Oliver Salvatore Riordan

Bachelor's thesis

To what extent do social and personal norms, together with demographic and socioeconomic variables predict electric car use?

Candidate number: 10003 / Subject code: PSY2900
Supervisor: Milad Mehdizadeh / Word count: 9430

May 2022

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Norwegian University of Science and Technology
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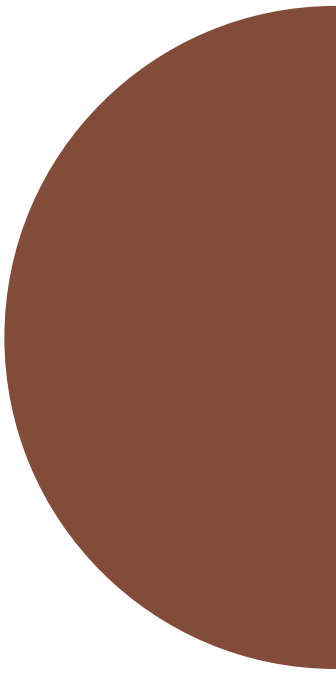

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Preface and self-declaration

The framework of this study was derived from an empirical research project conducted by my supervisor, Milad Mehdizadeh. His study is entitled "Socio-psychological predictors of transport mode use" and focuses on various predictors' relationships to different modes of transportation such as walking or cycling. Eight psychology students took part in this project, each of whom chose one transport modality. For my project, electric vehicles (EVs) were chosen as the dependent variable. I chose EVs because I have always had an interest in private cars. Before this project, I read a number of papers regarding cars and their significance, both from a social, environmental and psychological perspective. Therefore, I was motivated to pursue this project within the framework of EVs. Moreover, I am intending to continue my studies within the domain of social psychology, which guided my focus in introducing social and personal norms as predictors of EV use. I found this to be an especially rich contribution in addition to the other variables laid out in the original study. Further, my supervisor helped narrow my focus when it came to discussing social and personal norms since I could have used an array of different theories within these areas. The choice of method for statistical analysis was made based on instructions from my supervisor.

I would like to thank my supervisor for helping me reach this level of focus, as well as clarifying several statistical questions such as the reliability of Chronbach's alpha, as well as numerous problems with a principal components analysis (PCA). I would also like to thank the project's assistants, Matilde Flåten and Per Helge Haakstad Larsen, as well as my fellow students for mutual help during the data analysis stage. Having said all this, I declare this body of work as my own.

Abstract

Research surrounding sustainable transportation has gained substantial momentum in the last few years, largely due to increased awareness surrounding climate change, as well as the development of battery technology for electric vehicles (EVs). The present study posited that demographic (younger age, male gender), socioeconomic (high income, higher education, financial incentives (cost factors)) and psychological (social norms, personal norms) factors would predict greater EV use. This was presented through two research questions and seven hypotheses. A cross-sectional design employing snowball and convenience sampling via a self-completion survey was utilised, leading to a reasonably good sample (N = 384). Descriptive statistics were employed to represent sample characteristics, a principal component analysis (PCA) was run to reduce quality attributes, and a hierarchical linear regression utilising three blocks was run to analyse the predictive power of the independent variables. The results of this study supported two out of the seven hypotheses related to EV use, meaning that high income and personal norms reliably predict EV use, thus partially supporting the first and second research questions. The implications of this study could help inform further research investigating high income, as well as those investigating personal norms in the qualitative domain since this was such a meaningful predictor. Some applications of said research could influence policymaking and incentives surrounding personal norm appeals, especially in more individualistic societies.

Introduction

The electric car, which predates conventionally powered petrol and diesel cars (Taylor, 2022) is playing an increasingly important role in modern society (van Wee et al., 2012), especially in the Nordic region, where the electric car market is predominant (Barth et al., 2016; Chen et al., 2020; Klöckner, 2014; Noel et al., 2019; Ryghaug & Toftaker, 2014; Simsekoglu, 2018; Sovacool et al., 2018; Thøgersen & Ebsen, 2019). An electric vehicle is a vehicle that relies on electricity (stored in a battery) as a fuel source as opposed to one that is powered by fossil fuels (Linde, 2010, p. 7). There are different types of electric vehicles: Hybrid Electric Vehicles, which contain a conventional internal combustion engine in addition to a small battery, Plug-in Hybrid Electric Vehicles which have a smaller internal combustion engine and allows the user to plug the car in to charge (more powerful battery) and finally Battery Electric Vehicles (BEVs), which do not have an internal combustion engine and rely exclusively on a battery (Egbue & Long, 2012). In this thesis, the term "EV" will be used to denote electric vehicles since the sole focus will be on BEVs.

A primary reason for why there is greater societal (Nayum et al., 2016; Simsekoglu, 2018; van Wee et al., 2012), psychological (Nayum & Klöckner, 2014; Simsekoglu, 2018), and scientific/ technical (Egbue & Long, 2012; Liao et al., 2016; Ryghaug & Toftaker, 2014) interest in EVs is due to the ongoing climate crisis (van Wee et al., 2012). Since the industrial revolution, the Earth's atmospheric CO_2 levels have been increasing, causing the atmosphere to heat up, consequently increasing global temperatures (Letcher, 2021, p. 4). This increase is a result of humans burning and consuming fossil fuels (Letcher, 2021, p. 4), which is unsustainable (Letcher, 2021, p. 8), and contributes to the "greenhouse effect" (Letcher, 2021, p. 4), since 95% of global transport energy is acquired through the burning of fossil fuels (Pettifor et al., 2017). Climate change presents many problems to society in that weather patterns are far less predictable (Letcher, 2021, p. 4), biodiversity is reduced (Bellard et al., 2012), and the general global equilibrium is upset (Letcher, 2021, p. 4), which can have catastrophic consequences on the Earth's ecological balance. Further, road transportation contributes immensely to CO_2 build-up in the atmosphere in that this sector alone was responsible for 74.5% of all global transport emissions in the year 2018 (Ritchie, 2020). Further, since road transport is localised closer to humans (unlike maritime transport for example), pollution from it yields significant health detriments (van Wee et al., 2012), such as respiratory and heart diseases and, as a consequence, a higher risk of premature death (ca.

23,500 deaths per year) (Jones, 2019). It is therefore necessary that the amount of CO_2 we produce is radically reduced, so that the "best case scenario" of a stable warmer climate, as well as increased public health, can be achieved (Letcher, 2021, pp. 4-9). In order for this to be possible, transportation (at least by road) needs to be electrified, which can hopefully pave the way for mass adoption of EVs. Therefore, this thesis' dependent variable will be EV use, and will have a number of different independent variables spread across seven hypotheses. Independent variables related to demographic factors include age and gender, socioeconomic ones related to income and education, quality attributes related to costs and environmental friendliness, and finally, regarding psychological factors, social and personal norms. This study therefore aims to examine which variables are significant in predicting EV use.

Literature review

Prior research investigating this area has identified some clear trends, as well as contradictory information. Most of the research reviewed here was conducted in the Nordic region, meaning generalisation to other world regions could be limited, which is a considerable hole in current research. Moreover, it is important that this topic is thoroughly researched and investigated since it is so vital to the future of mobility, as well as the overall shift to sustainable modes of transportation. Knowing the reasons for why an individual would or would not use an EV can not only enrich one's knowledge of human psychology but can also help in the development of campaigns and incentivisation programmes, with the aim to facilitate the shift to electric mobility.

