Consumer Adoption Behaviour for Electric Vehicles. A Holistic Research on Theories with Empirical Evidence on Motivational Factors when Adopting Electric Vehicles.

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International Doctorate in Entrepreneurship & Management (iDEM)

Doctoral Thesis

Consumer Adoption Behaviour for Electric Vehicles.

A Holistic Research on Theories with Empirical Evidence on Motivational Factors when Adopting Electric Vehicles.

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Supervisor: Prof. Dr. Josep Rialp

February 2023

Declaration

I hereby declare that this doctoral thesis represents my own work as dissertation of the iDEM program (international Doctorate in Entrepreneurship and Management) at the Universitat Autònoma of Barcelona (UAB).

Wherever contributions of others are involved, every effort is made to indicate this clearly, with due reference to the literature, and acknowledgement of collaborative research and discussions. I clearly marked and separately listed all of the literature and all of the other sources which I employed.

I am aware that the violation of this regulation will lead to failure of the dissertation.

Kathrin Monika Buhmann

PhD Student, 1398652

Additional information: The doctoral thesis is written in British English as language guideline, although direct citations use the original language, which is often oriented toward American English. The paper "Consumers' preferences for electric vehicles: The role of status and reputation." which was published in the Elsevier Journal Transportation Research Part D: Transport & Environment is written in American language (see paper in Appendix).

Acknowledgement

This journey of my doctoral thesis started in 2014 when I moved to Barcelona to study and enrol into the Master of Science MAREB program (Master of Applied Research in Economics and Business). It is a master's program focused on providing the relevant academic tools and knowledge necessary to complete a PhD doctoral program. However, after finishing the Master of Science in 2015, I started another master's in marketing to accumulate ECTS points necessary for the PhD program. This was because in Germany my bachelor's degree in "International Management and Relationship" was composed of 7 instead of 8 semesters, compared to the program in Spain. At the same time, and based on my background of coming from an entrepreneurial family and my previous work experiences at different companies, I decided to focus first on my industrial career and to continue with a prestigious Trainee/ Graduate program at Volkswagen Group Spain. However, 3 years later I got the opportunity to give classes at the UAB for Bachelor students in Marketing I and II. I loved this opportunity and learned a lot! After completing three semesters of classes, tutoring and exam preparation, I finally took the decision to focus on my PhD. So, in 2019, I asked Prof. Dr. Josep Rialp if he would be willing to support me as Supervisor and Director for my doctoral dissertation. He had already been my supervisor for my master's thesis, and I highly appreciate his undoubtedly best knowledge for statistics and solution-finding for the empirical part. Luckily, he accepted and for the past almost four years we maintained a very good supervisor-student relationship. He supported me in an excellent way during this time, and I am very grateful for all his help and professional support. I remember him telling me in the beginning, when I decided to realize the PhD parallel to the demanding work I have: "Kathrin, there might come a time where you want to put everything in a box to throw it into the ocean. If this moment comes, call me first and I'll try my best to convince you otherwise." Luckily, such a pronounced feeling didn't present itself, however I must admit that I got to my limits the last years. Specifically, the last two years were a real challenge, and I got the point where I calculated my time in minutes and I did sacrifices both for my social and health life. However, where's passion, there's motivation and determination 😊. As my grandfather used to say: "You're the master of your own destiny.", which I always recalled to myself.

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Invitation to the 2nd International Meet on Infrastructure and Construction (INFRAMEET2023**)** which will be held in Paris, France on June 05-07, 2023.

Invitation to the International Meet on Environmental Science and Engineering (IMESEMEET2023) which will be held in Rome, Italy during November 02-04, 2023.

Doctoral Thesis: Abstract

The aim of this dissertation is to explore consumer behaviour for the adoption of Electric Vehicles (EVs), to understand the different drivers and barriers consumers face when adopting or not EVs, and to empirically assess the factors and characteristics of consumers. The motivation for this dissertation is the world-wide growing concern for environmentally friendly products and the pressure to reduce the carbon footprint. EVs are considered a sustainable transportation solution to reduce greenhouse gas emission and to mitigate the causes of climate change on a global level. EVs have the potential to alleviate environmental problems, especially in the transport sector. However, the adoption rate for EVs is still low and consumers seem to be a reluctant to adopting this kind of technology.

First, a systematic literature review was conducted to understand the different theories that are used to analyse consumers adoption intentions for EVs. The theories examined in Chapter 1 are systematically compared in their scope, approach, and findings to point out similarities and to create a foundation for future research in this field. Based on existing literature, particular interest is put on the Theory of Planned Behaviour and its antecedents, which is then applied to our own data set in Chapter 3.

Based on the literature review, Chapter 2 explores the perceptual and motivational reasons for consumers when adopting EVs. This chapter offers an empirical approach with a primary data set sample of n>2.000 to better understand the factors for EVs adoption. A multiple logit regression model was developed, and several different analyses were run to explore factors that influence the likelihood of buying an EV, applying different aspects such as demographic variables, car attributes and external environmental factors. It is found that age, being male, having children, education, living in urban areas, and previous experience positively influence EV adoption. Better infrastructure and information availability help to promote EVs. Referring to consumer behaviour, it appears that reputation-driven consumers prefer EVs only when the purchase price is more expensive than that of other vehicles, suggesting that true environmental concern is attenuated by reputation motives and that the desirability of EVs as sustainable products only exists when prices are more expensive. The role of status and reputation as important motive for the adoption of EVs is highlighted and is of great research interest. In summary, this chapter adds new insights into the adoption of EVs from a consumer behavioural perspective and confirms certain earlier findings while implementing new empirical approaches.

Ultimately, in Chapter 3, the Theory of Planned Behaviour is applied to the primary data set sample using Smart PLS4 to analyse the impact of attitude, subjective norm, perceived behavioural control, moral norm, and environmental concern. In addition, based on previous research highlighting the importance of experience, education, and gender, a new dimension of

consumers as variable “profile” is created. Several analyses within PLS SEM Modelling are conducted, such as PLS Algorithms, Bootstrapping, Multigroup Analysis. The empirical analysis shows that the constructs “Attitude”, “Perceived behavioural control”, “Subjective Norm”, and “Moral Norm” have a direct positive impact on the adoption intention for EVs, with “Attitude” having the strongest relationship. As for the effect of “Environmental concerns”, this construct showed a positive indirect impact on the adoption intention, while no direct relationship of EC towards adoption intention could be found. Among the mediating variables, “Moral Norm” showed the strongest impact on adoption intention via the construct “Environmental concern”. The newly created variable “profile” showed no significant impact on the relationships towards adoption intention for EVs. The results confirm previous findings and serve as guideline for government and manufacturers. Based on the study’s results, the appropriateness of the TPB model is confirmed and it has a good explanatory power in predicting consumers’ intention to adopt BEVs.

