-06 | -0.04 | 0.99 | 2 | 0.03 |
| Egoistic values | 5.41 | 5.48 | 5.53 | -0.07 | -0.12 | 0.05 | 0.13 | 2 | 0.00 |
| Altruistic values | 2.95 | 3.08 | 3.16 | -0.14 | -0.21 | -0.07 | 1.12 | 2 | 0.04 |
| Biospheric values | 3.25 | 3.47 | 3.47 | -0.22 | -0.21 | -0.01 | 1.70 | 2 | 0.05 |
| Hedonistic values | 3.77 | 3.71 | 3.76 | -0.07 | 0.01 | 0.06 | 0.13 | 2 | 0.00 |
| Environmental-economic attributes | 4.49 | 3.84 | 4.36 | 0.65*** | 0.13* | 0.52*** | 81.83*** | 2 | 0.21 |
| Instrumental attributes | 3.51 | 2.64 | 3.38 | 0.87*** | 0.13 | 0.75*** | 127.12*** | 2 | 0.29 |
| Symbolic attributes | 3.34 | 2.57 | 3.17 | 0.77*** | 0.17 | 0.60*** | 57.91*** | 2 | 0.16 |
| Number of correct answers | 8.58 | 8.06 | 8.61 | 0.52** | -0.02 | 0.55*** | 17.29*** | 2 | 0.05 |

Wilk's Lambda=0.57, F= 16.38 $p<0.001$

*$p<0.05$
**$p<0.01$
***$p<0.001$

Table 5. Predictors of type of car/s owned by the drivers

| | Electric car (n=223) | | | Both electric and conventional car (n=221) | | |
|---|---|---|---|---|---|---|
| **Indicators** | **OR** | **95% CI** | ***B*** | **OR** | **95% CI** | ***B*** |
| **Demographic variables** | | | | | | |
| Gender (female) | 3.49 | 1.75.6.98 | 1.25*** | 1.39 | 0.69-2.80 | 0.33 |
| Education (basic) | 2.48 | 0.23-27.01 | 0.91 | 1.44 | 0.13-16.25 | 0.36 |
| Education (secondary-vocational) | 0.87 | 0.36-2.11 | -0.14 | 0.80 | 0.35-1.85 | -0.22 |
| Education (secondary-general) | 1.34 | 0.45-4.03 | 0.30 | 0.98 | 0.33-2.87 | -0.24 |
| Education (bachelor's degree) | 1.21 | 0.62-2.38 | 0.19 | 0.83 | 0.43-1.60 | -0.19 |
| Income (under 250 000 NOK) | 0.33 | 0.03-3.67 | -1.10 | 0.30 | 0.03-3.31 | -1.21 |
| Income (250 000-300 000 NOK) | 1.64 | 0.41-6.59 | 0.50 | 0.36 | 0.07-1.78 | -1.04 |
| Income (350 000-500 000 NOK) | 0.35 | 0.14-0.87 | -1.05* | 0.31 | 0.13-0.74 | -1.18** |
| Income (500 000-900 000 NOK) | 0.43 | 0.21-0.91 | -0.84* | 2.11 | 1.05-4.27 | -0.75* |
| Age | 0.93 | 0.91-0.96 | -0.07*** | 0.47 | 0.23-0.96 | -0.05*** |
| **Normative variables** | | | | | | |
| Personal Norm | 0.96 | 0.63-1.47 | -0.04 | 0.90 | 0.60-1.34 | -0.11 |
| Awareness of consequences | 1.51 | 0.80-2.84 | 0.41 | 0.89 | 0.49-1.62 | -0.12 |
| Ascription of responsibility | 0.51 | 0.28-0.94 | -0.67* | 0.64 | 0.36-1.15 | -0.45 |
| **Attributes** | | | | | | |
| Environmental-economic | 4.09 | 2.17-7.71 | 1.41*** | 3.03 | 1.70-5.42 | 1.11*** |
| Instrumental | 14.32 | 7.96-25.77 | 2.66*** | 12.62 | 7.10-22.41 | 2.54*** |
| Symbolic | 3.19 | 2.04-4.98 | 1.16*** | 2.57 | 1.67-3.96 | 0.94*** |
| **Knowledge** | 1.74 | 1.33-2.27 | 0.55*** | 2.02 | 1.56-2.62 | 0.70*** |

-2 log likelihood=956.45, $\chi 2$=442, 87, p<0.001

Reference category includes drivers owning only a conventional car (n=194).

*p<0.05, **p<0.005, ***p<0.001