Firstly, research investigating demographic predictors have demonstrated that men are the ones most likely to use an EV (Barbarossa et al., 2017; Chen et al., 2020; Egbue & Long; Gulzari et al., 2022; Jensen et al., 2014; Liao et al., 2016; Li et al., 2017; Nayum et al., 2016; Priessner et al., 2018; Ryghaug & Toftaker, 2014; Sovacool et al., 2018), since they often exhibit a higher degree of car ownership (Nayum et al., 2016; Sovacool et al., 2018). Numerous studies have ascertained that this gender difference could be due to a number of reasons. Firstly, men that are high-earning and technologically inclined (Chen et al., 2020; Li et al., 2017; Simsekoglu, 2018) are more motivated to buy an EV due to increased awareness of technology and increased financial prosperity and would therefore exhibit greater openness to the technology as opposed to women (Chen et al., 2020; Sovacool et al., 2018). Men also demonstrated a preference for faster acceleration (Liao et al., 2016), which is more

pronounced than a conventional car (Bühler et al., 2014). However, other studies indicated that women are more likely to use EVs (Simsekoglu, 2018), due to the perceived higher driving performance (Chen et al., 2020; Jensen et al., 2014), as well as being more environmentally friendly (Chen et al., 2020; Dietz et al., 1998; Sovacool et al., 2018). Studies such as Rasouli & Timmermans, 2013, actually indicated that both men and women would be equally inclined to use EVs.

Regarding age, many research papers concluded that younger people (usually between 25-34 years old) were most likely to use EVs (Barbarossa et al., 2017; Chen et al., 2020; Gulzari et al., 2022; Hidrue et al., 2011; Li et al., 2017; Nayum et al., 2016; Simsekoglu, 2018; Sovacool et al., 2018), or something else pro-environmental (Dietz et al., 1998) since a relationship was discerned between younger age and being pro-environmental. Some potential reasons for why this is the case is that in general, younger people are more engaged with climate change since they will be the ones to live through its consequences, as well as being future world leaders (Ojala, 2012), therefore having a greater future-orientation (Ryghaug & Toftaker, 2014). Younger people are also more idealistic and less aware of the practicalities of implementing environmentally friendly policies. Upon further examination, one can see that there are other reasons. Firstly, Axsen and colleagues explored the connection between lifestyle liminality and openness to change, which usually occurs during life's major transitional periods. Since younger people do not have a firmly established lifestyle, it is not unreasonable to assume that they would be more open to new technological developments such as EVs (Axsen et al., 2012; Barbarossa et al., 2017). Barbarossa and colleagues also discussed this and found younger people to be more concerned with "self-enhancement", which was a reliable predictor of EV use (Barbarossa et al., 2017). Simsekoglu's study found that younger people with children have greater mobility needs (transporting children) and that they use EVs from a perspective of convenience since they are cheaper to run and can benefit from financial incentives (Simsekoglu, 2018), since younger people have less purchasing power compared to older people (Chen et al., 2020). However, Dietz and colleagues' study discovered that this connection is not so clear cut, and thus should not be taken for granted that younger people are always the ones who are most engaged and pro-environmental, which further reinforces the fact that all these factors must be examined holistically (Dietz et al., 1998). Lastly, Sovacool's study found relationships between middle aged people and EV use in addition to young people, meaning that many other variables such as financial stability must also be considered (Sovacool et al., 2018).

Research that investigated psychological predictors came to many conclusions. Firstly, having an environmentally minded orientation, which is very widespread in the Nordic region (Barbarossa et al., 2015; Jansson et al., 2017; Vainio & Paloniemi, 2014; Vikan et al., 2007), was seen as an influential predictor of EV use (Barbarossa et al., 2015; Barbarossa et al., 2017; Barth et al., 2016; Chen at al., 2020; Egbue & Long, 2012; Gulzari et al., 2022; Jansson et al., 2017; Jensen et al., 2014; Liao et al., 2016; Li et al., 2017; Moons & De Pelsmacker, 2015; Nayum et al., 2016; Peters et al., 2018; Simsekoglu, 2018; Thøgersen & Ebsen, 2019). Moreover, EV use is higher in this region (Barth et al., 2016; Chen et al., 2020; Klöckner, 2014; Noel et al., 2019; Ryghaug & Toftaker, 2014; Simsekoglu, 2018; Sovacool et al., 2018). Research investigating this postulated that this orientation is especially salient due to more liberal politics (Dietz et al., 1998), as well as the fact that these countries exhibit lower levels of uncertainty avoidance in relation to Hofstede's cultural dimensions, as well as being more feminine and egalitarian (Dietz et al., 1998; Barbarossa et al., 2015). Usually, people who are environmentally minded would behave in a sustainable way so they perceive they are actively doing something to protect the environment (Chen et al., 2020), and thus would be more inclined to use an EV (Bobeth & Kastner, 2020; Chen et al., 2020; Jensen et al., 2014). This can be further seen as a manifestation of one's "green self-identity", where one engages in a pro-environmental lifestyle (Axsen & Kurani, 2012; Axsen et al., 2013; Axsen et al., 2012; Bobeth & Kastner, 2020; Chen et al., 2020), which can lead to increased positive self-image and self-esteem (Barbarossa et al., 2015; Li et al., 2017), since one's self concept is so intimately connected to lifestyle (Axsen et al., 2012; Axsen et al., 2013). However, since radically changing habits and behaviour is difficult (Dahlstrand & Biel, 1997), many environmentally minded people view EV adoption and use as a sufficient environmental measure (Simsekoglu, 2018). On the other hand, other pieces of research have been more critical of this connection. Egbue & Long's study demonstrated that environmentally minded people express some reservations as to the true environmental efficacy of EVs. This was mainly to do with concern regarding electricity production (gas or coal power) (Egbue & Long, 2012). However, since this study was conducted in the United States, it is likely that this is less of an issue in regions such as the Nordic one, where electricity production is cleaner (Graabak et al., 2019). Similarly, other research has also cited electricity production and the manufacturing process as potential issues that people would have in terms of an EV's environmental efficacy (Bühler et al., 2014; Hawkins et al., 2012). Another study conducted by Axsen and colleagues discussed the fact that some people, who very much identify

themselves as “environmentally minded”, prefer to engage in other behaviours, such as installing solar panels on one’s house, or reducing car-related travel altogether (Axsen et al., 2012). The point being made here is that even though there is an abundance of research pointing at a direct relationship between being environmentally minded and adopting an EV, one should examine the issue more closely since there is some variation in the behaviours that different individuals would ascribe as “pro-environmental” (Axsen et al., 2012). Conversely, some older studies reviewed by Axsen and colleagues have shown that environmental mindedness alone does not necessarily lead to environmentally friendly behaviours (Gill et al., 1986; Oskamp et al., 1991; Scott & Willits, 1994; Van Liere & Dunlap, 1981), suggesting other things such as norms being potentially more influential.