In summary, the dissertation allows a deeper understanding of consumer behaviour for the adoption of EVs by applying systematic literature reviews and different statistical analyses based on an empirical primary dataset, thus revealing valuable contributions to the literature, and allowing for helpful conclusion for governments and industries.

Keywords:

Electric vehicles, Battery Electric Vehicles, Consumer preferences, Consumer behaviour, Theories, Adoption intention, Reputation, Extended Theory of Planned Behaviour, Environmental concern, Attitude, Subjective norm, Sustainability issues

Table of Contents

List of Tables

List of Figures

Appendix

List of Abbreviations

AFVs	Alternative Fuel Vehicles
AI	Adoption Intention
ATT	Attitude
AVE	Average variance explained
BEV	Battery Electric Vehicles
CFA	Confirmatory Factor Analysis
CMB	Common method bias
CMV	Common Method Variances
CO2	Carbon dioxide
CR	Composite reliability
CS	Car Sharing
CT	Constructive theory
DCE	Discrete Choice Experiment
DoI	Diffusion of Innovation
EC	Environmental Concern
EFA	Exploratory Factor Analysis
EM	Electro mobility
EU	European Union
EVs	Electric Vehicles
FCEVs	Fuel-cell electric vehicles
FFV	Flexible Fuel Vehicle
FT	Functional Theory
GHG	Greenhouse gas
HEVs	Hybrid Electric Vehicles
HTMT	Heterotrait-monotrait ratio matrix
ICEV	Internal Combustion Engine Vehicles
IDT	Innovation Diffusion Theory
IEA	International Energy Agency
JIF	Journal Impact Factor
LCM	Latent class model
MCA	Multiple Correspondence Analysis
MHEV	Mild-hybrid Electric Vehicle
MICOM	Measurement Invariance of Composite Models
MN	Moral Norm
NMIP	Non-monetary incentives policy
OEM	Original Equipment Manufacturer
OEMs	Original Equipment Manufacturer
PBC	Perceived behavioural control
PEOU	Perceived ease of use
PHEVs	Plug-in Hybrid Vehicles
PLS	Partial Least Squares
PSS	Product-service system
PU	Perceived usefulness
PVS	Personal Vehicle Sharing
REEV	Range-extended electric vehicle

SCI	Science Citation Index
SEM	Structural Equation Model
SN	Social/ Subjective norm
S-O-R	Stimulus-organism-response
TAM	Technology acceptance mode
TPB	Theory of Planned Behavior
TRA	Theory of Reasoned Action
UAB	Universitat Autonoma de Barcelona
UTAM	Unified Technology Acceptance Model
UTAUT	Unified Theory of Acceptance and Use of Technology
VBN	Value Believe Norm
VIF	Variance Inflation Factors
WoS	Web of Science

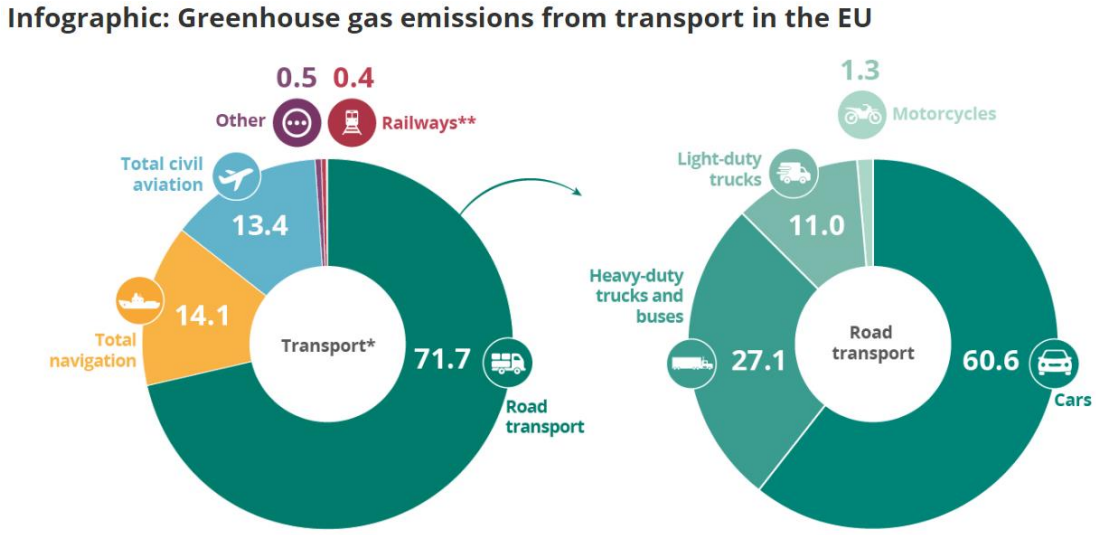
1 Introduction

1.1 The Role of Electric Vehicles today

Citing the importance of taking action in regards to climate change with its anthropogenic consequences are widely discussed and considered proven within the scientific community (Jochem et al., 2015). Many governments are promoting Electric Vehicles (EVs) to increase its market share (Gallagher & Muehlegger, 2011; Hardman et al., 2017; Li et al., 2019; Turcksin et al., 2013), while defining EVs as one possible solution to overcome environmental concerns. Air pollution in cities and growing environmental concerns result in a higher demand for acting responsibly for both companies and consumers.

The degradation of air quality concerns society´s health on a global level, while transport emissions are responsible for around 25% of the European Union's (EU) total greenhouse gas emissions (GHG) (European Commission, 2022). The European Commission set ambitious targets for all 27 EU member states to reduce CO2 emissions of new cars and vans, aiming at a 55% reduction of emissions from cars by 2030, compared to 1990 levels. The goal is to be the first climate-neutral continent by 2050. The transport sector itself represents a quarter of Europe´s GHG emissions and is considered the main cause of air pollution in cities (European Commission, 2022). Out of these emissions, over 70% stem from road transport, as the following figure shows.