Research investigating social and personal norms were also investigated. From a general perspective, social norms can be defined as “rules and standards that are understood by members of a group, and that guide and/ or constrain social behaviour without the force of laws” (Elgaaied-Gambier et al., 2018, p. 179). Social norms were chosen since it is an interesting way to measure the degree of conformity in a society or group, as well as its importance to high-involvement decisions such as using an EV. Further, adherence to social norms was a good way of measuring the degree of conformity (or nonconformity) in a society, which can further help inform policymaking, especially in societies that value conformity. In continuation, personal norms are seen as an internalisation of social norms, which are much closer to one’s core constitution and personal value system (Klockner & Mattheis, 2004), and thus endow one with a sense of moral obligation (Asadi et al., 2021; He & Zhan, 2018). Due to this connection to one’s core self and internalised value system, it was seen as highly beneficial to investigate personal norms since it allowed an insight into how one thinks and feels about certain things such as EVs, which is highly meaningful. It also enables one to properly appreciate the truly diverse and individualistic nature of personal norms, which is highly desirable within transportation and psychological research in general.

Examining social norms first, many pieces of research have demonstrated connections between social norms and EV use (Axsen & Kurani, 2012; Barth et al., 2016; Bobeth & Kastner, 2020; Elgaaied-Gambier et al., 2018; Gulzari et al., 2022; Li et al., 2017; Pettifor et al., 2017; Thøgersen & Ebsen, 2019). Reasons for this could include the fact that we often need social validation before adopting an innovation (Barth et al., 2016), and the fact that uncertainty surrounding new innovations/ technologies involves people looking at what the

group does (Gilbert et al., 1998, p. 154) so that orientation can be gained (Bobeth & Kastner, 2020). The group's behaviour would influence one's individual behaviours if there is a high degree of novelty and uncertainty (Jansson et al., 2017; Pettifor et al., 2017; Smith & Louis, 2009; Thøgersen & Ebsen, 2019). Moreover, the concepts of descriptive and injunctive norms (Axsen & Kurani, 2012; Barth et al., 2016; Elgaaied-Gambier et al., 2018; Gilbert et al., 1998, pp. 151-162; Liao et al., 2017; Li et al., 2017; Pettifor et al., 2017; Schultz et al., 2007; Schuster et al., 2016; Smith & Louis, 2009; Smith et al., 2012; Thøgersen & Ebsen, 2019) are very important in terms of EV use. Descriptive norms relate to the extent that one can perceive others engaging in a certain behaviour in one's environment, and injunctive norms are related to one's perceptions of what behaviours are approved of in a community (Gilbert et al., 1998, pp. 155-157; Schuster et al., 2016; Smith et al., 2012). Research has shown that if these norms (i.e. EVs are accepted and visible in a community) are present (especially injunctive ones (Axsen & Kurani, 2012), but ideally both (Smith et al., 2012)), then the likelihood that one would use an EV is increased (Barth et al., 2016; Jansson et al., 2010; Pettifor et al., 2017; Smith et al., 2012), since we value social approval (Barth et al., 2016), and want to align ourselves with the behaviour of the group (our household, neighbourhood or friend group (Masson & Fritsche, 2014)), since maintaining social relationships is so important (Gilbert et al., 1998, p. 152). In this vein, the "subjective norms" component of the "Theory of Planned Behaviour" (TPB) (Ajzen, 1991) would bear some relevance here (Asadi et al., 2021; Nayum & Klöckner, 2014; Nayum et al., 2016) since studies such as Asadi et al., 2021 and Nayum et al., 2016 demonstrated that the expectations of significant others are very influential in one's own decision-making process regarding EV use. However, social norms can be a double-edged sword, primarily in the case of descriptive norms since if a behaviour is not present in a community, it would lead to a lesser likelihood of individuals partaking in said behaviour (Barth et al., 2016; Smith et al., 2012). This was the case of an EV study conducted in Denmark (Thøgersen & Ebsen, 2019). Therefore, it is important that EV use is visible and accepted in the community for social norms to have an effect.

Regarding personal norms, some research demonstrated that social norms are often internalised as personal norms (Asadi et al., 2021; Jansson et al., 2017; Liao et al., 2017; Klockner & Mattheis, 2004), which reflects positively on EV use (Asadi et al., 2021; Bobeth & Kastner, 2020; He & Zhan, 2018; Jansson et al., 2017; Klöckner & Matthies, 2004; Liao et al., 2017; Nayum & Klöckner, 2014). If one's internalised personal norms promote pro-environmental "green" behaviour (increased awareness and concern (Barbarossa et al., 2015;

Barbarossa et al., 2017; Dietz et al., 1998)), then it is likely that one would be motivated to use an EV, due to a feeling of moral obligation (Asadi et al., 2021; Barbarossa et al., 2015; Barbarossa et al., 2017; He & Zhan, 2018; Jansson et al., 2017; Liao et al., 2016; Nayum et al., 2016; Simsekoglu, 2018; Thøgersen & Ebsen, 2019). Furthermore, personal norms can be discussed in relation to the "Norm Activation Model" (NAM) which is an important theory in relation to environmentally significant behaviour (Asadi et al., 2021; Bobeth & Kastner, 2020; De Groot & Steg, 2009; Dietz et al., 1998; He & Zhan, 2018; Klockner & Mattheis, 2004; Nayum & Klockner, 2014; Nayum et al., 2016; Stern, 1999; Stern, 2000). In brief, this theory consists of several components, chiefly, personal norms (focus here), beliefs of behaviour, awareness of consequences and ascription of responsibility (De Groot & Steg, 2009; Dietz et al., 1998; He & Zhan, 2018; Nayum et al., 2016; Schwartz, 1973; Stern, 1999; Stern, 2000). Research demonstrated that individuals less inclined to use EVs exhibit less environmental concern, (Asadi et al., 2021; Beck et al., 2016; He & Zhan, 2018; Thøgersen & Ebsen, 2019), since to them EV use is less of a moral obligation (De Groot & Steg, 2009; Stern, 1999; Stern, 2000), which would be anteceded by a non-activation of the norm (Barbarossa et al., 2015; Barbarossa et al., 2017; Bobeth & Kastner, 2020; Thøgersen & Ebsen, 2019). Many studies have suggested that this intrinsic moral obligation is a critical component of one's self-identity and personal value system (discussed above) (Barbarossa et al., 2015; Barbarossa et al., 2017; Peters et al., 2018). If one identifies as a "green" person, and subsequently does not engage in "green" behaviours, it is possible that a form of dissonance could occur from this incongruence (Axsen et al., 2012; Barbarossa et al., 2015). Lastly, it is worth pointing out that many studies found that personal norms were a much stronger predictor than social norms when it came to environmentally significant behaviour (Bobeth & Kastner, 2020; De Groot & Steg, 2009; Jansson et al., 2017; Klockner & Mattheis, 2004; Smith & Louis, 2009). Conversely, Nayum and colleagues' study found social and personal norms to be a weak predictor of EV use (Nayum et al., 2016).

Research investigating socioeconomic predictors has demonstrated that cost related factors (taxes, financial incentives etc.) and high income are important predictors of EV use (Bühler et al., 2014; Chen et al., 2020; Noel et al., 2019). In Europe, especially in the Nordic region, fuel tax is high (Ryghaug & Toftaker, 2014), a factor that can accelerate the shift towards electric mobility (Nayum & Klöckner, 2014; Nayum et al., 2016). Indeed, the Norwegian EV market is one the most developed EV markets in the world (Jansson et al., 2017). Reasons for this include government subsidies and incentives encouraging EV use (Nayum & Klöckner,

2014; Ryghaug & Toftaker, 2014), such as reduced taxes and cheaper (or free) road tolls (Ryghaug & Toftaker, 2014). However, even in countries where conventional fuel is cheaper, such as the United States, raising the price of fuel to approximately 5.42 dollars per gallon (roughly 12.7 NOK/ litre) could persuade the average American to use an EV (Egbue & Long, 2012). Moreover, in countries such as Norway, especially in the early 2010s, "saving time and money" (Ryghaug & Toftaker, 2014) were regarded as primary reasons for adopting an EV, suggesting many consider financial reasons paramount. Research such as He and Zhan's study demonstrate that financial barriers ("low-cost hypothesis") to EV adoption are a significant problem, even if one identifies as being "environmentally minded" (He & Zhan, 2018; Thøgersen & Ebsen, 2019). Other studies have found a positive relationship between financial incentives and EV adoption intention (Asadi et al., 2021; Axsen & Kurani, 2012; Chen et al., 2020; Nayum et al., 2016), in terms of purchase price (Barth et al., 2016; Liao et al., 2017; Pettifor et al., 2017), lower cost of maintenance and fuel (Barth et al., 2016; Bühler et al., 2014), utility maximisation (Egbue & Long, 2012), or in terms of rental intention among people who are sceptical about EVs (Gulzari et al., 2022). Interestingly, even with financial incentivisation, many studies discerned a relationship between high income and EV use (He & Zhan, 2018; Jansson et al., 2017; Nayum & Klöckner, 2014; Nayum et al., 2016; Rasouli & Timmermans, 2013), in terms of being male (Chen et al., 2020), or female (Sovacool et al., 2018), or when it came to the choice of an additional car, as Simsekoglu's 2018 study showed. This could potentially be tied to (1) higher income people having greater financial security in the face of uncertainty (high involvement decision) (Gulzari et al., 2022; Thøgersen & Ebsen, 2019), (2) EVs being a symbol of wealth, status and image (Axsen et al., 2012; Liao et al., 2015; Li et al., 2017; Nayum & Klöckner, 2014; Simsekoglu, 2018; Sovacool et al., 2018), or (3) reduced price sensitivity (Liao et al., 2016). On the other hand, some studies included in Liao and colleague's literature review did not find income as a significant predictor (Liao et al., 2016), the same went for Egbue & Long, 2012 and Hidrue et al., 2011. Reasons for this could be due to other factors such as financial incentives, since people would naturally prioritise other domains over car-related expenses.

In terms of education, research has shown that in general, people who have a higher education degree are not only more likely to use an EV (Hidrue et al., 2011; Jansson et al., 2017; Nayum & Klockner, 2014), but are also more environmentally minded (Axsen & Kurani, 2012; Chen et al., 2020; Dietz et al., 1998; Gulzari et al., 2022; Nayum et al., 2016; Ryghaug & Toftaker, 2014; Simsekoglu, 2018; Sovacool et al., 2018). Reasons for this could be because of the idea

that universities are liberal institutions that espouse liberal values (Sovacool et al., 2018), or the fact that well-educated people usually have a greater awareness of technology and how it works, or even the fact that university-goers are younger and more future-oriented (Chen et al., 2020; Ryghaug & Toftaker, 2014). Axsen & Kurani's 2012 study also demonstrated that individuals with higher education are the "early adopters" of EVs, suggesting that they are less averse to change and innovation. Studies such as He & Zhan, 2018 instead did not find education to be a significant predictor of EV use.

Hypotheses and predictions

This thesis will investigate two research questions:

- "To what extent do social and personal norms predict electric car use?" (**RQI**)
- "To what extent do demographic and socioeconomic variables predict electric car use?" (**RQII**)

These questions will be investigated through seven hypotheses:

- "Personal norms expressed as moral obligations will predict greater EV use" (**H1**)
- "Social norms will predict greater EV use" (**H2**)
- "Younger age will predict greater EV use" (**H3**)
- "Male gender will predict greater EV use" (**H4**)
- "Higher education will predict greater EV use" (**H5**)
- "Higher income will predict greater EV use" (**H6**)
- "Financial incentives will predict greater EV use" (**H7**)

It is expected that pro-environmental norms (expressed as moral obligations) will be a salient component of social and personal norms, since this research was conducted in the Nordic country of Norway, where pro-environmental norms are prominent (Vainio & Paloniemi, 2014). One problem that this piece of research can hopefully shed some light on is the fact that there is a very complicated picture surrounding the different predictors of EV use, therefore it is hoped that it can elucidate the most influential predictors of EV use in the Nordic region in this transitional period of history.

Method

Procedure

In this study, a self-completion survey was used to gather data, employing a cross-sectional design. In terms of sampling, both convenience and snowball sampling were used. Firstly, convenience sampling took the form of orally recruiting respondents at a fixed physical location, in this case, two shopping centres in Trondheim, Norway, during February 2022 (one of them was in the city centre and is less car-orientated, whereas the other was more peripherally located and is more car-orientated). Respondents were asked if they wished to participate in a quick digital survey that was completely voluntary and anonymous. Secondly, snowball sampling took the form of the researchers themselves sending the survey to acquaintances (via SMS, email and online messaging), with the hope that they would in turn pass it on to their acquaintances and so on. Eight psychology students were involved in the project and were responsible for data collection. Data collection took place between Monday the 21st of February and Monday the 28th of February between the hours of 10:00 and 16:00. When it came to age and gender, it was attempted to recruit as diverse a sample as possible, however this was challenging since there were, on average, more women present at the shopping centres than men. Lastly, before participation, the respondents were all informed about confidentiality issues, such as anonymity and the security of their data.

Sample

The sample consisted of 396 individuals. However, one of the respondents did not consent to having his data used in the study and was eliminated. Further, nine respondents that were under the age of 18 were also eliminated, as well as two that did not select a binary gender. Of the remaining 384 individuals, 217 (56.5%) were female and 167 (43.5%) were male. The age group 18-30 consisted of 140 (36.5%) individuals of which 80 (57.1%) were female and 60 (42.9%) were male. The next group (31-50 years old) consisted of 90 (23.4%) individuals of which 59 (65.6%) were female and 31 (34.4%) were male, the penultimate group (51-70 years old) consisted of 108 (28.1%) individuals of which 56 (51.9%) were female and 52 (48.1%) were male. The final age group, where people were 71 years or older consisted of 46 individuals (12%) where 22 (47.8%) were female and 24 (52.2%) were male. Moreover, the minimum age was 18 and the maximum was 98 years, the mean and standard deviation were

44.58 and 19.69 years respectively. Further, 17 (4.4%) individuals completed only primary school, 125 individuals (32.6%) high school, 223 (58.1%) university, and the remaining 19 (4.9%) people chose "other" in terms of education. Finally, with income, 296 (77.1%) individuals had an average or lower income, and 88 (22.9%) individuals had an above average income.

Measures and instruments

Demographic, socioeconomic, and situational factors. Demographic questions (age and gender) were included at the end of the questionnaire. For gender, four options were available: "male", "female", "other", or "prefer not to say". For socioeconomic factors, two questions were asked regarding income and education. To gather information about the respondents' income, they were asked to indicate whether he/ she earned about the same as the Norwegian national average (587, 600 NOK per year), slightly less, a lot less, slightly more or a lot more. This was achieved by utilising a scale ranging from 1 to 5; 1 being a lot less, 3 being average, and 5 being a lot more than the national average. The second socioeconomic factor, education, was measured by presenting the respondents with four options in response to a question asking one's highest education level. The four options ranged from lowest to highest education level (1 being the lowest and 4 being the highest); "primary school", "secondary school", "university", and "other". Regarding situational factors, seven questions were asked. The first one involved walking distance to the city centre. Here, the participant was simply asked to indicate the walking time in minutes, (minimum value 0 and maximum 99). The next question asked whether the participant was in possession of a driving licence or not ("yes" or "no"). The third and fourth situational questions were similar; they asked whether the participant had access to a conventional and electric car respectively ("yes" or "no"). The remaining questions investigated electric scooters (both owned and shared) and car sharing services.