Figure 1: Greenhouse gas emissions form transport in the EU



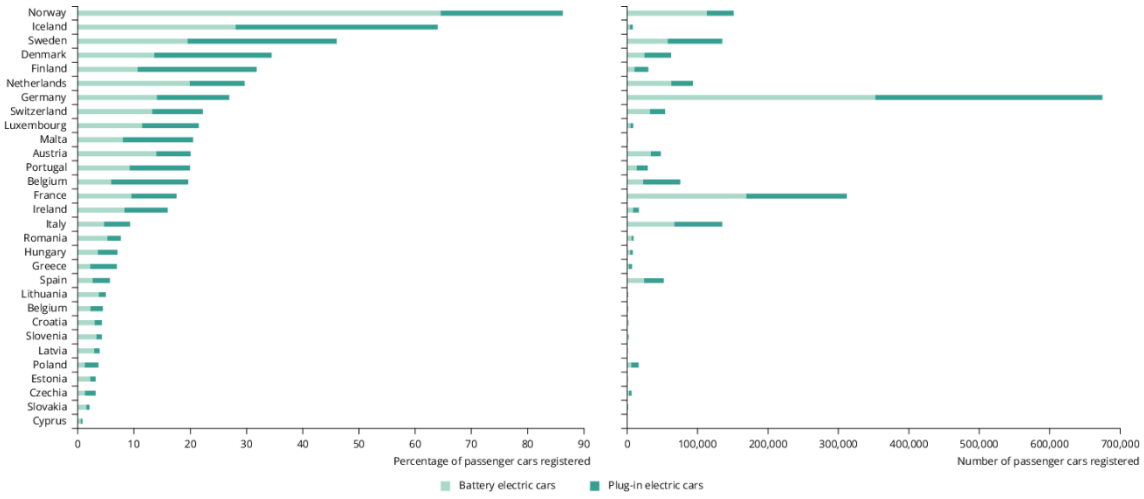
Source: European Commission, 2022

Therefore, in recent years, Plug-in Hybrid Electric Vehicles (PHEVs) and Battery Electric Vehicles (BEVs) have increased in relevancy in the field of sustainable transport. However, despite the increasing demand, the diffusion of EV is still limited, counting only 2,7% for BEV and 4,9% for PHEV of all cars registered in Spain in the end of 2021 (MSI Iberia, 2022). In 2019,

new registrations of electric cars increased significantly up to 2,1 million globally to boost the stock to 7,2 million electric cars (IEA, 2020). In 2020, Electric Vehicles sales even increased by 41% with 3 million vehicles worldwide (IEA, 2021). The Global Electric Vehicle Outlook highlighted that policy approaches show a clear, long-term transition into an economically sustainable environment and highlights the importance of technological progress in the electrification (IEA, 2021). The steady increase between 2013-2019 of the EU´s domestic transport emissions is related to the growth in passenger transport volume (EEA, 2022a). Although greenhouse gas emissions (GHG) from the EU transport sector decreased in 2020, this decrease refers to an overall lower activity due to the Covid-19 pandemic, and road transport remains the main GHG contributor of all transport emissions (EEA, 2022a).

The following Figure 2 reports the number of newly registered electric cars in the EU27 and non-EU EEA countries (EEA, 2022b). In addition, Figure 2 shows Spain as bad performer referring to the percentage of electric cars registered, whereas countries such as Norway, Iceland, Sweden, Denmark, and Finland are considered Benchmark.

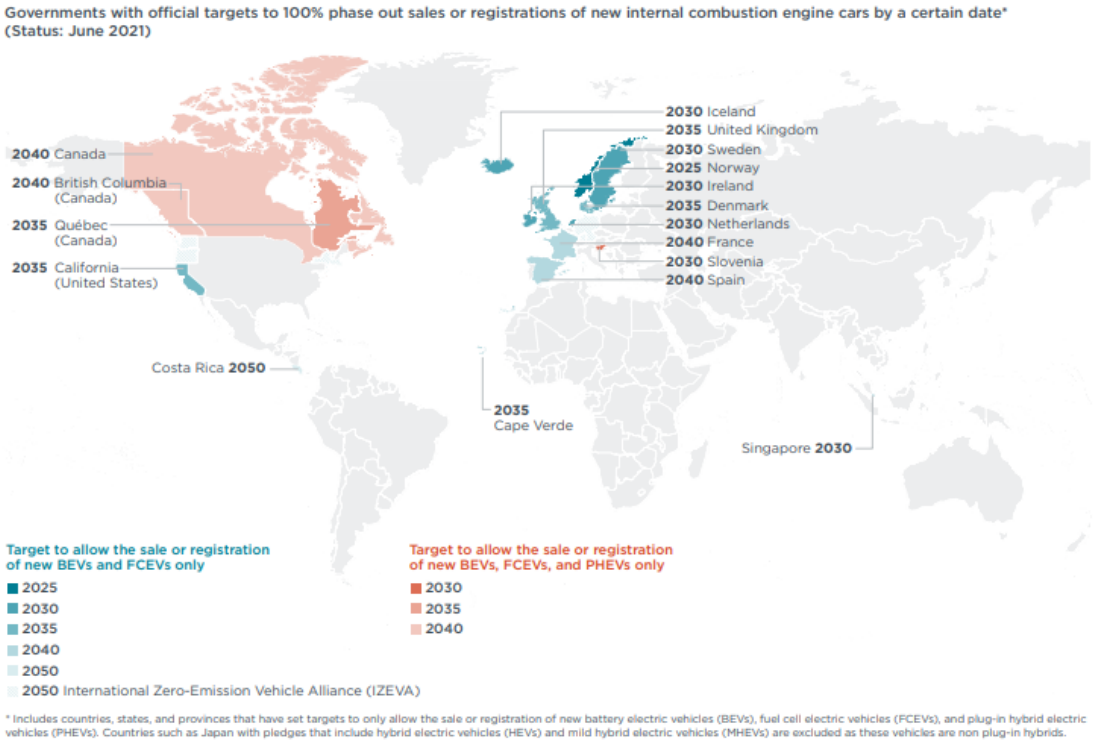
Figure 2: Newly registered electric cars by country



Source: EEA, 2022b

Furthermore, some countries have announced plans to ban internal combustion engine vehicles from city centres or excluding them from governmental supports, which marks an important step in the development of electric vehicles. In general, EU member states should implement additional measures to reduce transport emissions, and policies should focus on promoting further low-carbon fuels or electric cars, and they are also focusing on a modal shift to public transport (EEA, 2022a). Figure 3 provides a status worldwide of when governments plan to phase out sales or registrations of new internal combustion engine vehicles.

Figure 3: Targets per countries to phase out sales ICE cars



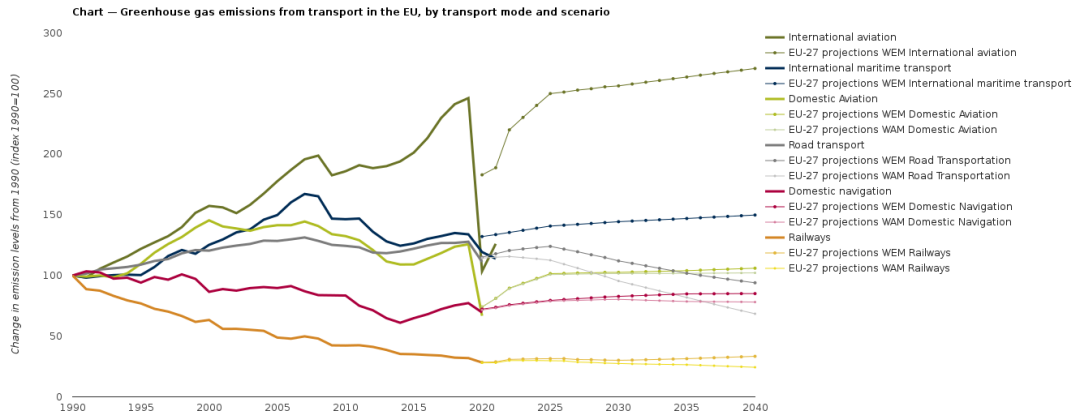
Source: ICCT, 2021

Considering these facts and figures, it is no surprise of the amount studies analysing contextual factors to incentive an EV purchase, and taxes and subsidies are considered as very important ones. Countries such as Denmark have exempted EVs from the car registration tax, like in Norway (Thogersen & Ebsen, 2019). In comparison to Europe, the market share of EVs in Spain is still expandable. The charging infrastructure in Spain in November 2022 is composed of 10.404 charging points (Electromaps, 2022).

1.2 Description of different types of Electric Vehicles

Although a steady trend for reducing greenhouse gas in Europe can be witnessed in recent years, the transport sector has not yet adequately followed and shows a significant relative contribution to overall GHG emissions in Europe (EEA, 2022a). Nevertheless, it is important to clarify that the transport sector shows lower greenhouse gas emission than aviation and maritime transport, but still needs to be more ambitious to achieve its goal set in the European Green Deal. The European Green Deal outlines a number of initiatives across all policy sectors defined by the EU with the aim of making the EU climate neutral by 2050 (European Commission, 2020). In general, the impact of Covid-19 induced a reduction of greenhouse gas emissions in 2020 in all sub-sectors as shown in the following Figure 4.

Figure 4: Greenhouse gas emissions from transport in the EU



Source: EEA, 2022

EVs offer a viable alternative to conventional vehicles that could help to meet the target of reducing Co2. There exist different types of EVs, such as vehicles that are fully electric, standard hybrids, or rechargeable hybrids. The first group is powered entirely by electricity, and therefore produces no emissions while driving. In contrast, traditional vehicles called internal combustion engines (ICE) emit higher amounts of greenhouse gases and have internal combustion engines that burn petroleum. Based on the growing concerns towards environmental issues, Original Equipment Manufacturers (OEMs) are being pushed to produce more environmental-friendly cars, with regulations aimed at reducing CO_2 emissions. Table 1 explains the different types of vehicles with their corresponding abbreviations. Hybrid Electric Vehicles (HEVs) as being vehicles that have an internal combustion engine alongside a supplementary electric motor driven by a battery are not considered further for this research. HEVs do not require a drastic change in consumer behaviour due to their similarity to ICE vehicles, and therefore show less or nondisruptive innovation in transportation technology.

Table 1: Overview EVs Technology

Vehicle type	Short name	Description
Battery Electric Vehicles	BEVs	BEVs are powered entirely by an electric motor which works with batteries, and thus without any combustion gasoline engine. The batteries are usually larger than the ones for PHEVs and are rechargeable, so that the vehicle can be plugged into an external source of electricity. BEVs can also, like all electric vehicles, recharge their batteries through regenerative braking for which its kinetic energy is converted into electricity when slowing the car down. Such cars are zero emission vehicles.
Plug-in Hybrid Electric Vehicles	PHEVs	PHEVs are made up of an electric or battery motor in combination with a gasoline engine, while the battery-powered electric motor is the main power source. It continues to use this electric motor until the battery is used up. The battery is often smaller than the one in pure BEVs. Such vehicles can be recharged with electricity or refuelled with gasoline and have very low emissions. Both HVs and PHEVs combine the internal combustion engine with

		the battery and electric motor, but the PHEVs can be recharged from external sources, such as plugging them in at home, regenerative breaking, or by gas engine.
Hybrid electric vehicles	HEVs	HEV is a type of hybrid vehicle and electric vehicle and is mainly powered by an internal gasoline combustion engine. The electric motor is only used to complement this combustion engine. Such cars use the electric motor at low speeds and then change into gasoline power, in contrast to PHEVs. Thus, the main power source is still gasoline. In doing so, such cars combine benefits of both kinds of power sources and are considered a combination of low emission and conventional cars.
Fuel-cell electric vehicles	FCEVs	FCEVs runs on electricity using hydrogen from an on-board tank that is combined with atmospheric oxygen
Range-extended electric vehicles	REEVs	REEV is powered by an electric motor and a plug-in battery. The auxiliary combustion engine is used only to supplement battery charging.
All electric vehicles	AEVs	Abbreviation that includes both BEVs and FCEVs. In addition to charging from the electrical grid, both types are charged in part by regenerative braking, which generates electricity from some of the energy normally lost when braking.

** Further types are existing, but are not explained in more detail here, e.g. hydrogen fuel cell vehicles, natural gas NGV*

It is important to highlight that this dissertation aims to analyse the consumers of EVs from a marketing and managerial perspective. Thus, when focusing on the keyword "Electric vehicles", it is always examined from a consumer´s point of view and not from a technical point of view.

1.3 Problem Statement

As previously explained, there is growing interest in EVs as a possible sustainable solution for the transportation sector. However, consumers are still reluctant to adopting this kind of technology, as it is reflected in the low adoption rates of EVs. Spain as southern country of the European Union lags behind in the adoption of EVs with only 2.7% for BEV and 4.9% for PHEVs of all vehicles registered in 2021 (MSI Iberia, 2022), compared to countries such as Norway, Iceland, Sweden and Denmark with shares of 86%, 64%, 46%, and 35% respectively (EEA, 2022a). On one side, society is demanding more environmental-friendly products to reduce carbon footprint, and on the other side, consumers in the transportation sector adopt EVs very slowly with EVs representing minor market share quotes. Despite the incentives and the EU's ambitious goals to reduce gashouse emissions in the transport sector, market diffusion of EVs is still low. Concisely, the road to the progress of the adoption for EVs still cannot be called a success. Therefore, what is the reason for consumer reluctance to adopt EVs? What are the motivational factors of adopting or not adopting an EVs from a consumer perspective? What are consumers' perceptions and attitudes towards EVs? What are the sociodemographic variables of a consumer who purchased EVs? This dissertation analyses the factors that hinder the adoption

process for EVs from a consumer perspective, while examining the enablers that promote the adoption of EVs.