Transportation modes. Questions were asked about different modes of transportation wherein the participant had to indicate (1 to 9 scale) how often one would use a mode of transportation in a post-covid world (even if said mode is not currently available/ widespread). On the scale, 1 indicated "never", 5 indicated "sometimes", and 9 indicated "always". The modes of transportation asked included walking, conventional bicycle, electric bicycle, electric scooter, conventional car, electric car, hydrogen car, autonomous vehicle, carsharing, ridesharing, bikesharing, taxi, public transport, and urban air vehicles.

Quality attributes and psychological factors. Here, 17 questions were asked regarding the quality attributes of various transport modalities where the respondents had to choose from 1 (strongly disagree) to 5 (strongly agree) the degree to which they agreed or disagreed with the following quality attributes being important to them. The quality attributes used here were as follows: “safety”, “comfort”, “environmental friendliness”, “self-image”, “costs”, “stress”, “flexibility”, “protection from bad weather”, “travel time”, “convenience”, “physical activity”, “reliability”, “security”, “fitness”, “travel speed”, “accessibility”, and “novelty”. Moreover, an array of various psychological factors was measured using Likert scales. Said scales ranged from 1 (strongly disagree) to 5 (strongly agree). Of these questions, four were specifically about walking and another four about EV use. Of the four questions about EV use, two of them were specifically aimed to measure personal norms, (“I feel that I have a moral obligation to use an electric car as opposed to a conventional one” and “I believe that using an electric car is congruent with my personal values”), and the other two, social norms, (“Many people who live in my neighbourhood are very engaged in environmental issues” and “there is more pressure to buy an electric car if one lives in an urban environment”). The following five questions measured opinion leadership, social orientation, general attitude regarding emerging mobility, and finally social norms regarding emerging mobility. Lastly were five questions exclusively about alcohol use and electric scooters.

Statistical procedures

All statistical analyses were conducted using IBM SPSS Statistics 28. When it came to the variables, EV use was the dependent variable and the demographic variables of age and gender, socioeconomic variables of income and education, the quality attributes of “cost” and “environmental friendliness”, as well as the reduced components of “safety and security”, “ease of use”, “physical health” and “status”, and the psychological variables of social and personal norms were the independent variables. Furthermore, the psychological variables of social and personal norms were created by averaging the two questions regarding social and personal norms together into one variable. In continuation, the variable “gender” was cleaned by making it binary (hence removing the values “prefer not to say” and “other”) and changing the value of “female” from “1” to “0” and male from “2” to “1”. Penultimately, the variable “education” was coded into the dummy variable “well educated”, with the labels “other” and “university”; the latter label including the original option “university” and the former everything else. Lastly, “income” was dummy coded to “high income”, which contained the

items “average or less” and “above average” which included labels 1, 2, 3 and 4, 5 respectively.

Furthermore, descriptive statistics were used to ascertain the distribution of sample characteristics for the demographic variables of age and gender, the socioeconomic variables of income and education, the quality attributes of “cost” and “environmental friendliness” and the psychological variables of social and personal norms.

Next, a PCA with iteration, Kaiser criterion and direct oblimin (oblique) rotation was carried out with the intent to reduce the number of quality attributes in the study. Direct oblimin rotation was chosen because it allowed the components to correlate (Brenner, 2019), which is usually favoured in psychological research.

Finally, a hierarchical linear regression analysis was chosen because the analysis involved three stages (Field, 2018, p. 1283). This analysis, consisting of three blocks, was completed to predict EV use. The first block included the demographic variables of gender and age and the socioeconomic variables of income (dummy coded to “high income”) and education (dummy coded to “well educated”). The second block included all these variables in addition to the reduced dimensions of “wellbeing and protection”, “ease of use”, “physical health” and “status”, as well as the separate quality attributes of “costs” and “environmental friendliness”. The final block included everything above in addition to the psychological variables “social norms” and “personal norms”. The reason for why this analysis involved three blocks was to see if the relevant quality attributes and psychological variables added to the explained variance, as well as discerning the real influence of said attributes on the independent variable. For all three analyses, multicollinearity was not discovered due to the largest variance inflation value (VIF) being well below 10 (averaging around 1) (Field, 2018, p. 534), as well as the tolerance statistics being well above 0.2 (Field, 2018, p. 554). Lastly, this hierarchical regression analysis included a Durbin-Watson test which tested for correlations between residuals. However, since this test statistic was 1.93 and a value of 2 indicates uncorrelated residuals (Field, 2018, p. 514), it was assumed that the residuals were not correlated.

Dimensionality and reliability of the measurement instruments

The outcome of the PCA is shown in table 1 below. Six items were removed from the analysis meaning that the initial 17 items were reduced to four components. The quality attributes that were removed included “stress”, “costs”, “environmental friendliness”, “protection from bad

weather", "reliability" and "travel time". Of these components, "protection from bad weather", "reliability" and "travel time" were removed because they loaded more than once, "costs" and "environmental friendliness" were removed because they did not fit into any category and needed to be examined on their own (and were therefore retained as separate components because they related directly to **H7** and **H1**/ **H2** respectively), and "stress" was removed because it loaded with "costs" which did not constitute a valid category. Cumulatively, the components explained 65.95% of the total variance. The first component was entitled "wellbeing and protection", and consisted of the items "safety", "security" and "comfort". The second one was named "ease of use", and consisted of the items "travel speed", "convenience", "flexibility" and "accessibility". The third component, "physical health" included "fitness" and "physical activity". The final component, "status", included "self-image" and "novelty".

The reliability for all reduced dimensions was analysed using Chronbach's alpha. An alpha value of 0.70 or higher was seen as acceptable, but values of 0.80 or above were considered better (Field, 2018, p. 1054). The first component "wellbeing and protection" consisted of three items, $\alpha = .74$ yielding an acceptable degree of internal consistency. The second component, "ease of use", $\alpha = .69$, exhibited a lower degree of internal consistency, but was still acceptable. The penultimate component, "physical health", $\alpha = .86$, exhibited a very high degree of internal consistency. The final component, "status", $\alpha = .38$, instead demonstrated a very low degree of internal consistency, which therefore led to a correlation analysis being run instead[1]. Said analysis yielded a significant result, $r\ (382) = .24$, $p < .001$. A Pearson correlation analysis was chosen due to the fact that this component consisted only of two items. Some literature suggests Cronbach's alpha is meaningless in relation to two-item scales, and that Pearson correlation should be reported instead (Eisinga et al., 2012). For this reason, this component was retained in the final analysis.

[1]After consultation with the supervisor

Table 1
PCA of quality attributes (*N*= 384)

	Wellbeing and protection	Ease of use	Physical health	Status	Communality
Safety	**.91**	-.11	.03	-.09	.80
Security	**.78**	.09	.13	-.07	.69
Comfort	**.70**	.09	-.15	.19	.58
Travel speed	-.12	**.75**	.03	.16	.60
Convenience	.01	**.73**	-.08	.02	.54
Flexibility	.01	**.73**	.04	-.17	.54
Accessibility	.11	**.66**	.02	-.00	.47
Fitness	-.03	.02	**.93**	.05	.87
Physical activity	.01	-.01	**.93**	-.00	.87
Self-image	-.13	.00	-.05	**.87**	.74
Novelty	.26	.01	.18	**.63**	.57
Eigenvalue	2.80	1.87	1.42	1.16	
% of variance	25%	17%	13%	11%	
Total variance				65.95%	

Note. Factor loadings higher than ±0.4 are in bold. Extraction method was Principal Component Analysis; rotated with oblimin with Kaiser normalisation

Results

Firstly, table 2 exhibits the descriptive statistics for the demographic variables of age and gender, the socioeconomic variables of education and income, and the psychological variables of social and personal norms.

Table 2

Descriptive statistics for demographic variables, socioeconomic variables, quality attributes and psychological variables (*N*= 384)

Variable	Min	Max	Mean	SD
Demographic variables				
Age	18	98	44.58	19.69
Socioeconomic variables				
Education	1	4	2.64	0.65
Income	1	5	2.57	1.16
Quality attributes				
Costs	1	5	4.09	0.91
Environmental friendliness	1	5	3.77	1.01
Psychological variables				
Social norms	1	5	3.27	0.83
Personal norms	1	5	3.12	1.16

Table 3

Hierarchical linear regression for predicting EV use (*N*=384)

Step	Independent Variable	*B*	*SE B*	β	*t*	*p*	ΔR^2	R^2_{adj}
Block 1							.02	.01
1	Age	-0.01	0.01	-0.03	-0.64	.53		
2	Gender	-0.17	0.31	-0.03	-0.56	.58		
3	Education	-0.02	0.31	-0.00	-0.08	.94		
4	Income	1.10	0.38	0.16	2.93	.00*		
Block 2							.07	.07**
1	Age	-0.01	0.01	-0.05	-0.88	.38		
2	Gender	0.16	0.31	0.03	0.53	.60		
3	Education	0.10	0.31	0.02	0.32	.75		
4	Income	1.06	0.37	0.15	2.89	.00*		
5	Wellbeing and protection	0.62	0.16	0.21	3.84	.00**		
6	Ease of use	0.16	0.15	0.06	1.07	.28		
7	Physical health	-0.31	0.17	-0.11	-1.90	.06		
8	Status	-0.02	0.15	-0.01	-0.11	.91		
9	Costs	0.14	0.17	0.04	0.81	.42		
10	Environmental friendliness	0.31	0.16	0.11	2.00	.05		
Block 3							.07	.13**
1	Age	-0.00	0.01	-0.02	-0.32	.75		
2	Gender	0.28	0.30	0.05	0.94	.35		
3	Education	0.05	0.30	0.01	0.17	.87		
4	Income	0.85	0.36	0.12	2.40	.02		
5	Wellbeing and protection	0.69	0.16	0.24	4.43	.00**		
6	Ease of use	0.25	0.15	0.09	1.74	.08		
7	Physical health	-0.28	0.16	-0.09	-1.73	.08		
8	Status	-0.05	0.15	-0.02	-0.35	.73		
9	Costs	0.10	0.16	0.03	0.63	.53		
10	Environmental friendliness	-0.06	0.17	-0.02	-0.35	.73		
11	Social norms	-0.32	0.18	-0.09	-1.73	.08		
12	Personal norms	0.79	0.14	0.31	5.48	.00**		

Note. * significant at $p < .005$ ** significant at $p < .001$

Secondly, a hierarchical linear regression containing three blocks was conducted to predict EV use. The results from these analyses were reported in table 3 above. Of the three blocks, the second and third were significant in predicting EV use, $R^2_{adj} = .07$, $F(10, 373) = 3.82$, $p < .001$ and $R^2_{adj} = .13$, $F(12, 371) = 5.94$, $p < .001$ respectively. These two blocks exhibited significant F change at $p < .001$, explaining 7% and 13% of the total variance respectively. The first block was not significant, $R^2_{adj} = .01$, $F(4, 379) = 2.21$, $p = .07$. With regards to individual predictors, two were significant at $p < .001$. The first was "wellbeing and protection", ($\beta = 0.24$, $p < .001$), and the second, which supported **H1**, was "personal norms" ($\beta = 0.31$, $p < .001$). The variable "income" exhibited significance at $p < .005$, but only in

blocks one (β= 0.16, *p* = .004) and two (β= 0.15, *p* = .004). However, this would still support **H6** in that high income predicted EV use. In the third block, this variable became nonsignificant (β= 0.12, *p* = .02). The second hypothesis, **H2**, was not supported by the data since the variables "environmental friendliness" and "social norms" were (β= -0.02, *p* = .73) and (β= -0.09, *p* = .08) respectively. However, it is worth noting that the variable "environmental friendliness" was almost significant in the second block (β= 0.11, *p* = .05), but became highly nonsignificant in the third. Further, hypotheses **H3, H4, H5** and **H7** which predicted younger age, male gender, higher education, and financial incentives (cost) (respectively) in relation to EV use were not supported by this analysis since the data were nonsignificant at (β= -0.02, *p* = .75), (β= 0.05, *p* = .35), (β= 0.01, *p* = .87) and (β= 0.03, *p* = .53) respectively. Therefore, it is highly evident that the variable "personal norms" is an important predictor of EV use.

Discussion

Psychological factors

The results from this study demonstrate partial support for the first research question (**RQI**) in that personal norms were a significant predictor of EV use (**H1**), but not social norms (**H2**). This was in line with some prior research that made this comparison (Bobeth & Kastner, 2020; Jansson et al., 2017; Klockner & Mattheis, 2004). Possible reasons for why this may be the case lies in the fact that personal norms, unlike social norms, are explicitly moral issues, as Thøgersen & Ebsen's study described (Thøgersen & Ebsen, 2019), and that personal norms form a much more influential aspect of one's self concept, becoming part of one's internalised value system (Barbarossa et al., 2015; Barbarossa et al., 2017; Bobeth & Kastner, 2020; Elgaaied-Gambier et al., 2018; Jansson et al., 2017; Klockner & Mattheis, 2004; Peters et al., 2018). When interpreting these results, it is evident that one's moral obligation to protect the environment and reduce the negative environmental effects of car travel (Bobeth & Kastner, 2020) is more influential than peer comparison due to the nonsignificant effect of social norms. Since being "environmentally friendly" alone was not a significant predictor, it is possible that this variable could act in tandem with personal norms. One can presume that this is meaningful because, as Axsen described, it is a "paradigm shift" in terms of one's personal

values[2], suggesting something permanent as opposed to a superficial and temporary change (Axsen & Kurani, 2012). Taking a more applied perspective in the Nordic context, one can see that the sense of individual responsibility as well as one's awareness of negative consequences (of non-EV use for example) (Asadi et al., 2021; Bobeth & Kastner, 2020; De Groot & Steg, 2009; He & Zhan, 2018) is strong in that it leads to an explicit moral obligation surrounding the need to reduce the negative consequences of climate change (Asadi et al., 2021). The Nordic countries such as Norway have a lot to lose if climate change gets worse. Some examples of this include the melting of polar ice caps (especially in Svalbard), biodiversity loss (especially in central and northern Norway), ecosystem change, loss of plant life and so on (Descamps et al., 2016; Holten & Carey, 1992), as well as the loss of cultural activities such as skiing. Individual awareness of these detrimental effects is likely to be the primary motivator for one's moral obligations surrounding EV use. Also, it is worth noting that the sample of two of the reviewed studies came from China (He & Zhan, 2018) and Malaysia (Asadi et al., 2021), which reflects positively in terms of generalisability.