In order to shed light on this situation, it is critical to understand consumers' perception and behaviour. Consumer behaviour plays an essential role in business growth and marketing, and a company's success depends on the satisfaction of their consumers. Sundareswaran et al. (2022) defined consumer behaviour as "*the study of consumers and how they choose or eliminate products*" (Sundareswaran et al., 2022, p.82). The authors also pointed out the need to focus on the factors that influence consumer buying behaviour, in order to introduce specific measures. Herberz et al. (2020) mentioned the difficulty of changing specific consumer behaviour in more conservative sectors such as transportation. In brief, it is important to understand the different thought processes and attitudes consumers exert towards purchasing a specific product. Consumer behaviour is formed by social, economic, and environmental concerns which lead to new consumption demands and different strategies for companies (Hofenk et al., 2019). Although research on sustainable consumption is gaining attention and it is of interest whether the adoption process can be influenced by the social and moral context, this research area is still underrepresented, and further research is required. At the same time, there exist a research gap for the impact of status and reputation when adopting EVs. Griskevicius et al. (2010) found that status motives even led consumers to choose green products over nongreen products. This leads to the following question: Are consumers environmentally concerned or are they more status and reputation oriented when adopting EVs? At the same time, what influence does moral norm and environmental concern play? Thogersen and Ebsen (2019) found that consumers' intention to purchase an EV increases with their perceived moral obligation to choose an environmental-friendly vehicle.

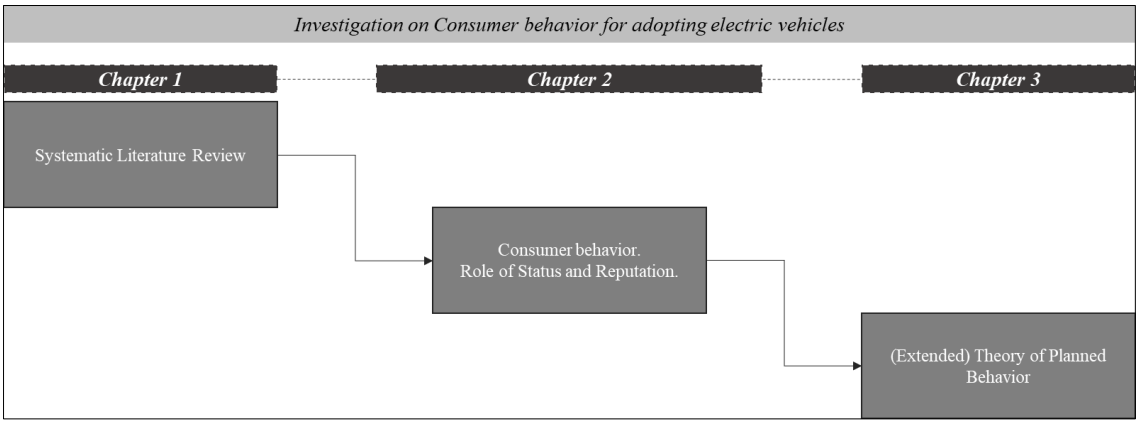
In current literature, there is very little academic evidence based on Spanish samples, which is another problem statement to highlight for this dissertation. It is important to consider the cultural differences between countries, and although academic results from other countries can serve as guidelines and can be related to Spanish consumers, it is still necessary to compare them with Spain and its cultural characteristics, based on empirical findings. Referring to Hofstede's dimensions (Hofstede, 2022), Spain stands out with a high score on the dimension called "power distance", which means that it is a hierarchical and autocratic society. It is also a society where "Uncertainty Avoidance", defined as the extent to which people feel threatened by unknown and ambiguous situations, scores highly, which in turn reflects the way consumers behave. Although Ashmore et al. (2018) did not focus on the context of Spain, the authors analysed the differences of symbolism of eco cars by including two of *Hofstede´*s cross-cultural dimensions such as power differential and individualism vs. collectivism.

In summary, further empirical research is needed to draw useful conclusions and to understand consumers' reluctance to adopt EVs. This dissertation aims to provide a deeper understanding of consumer behaviour based on an empirical dataset that allows for the investigation of sociodemographic, car attributes and environmental factors, while analysing the impact of experience as well as applying the Theory of Planned Behaviour with a focus on environmental concerns.

1.4 Purpose of the Thesis: Brief Description of the Chapters

In line with the Research Proposal presented in 2020, the dissertation aims to investigate consumer behaviour for the adoption of Electric Vehicles from a marketing and managerial perspective. With the aim to provide a complete overview, the dissertation is divided into different chapters, each with a different research objective to fulfil the requirements of an accumulative doctoral program such as the iDEM program. All chapters are coordinated and interrelated, and the results are used in the subsequent chapters. The following Figure 5 below shows the focus of the different chapters, while Figure 6 gives a more complete overview of their research questions, methodology and results.

Figure 5: Focus Chapters Dissertation



In the first chapter, a systematic literature review on the consumer adoption theory for EVs is conducted. Several stages were applied to ensure the systematic approach behind, and the Web of Science (WoS) was used as the main platform to extract the relevant papers. A specific combination of keywords was defined, and the focus was on published papers written in English. Several process stages were realized to narrow down the initial 56.400 results obtained from the WoS first to 7.676 papers by defining the categories and document type, and then to 831 papers by redefining the categories. The result resulted into 146 papers with the keywords combination of (1) electric vehicles, (2) adoption and (3) theory. After some additional steps, 76 papers were finally yielded and their abstract were reviewed, from which 49 papers were finally selected for this systematic literature review. The research questions of the Chapter 1 are the following:

1. What theories are applied in research studies to provide a better understanding about EVs adoption and purchase intention, from a consumer point of view?
2. What theory is recommended for future research in this area?

The objective of this chapter is to gain a profound understanding of the different academic studies on consumer behaviour for EVs adoption and purchase intention, and to analyse the different theories that are applied in the studies to make a recommendation for future studies in this area. The conclusion was that the Theory of Planned Behaviour is the study that should be used to further investigate consumer behaviour based on different behavioural constructs. In summary, Chapter 1 is relevant to both Chapter 2 and Chapter 3, which are explained in the following.

In Chapter 2, the research contributes to the literature by providing insights into consumer behaviour for EVs in the form of an empirical investigation based on a Spanish sample as the primary data set, conducted in 2021. This study helps to uncover factors and barriers for the adoption intention of EVs. It identifies the socio-demographic characteristics of the EV consumers, while applying a structured and global approach that also includes environmental aspects and car attributes. Additionally, and most importantly, the study analyses consumer behaviour when all vehicles cost the same. Therefore, the variable of purchase price for EV was controlled for, and it was found in this scenario that reputation-driven consumers are not interested in the adoption of EVs. It seems that a higher purchase price of EVs compared to other vehicles allows for a certain exclusivity and an increase in status, which apparently is important for reputation-driven consumers. The study also allows to conclude corporate and governmental recommendations to target psychological barriers to the adoption of EVs. The research questions of Chapter 2 show a clear focus on the factors impacting consumers to adopt or not EVs, and on consumer behaviour if all vehicles cost the same:

1. What are the factors that influence the EVs adoption? Answering this main research question, this research will be able to answer further:
    a. What does a consumer of EVs look like (sociodemographic variables)?
    b. What role play experience, governmental incentives, information availability and other car attributes?
2. What happens if all vehicles cost the same?
3. Are consumers' status- and reputation-driven or do they really care about the environment?

Regarding the sociodemographic conclusions of Chapter 2, it is found that age, being male and having children, higher education and living in urban areas, having had previous experience with EVs influence the adoption of EVs positively. In summary, this chapter helps to confirm previous

findings in the literature and to fill an important research gap in the field of consumer behaviour with its focus on status and reputation.

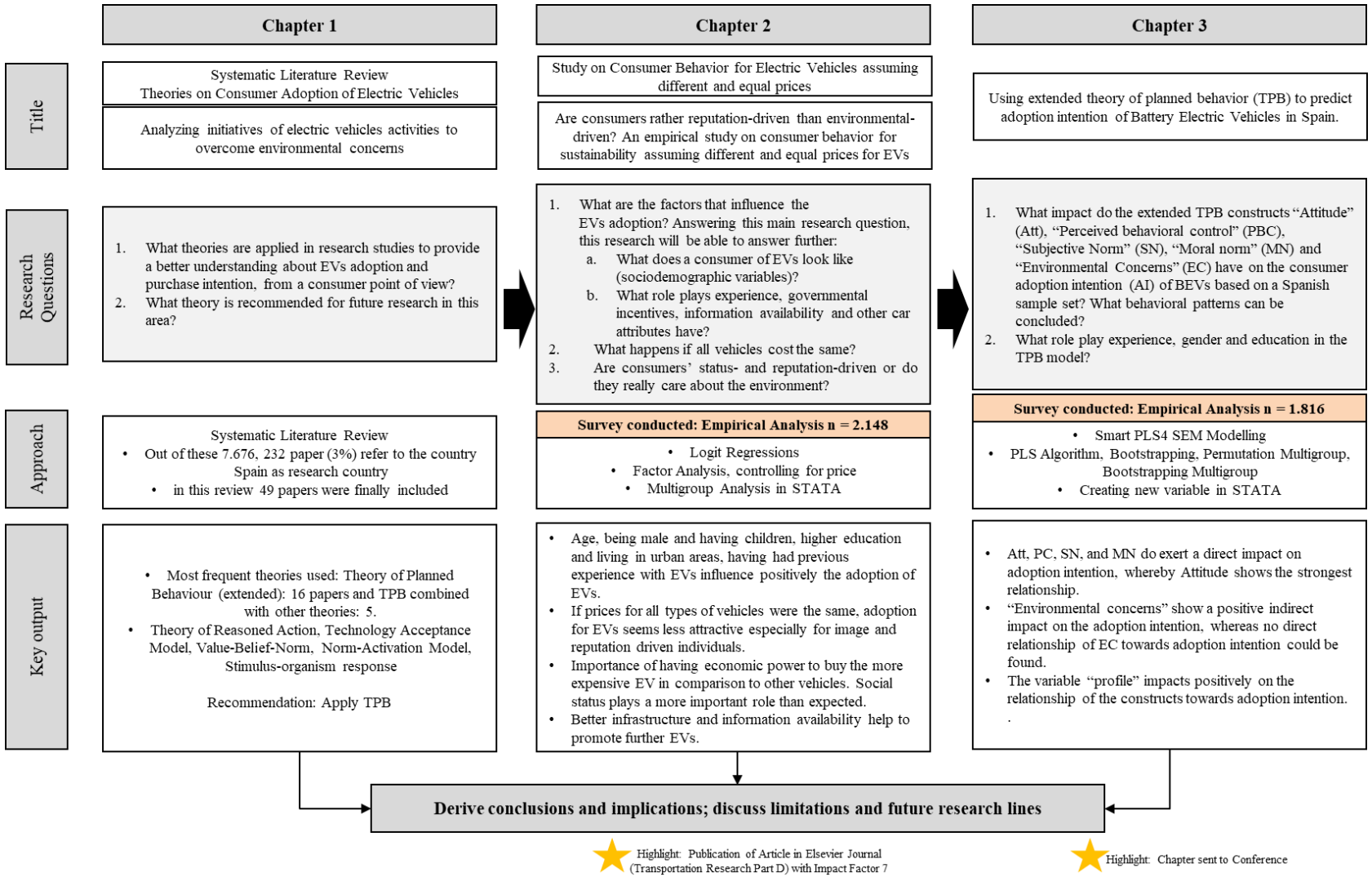
Chapter 3 then continues the empirical research by applying the Theory of Planned Behaviour from Ajzen (1991), as it is concluded as recommendation in Chapter 1. In Chapter 3, the constructs "Attitude", "Perceived behavioural control", "Subjective Norm" are included as defined in the traditional TPB, and the theory is extended with "Moral Norm" and "Environmental Concern". In this chapter, the study focuses exclusively on Battery Electric Vehicles, which is another useful contribution to the literature, as this kind of technology requires more consumer effort due to its often unfamiliar technology and incorrect image. Yang & Tan (2019) explained that BEV is a new product to many people, and its influence and identity has not yet been formed. The focus on BEV was clearly stated in the survey to avoid any confusion with other EVs. In addition, Environmental Concern is a construct with high importance based on the literature review, for which we have analysed it both as an indirect and direct impact on the adoption intention. Chapter 3 focuses on the following research questions:

1. What impact do the extended TPP constructs "Attitude" (ATT), "Perceived behavioural control" (PBC), "Subjective Norm" (SN), "Moral norm" (MN) and "Environmental Concerns" (EC) have on the consumer adoption intention (AI) of BEVs based on a Spanish sample set? What behavioural patterns can be concluded?
2. What role plays experience, gender, and education in the TPB model?