There are many possible reasons for why a nonsignificant result for social norms was attained (**H2**). Firstly, as many pieces of research have shown, EV diffusion is still at an early stage (Barth et al., 2016; Bobeth & Kastner, 2020; Egbue & Long, 2012; Liao et al., 2016; Thøgersen & Ebsen, 2019), meaning that descriptive norms would have a reduced effect. However, since the injunctive component of social norms was more influential, it is curious why a significant effect was not found. Possible reasons for this could be since injunctive and descriptive norms were not aligned, they were less influential (Smith & Louis, 2009; Smith et al., 2012), or because descriptive norms are more associated with behaviours and injunctive ones with attitudes (Elgaaied-Gambier et al., 2018). Moreover, within the Nordic context, Norway is classified as an "individualistic" country in relation to Hofstede's cultural dimensions (Kolstad & Horpestad, 2009). This suggests that the average person would be less influenced by peers and is instead guided to a greater extent by personal norms (internalised injunctive messages (Elgaaied-Gambier et al., 2018; Jansson et al., 2017; Klockner & Mattheis, 2004) and/ or environmental concern), and is less worried about social validation (Barth et al., 2016), in addition to the fact that EVs are far less novel in the Nordic region (Barth et al., 2016; Chen et al., 2020; Klöckner, 2014; Noel et al., 2019; Ryghaug & Toftaker, 2014; Simsekoglu, 2018; Sovacool et al., 2018; Thøgersen & Ebsen, 2019). Also, the type of

[2]Values provide justification for norms ("Social Values And Norms", 2022)

accommodation (apartments, detached homes, shared flats etc.) one lives in could have also influenced the degree of conformity (neighbourhood effects). Moreover, it is worth noting that the sample of this study was diverse in terms of age (M = 44.58), and that some studies reviewed (Pettifor et al., 2017; Smith et al., 2012) sampled university students. This can be troublesome since social psychological research suggests that young people are more susceptible to conformity effects as opposed to older people (Costanzo & Shaw, 1966; Knoll et al., 2015), which has the potential to bias results in an erroneously significant direction. However, since other studies used a diverse sample, this consideration is minor.

Demographic factors

When it came to demographic variables (younger age (**H3**) and male gender (**H4**)), no significant results were found. This nonsignificance is interesting since many prior studies found younger age (Barbarossa et al., 2017; Chen et al., 2020; Gulzari et al., 2022; Hidrue et al., 2011; Li et al., 2017; Nayum et al., 2016; Simsekoglu, 2018; Sovacool et al., 2018) and male gender (Barbarossa et al., 2017; Chen et al., 2020; Egbue & Long, 2012; Gulzari et al., 2022; Jensen et al., 2014; Liao et al., 2016; Li et al., 2017; Nayum et al., 2016; Priessner et al., 2018; Rasouli & Timmermans, 2013; Ryghaug & Toftaker, 2014; Sovacool et al., 2018) to be significant predictors for EV use. Granted, there was slightly more debate surrounding male gender (Chen et al., 2020; Jensen et al., 2014; Rasouli & Timmermans, 2013; Simsekoglu, 2018), but it appeared almost universal that younger people were the ones most likely to use EVs. The fact that this predictor was not significant suggests a few things. Firstly, Chen's point stating that younger people have less purchasing power compared to older age groups should be considered (Chen et al., 2020), especially in the context of a Nordic country such as Norway, where the cost of living (Warner-Søderholm et al., 2014) and vehicle taxes (Ryghaug & Toftaker, 2014) are very high, resulting in many young people (who are likely to identify as "pro-environmental") not having the ability to purchase an EV. The second point surrounds the fact that the sample of this study was predominantly urban, which suggests less car orientation. Studies such as Chen et al., 2020 and Pettifor et al., 2017 have a more mixed sample in terms of location. Younger people living in urban areas are usually not dependent on cars since these areas prioritise other forms of transport such as walking (Badland et al., 2017) or public transportation (Pflieger et al., 2009) as opposed to car use. Trends in urban planning such as compact city design (Bibri et al., 2020) also help reduce overall car dependence. Younger people also have more modern views regarding

transportation in general, often preferring to walk or use public transport for health and liveability reasons respectively (Brown et al., 2003; Egset & Nordfjærn, 2019) since they are more open to change than older people (Barbarossa et al., 2017). Further, since the sample consisted of few individuals with children, it is likely that this could have also biased the results in a nonsignificant direction since research demonstrated a relationship between EV use and having children (Chen et al., 2020; Jansson et al., 2017; Nayum et al., 2016; Simsekoglu, 2018).

The nonsignificant result of gender (**H4**) is less surprising. Even though the studies discerned a relationship between male gender and EV use, other elements must be considered. Firstly, two studies demonstrated that many facets of EVs, such as ease of operation, driving performance, safety, the fact that EVs are generally good for shorter trips and environmental benefits were generally preferred for women, not men (Jensen et al., 2014; Sovacool et al., 2018), as well as the fact that men were more concerned with range (Egbue & Long, 2012). It is possible that men value the hedonic nature of driving a non-EV (Tchetchik et al., 2020) to a greater extent than women, or that in this study's sample, gender was not important since there is a high degree of gender equality in Norway (Teigen & Wängnerud, 2009). Further, in more egalitarian societies like Norway, it is possible that more traditional associations between masculinity and driving non-EVs are less salient.

Socioeconomic factors

The significant result concerning high income (**H6**), and nonsignificant one concerning costs (financial incentives) (**H7**) demonstrates that EV use is associated with higher income (Chen et al., 2020; He & Zhan, 2018; Jansson et al., 2017; Liao et al., 2017; Li et al., 2017; Nayum et al., 2016; Nayum & Klöckner, 2014; Rasouli & Timmermans, 2013; Simsekoglu, 2018; Sovacool et al., 2018) regardless of any cost related factors. Some research demonstrated that financial incentives are a shallow measure that do not translate into long term behavioural change once the financial incentive is terminated (Barbarossa et al., 2015; Barbarossa et al., 2017), which can be applied to the Norwegian context since incentives, such as free parking (Rasmussen & Tiller, 2016) or free tolls (Kosowski, 2021) are slowly being eliminated. However, since other research showed that short-term financial incentives (Li et al., 2017; van Wee et al., 2012), as well as short-term urban privileges (van Wee et al., 2012) were highly effective in increasing EV use, one should be cautious about drawing concrete conclusions.

Upon further interpretation, one can theorise that the "low-cost hypothesis" (Axsen & Kurani, 2012; He & Zhan, 2018) was less important to this sample. This could be due to the strong environmental mentality of most Nordic (Norwegian) (Jansson et al., 2017; Vainio & Paloniemi, 2014; Vikan et al., 2007) people, as well as a stronger emphasis on climate change in the 2020s as opposed to the early 2010s, where cost appeared to be a more influential factor driving EV use (Ryghaug & Toftaker, 2014). Since Norway is a wealthy country, people can afford to purchase items (EVs) that align with their personal value system (Pettifor et al., 2017), especially those who have a high income.