Smart PLS4 tool was applied for the Structural Equation Modelling, which allowed to run several analysis and tests such as Bootstrapping, Permutation Group Analysis, etc. It is found that ATT, PBC, SN and MN do exert a direct positive impact on the adoption intention while EC shows no direct impact but a strong indirect impact on AI via the other constructs. The results are very helpful to further understand consumer behaviour.

In summary, all three chapters have a clear line of investigation and as a complete document they give useful understandings of consumer behaviour towards the adoption of EVs. The following Figure 6 gives an overview of all chapters.

Figure 6: Dissertation Approach



I) Chapter 1: Systematic Literature Review

Chapter 1

Systematic Literature Review:

Theories on Consumer Adoption of Electric Vehicles

1 Theories on Consumer Adoption of Electric Vehicles

1.1 Abstract

The quest for a more environmentally friendly, sustainable future is more relevant today than ever. Electric vehicles (EVs), in comparison to conventional vehicles, have positive effects such as lower greenhouse gas emissions that help to mitigate the causes of climate change. The transition towards more sustainable transport means in the transport sector are key to achieving national climate targets. Despite the positive environmental impacts of EVs, their market share remains marginal. There are several papers analysing the factors on consumers´ purchase intention and adoption of EVs. This chapter offers an in-depth literature review on different theories that are used to analyse consumer´s purchase intention and adoption for EVs. The theories are systematically compared in their scope, approach, and findings to point out similarities and create a foundation for future research in this field. A strong focus is put on the Theory of Planned Behaviour and its antecedent theories. The goal is to provide a solid foundation for finding a suitable theory for future research on consumers´ adoption for EVs. In addition, gaps and limitation are identified and suggestions for future research are provided.

1.2 Keywords

- Electric Vehicles
- Theory
- Adoption
- Consumer
- Behaviour
- Literature Review

1.3 Introduction

As previously highlighted, there are several papers analysing the factors behind the slow and marginal consumer adoption for EVs, with increasing interest in recent years. Several authors analysed socio-demographic variables to investigate on consumer's acceptance of EVs, with the objective of providing a better understanding of consumer behaviour and political and managerial guidelines. Schuitema et al. (2013) explained that the acceptance for EVs relies on consumer´s perception of EVs. Consequently, in order to promote EVs, it is critical to understand consumers' perception and the possible barriers and drivers they face when adopting an EV. To further enrich the literature, this systematic literature review analyses different theories to explain consumer's

adoption for EVs, and hence, consumer behaviour. Therefore, this chapter addresses the following research questions:

- What theories are applied in research studies to provide a better understanding about EVs adoption and purchase intention, from a consumer point of view?
- What theory is recommended for future research in this area?

The literature review analyses results from different research studies regarding EVs and their adoption. During the systematic review process, the quality of the studies is evaluated with the aim of drawing conclusions about the different theories used to explain consumer behaviour. Another objective is to create a profound understanding of the present literature with possible gaps for future studies, especially as preparation for the subsequent chapters of this doctoral dissertation.

1.4 Identifying relevant studies

A systematic, structured literature review is conducted to provide a broad understanding of the field for consumer behaviour for the adoption of EVs as sustainable products. To this extent, the research review consists of several stages. The focus hereby is on the Clarivate Analytic´s Web of Science (WoS) platform as main extractor of relevant papers. The WoS is a multidisciplinary research engine which serves both as a research tool for very diverse knowledge domains as well as a dataset for large-scale studies (Li et al., 2018). It is the "*world's leading scientific citation search and analytical information platform*" (Li et al., 2018, p.1). Dr. Eugene Garfield founded the Institute for Scientific Information and developed the Science Citation Index (SCI) to categorize and track scientific information which ultimately resulted in the Web of Science database. Based on the SCI, the Journal Impact Factor (JIF) was created to evaluate journals and to measure the quality of research. It is used globally for almost every knowledge domain (Li et al., 2018).

Additionally, the Research Gate Platform is used to locate missing papers that are not immediately accessible via the WoS platform. Besides the keyword combinations (explained in the following), the data search is limited to articles written in English language, and it is avoided to include any conference papers, book chapters or other un-published studies (proceedings papers).

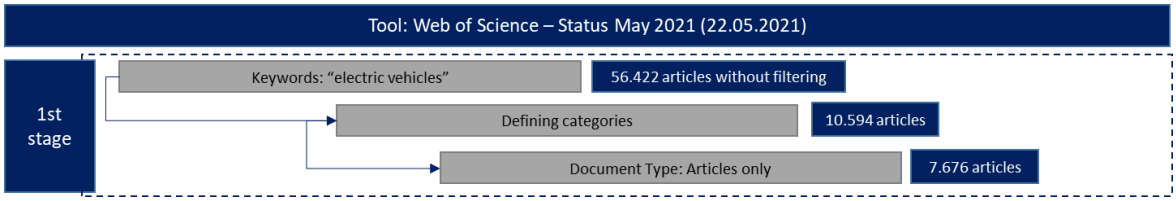
2 Process Stages

In order to obtain a global overview and profound knowledge and understanding of the research area, different process stages have been conducted to define the final sample to work with and to ensure an objective, systematic and profound knowledge acquirement.

2.1 Process Stage 1

In a first step, the key word “electric vehicles” is introduced in the platform Web of Science Core Collection which resulted in more than 56.400 results (status 22nd of May 2021) without applying any further filter. Different categories of the WoS were then refined, excluding electrical engineering, computer sciences, physics, chemistry, mechanics, telecommunications, thermodynamics, chemistry, or mathematics areas, to focus on management and marketing areas. This resulted in 7.676 papers.