Lastly, higher education was also nonsignificant when it came to EV use (**H5**). This result is curious since many studies (except He & Zhan, 2018) posited a relationship between higher education and EV use (Axsen & Kurani, 2012; Chen et al., 2020; Gulzari et al., 2022; Hidrue et al., 2011; Jansson et al., 2017; Nayum et al., 2016; Nayum & Klockner, 2014; Simsekoglu, 2018; Sovacool et al., 2018). Further, of these studies, five (Chen et al., 2020; Nayum et al., 2016; Nayum & Klockner, 2014; Simsekoglu, 2018; Sovacool et al., 2018) were conducted in (or included) Norway. The fact that studies with a Norwegian (or partially) sample found a significant result for education and the current study did not is interesting. Further, education was one of the most nonsignificant predictors, garnering a *p* value of over .90 in the first block. Understanding the reasons for this could lie in the fact that (as stated) Norwegian people are generally very environmentally aware (Jansson et al., 2017; Vainio & Paloniemi, 2014; Vikan et al., 2007) due to wide media coverage, and that Norway scores highly on Hofstede's long-term orientation (preparation for the future) (Warner-Søderholm, 2012), suggesting that Norwegian society is geared towards environmental issues and future orientation. Due to the above results, one can say that **RQII** was also partially answered.

Limitations

This research has many limitations. Firsty, as stated in the introduction, there are some problematic generalisability issues since this survey was conducted in the Norwegian city of Trondheim and contained a majority of "WEIRD" (western, educated, industrialised, rich and democratic) participants (Henrich et al., 2010). These issues could reduce generalisability outside the Nordic region, where pro-environmental norms are likely less salient. In continuation, since this survey examined transportation in Norway, the issue of season should be briefly outlined since it was conducted in February. What this means is that transportation modalities such as electric scooters and bicycles would be used to a lesser extent, either due to

difficult winter conditions such as snow and ice (Sande, 2017), or the nonavailability of public electric scooters in the city (Lambertsen, 2021). One potential problem could be the fact that some people might assume that the questions regarding frequency of use of transport modalities referred to present time, and not a general perspective. This therefore has the potential to bias results favouring more "year-round" forms of transportation such as public transport, walking or car use. One way to have remedied this would be to make explicit the non-temporal nature of the questions regarding transport modalities or to distribute the questionnaire at a different time of year.

In relation to sampling, convenience sampling, which took place at shopping centres presents a couple of generalisability issues, even from a city-wide perspective. Firstly, the precise week (21st - 28th of February 2022) that the sampling took place was the "winter holiday" week where many individuals were off work and schools were shut. The consequence of this was that many potential respondents were not present in the city, meaning adults who have children (usually aged between 30-50) were scarce. Moreover, since people with an average or high income usually travel away during the holidays, it is possible that the sample was biased in the direction of lower income people, since they would have had a greater presence in the city. In this same vein, shopping centres usually attract certain age groups more than others. In the case of the one located in the city centre, an abundance of younger people, as well as older people. Individuals in the mid age range were less common and harder to sample. Furthermore, it could have been beneficial to sample from an array of locations such as parks, squares or local forests since research has shown that people are generally less stressed and more relaxed in "natural" environments (Frumkin, 2001; Han, 2003). Shopping centres would naturally be more conducive to stress and "busyness" and would therefore mean potential respondents could have been less amenable to filling out the questionnaire.

Examining issues related to the questionnaire, we can see that since there were many questions regarding different transport modes, it is possible that respondents, to an increasingly great extent, would rely on "estimation strategies" instead of remembering how frequently they used a certain modality (Schwarz, 1999). This could in turn, lead to inaccurate responses. Many of the questions regarding quality attributes employed a Likert scale ranging from 1 to 5, with a 3 in the middle denoting neutrality, which can be both a limitation and a strength; a limitation in that it could "subdue" the participant into repetitively choosing the middle value since it requires less conscious effort and thought and therefore not being

representative of their true opinion. Another limitation surrounds social desirability bias and self-presentation (Schwarz, 1999). Here, these issues would arguably be more salient with the attitudinal questions. It is possible that respondents who answered the survey at the shopping centres wanted to give a "good impression" in that they, for example, harboured positive attitudes towards the environment. It is believed that this could have occurred among a number of older respondents, who required direct assistance from the researchers in answering the questions. Even though this may be an unconscious bias, it still could have biased the results from the attitudinal questions.

Strengths

Some strengths of this research include the fact that a combined sampling method was employed, in that there was not a total reliance on sampling from the shopping centres, meaning also that a more diverse sample was attained. In terms of the questionnaire, the "maxim of manner" was satisfied; the questions were unambiguous, clear, and straight to the point with minimal room for individual interpretation (Schwarz, 1999). For example, asking respondents to answer, "very frequently", "frequently", "not frequently" and so on leaves the door open for individual interpretation to a much greater extent than a concrete "once a year", "weekly" or "agree", "strongly agree" etc. Moreover, there was good room for nuance when it came to the questions about different transport modalities since the Likert scale employed a 1-9 range. Here, there was a higher chance that the respondents would stop and think exactly where they wished to answer, since there was more choice. This hopefully would have led to more meaningful answers. Lastly, the inclusion of a middle value (3) on the questions ascertaining quality attributes and psychological variables was beneficial since it served to reduce response bias (Croasmun & Ostrom, 2011). This was because it allowed respondents to remain neutral and not be forced into an opinion, or even worse not answer the question at all.

Implications for further research

This study paves the way for future research investigating high income and EV use, as well as within the domain of personal norms since personal norms were a significant predictor of EV use. Further, the flexibility of the combined convenience and snowball sampling would be beneficial to implement in future research since it enabled a more diverse sample to be attained. However, future studies of this nature should also endeavour to sample from locations such as "natural spaces" (parks, forests etc.), since a greater sample diversity could

be attained, as well as differentiating more between different nationalities and ethnicities. Penultimately, research in this area is becoming increasingly important due to the ongoing climate crisis and the need to transition to electric mobility. Hopefully, research can better inform policymakers and salespeople in the hope that EV use can be accelerated via personal norm appeals, especially in highly individualistic societies such as those in the Nordic region (Kolstad & Horpestad, 2009). It is interesting however to see if a greater effect would be obtained from private or public sector incentives. Lastly, it would be advantageous to further pursue qualitative research within this domain (such as open interviews) since there is great potential for richer data to be derived due to the individualistic nature of personal norms, especially from individuals of different societies.

Conclusion

In conclusion, this study demonstrated that personal norms significantly predicted EV use which has the support of many studies (Asadi et al., 2021; Bobeth & Kastner, 2020; He & Zhan, 2018; Jansson et al., 2017; Klöckner & Matthies, 2004; Liao et al., 2017; Nayum & Klöckner, 2014), the same can be said for high income (Chen et al., 2020; He & Zhan, 2018; Jansson et al., 2017; Liao et al., 2017; Li et al., 2017; Nayum et al., 2016; Nayum & Klöckner, 2014; Rasouli & Timmermans, 2013; Simsekoglu, 2018; Sovacool et al., 2018). All other variables did not significantly predict EV use. Due to this, **RQI** and **RQII** were only partially answered. These results help solidify research that has posited relationships between high income and personal norms in relation to EV use. As well as contributing to already established literature in terms of high income and EV use, this research can also inform further potential qualitative research within the domain of personal norms with the hope that a richer understanding of the underlying psychological mechanisms can be better understood and that action regarding personal norm appeals can be taken, especially in relation to the ongoing climate crisis.

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