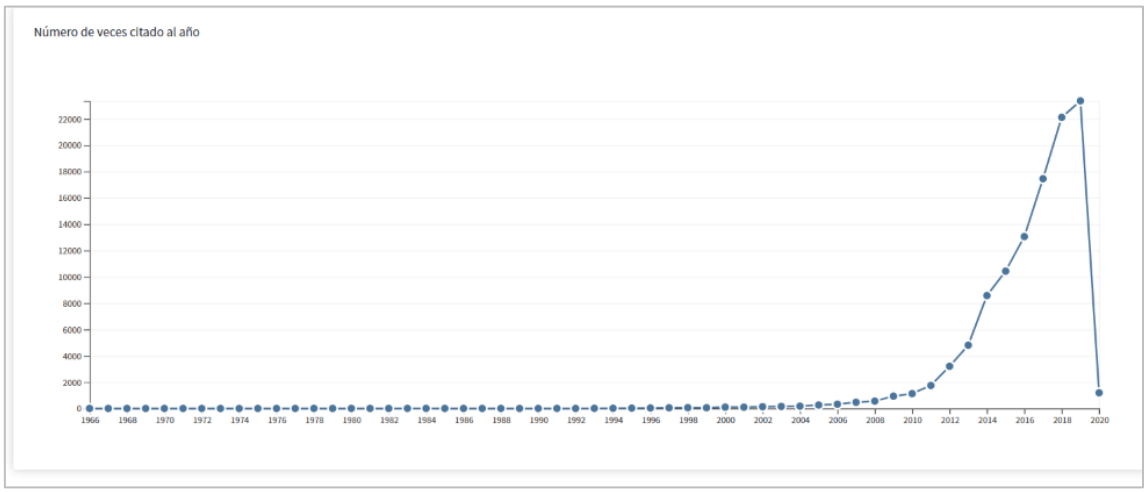
Figure 7: 1st stage Web of Science Research process (Chapter 1)



Note: Own work

The WoS platform offers different analysis options to quickly understand the results yielded, and the Citation Report reflects citations to source items indexed within WoS Core Collection. With the key word “Electric vehicles” it is worth to mention that there is a significantly increase since 2008 on with an incremental evolution since 2012.

Figure 8: Evolution papers Web of Science "Electric vehicles" (Chapter 1)

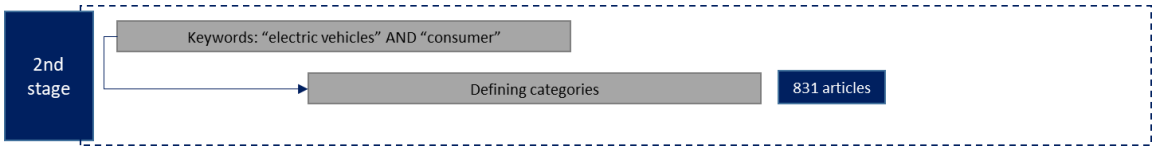


Note: WoS Citation Report

Out of these 7.676, 232 paper (3%) refer to the country Spain as research country. Reviewing some of the articles, many papers still focus on other areas out of interest for this chapter such as power resources and electric utilities that could use battery vehicles as storage. Therefore, the keyword “consumer” is included as additional mandatory search function to narrow down the

results and focusing on papers focusing on "consumer" from a managerial perspective, which resulted in 831 papers.

Figure 9: Keywords combination EV and Consumer (Chapter 1)



Note: Own work

2.2 Process Stage 2

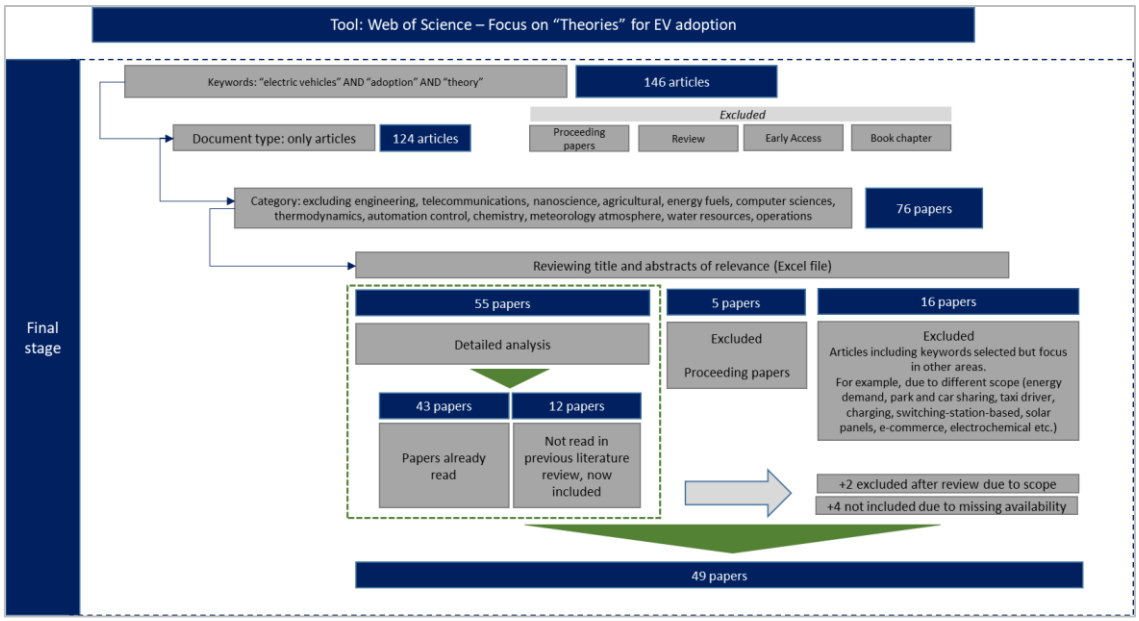
Based on the previous results, a first analysis of some papers mainly focusing on consumers and their purchase behaviour for EVs with different factors and barriers for (not) adoption was realized. This step was conducted in a more subjective way with the simple aim of acquiring further knowledge of the research topic and to ensure a correct final research definition. All papers were included in the tool "Mendeley" and those further analysed were presented in an Excel sheet created by the student (see Appendix 1). Although this step is not necessarily defined as systematic review, it was of importance to later chose the final selection of papers, and to ensure the right selection process for all papers to be included.

Therefore, once acquired further knowledge, the final focus is on the different theories applied to explore the consumers´ behaviour for EVs adoption as theoretical framework. The focus on the main theories used to examine EVs adoption, serves as basis for the third chapter of this dissertation. This literature review should also help other authors to faster decide which theory to include in their future study without the need of realizing an intense review as it was conducted here.

2.3 Final Process Stage

Based on the literature review realized during the first and second stage and considering the high number of papers yielded, the final keywords combination is defined into: **(1) electric vehicles**, **(2) adoption** and **(3) theory** which resulted in 146 papers, based on WoS Core collection search. The keyword "consumers" is finally not applied due to the reason that many authors define "consumers" as individuals, customers, users etc. when referring to the person interested in the adoption of EVs. Additionally, the WoS platform offers different categories to select which narrow down the area required. Trying other keywords combination with "green cars", or "alternative fuel vehicles", and "theory", and "adoption", and "behaviour" did not lead to more refined results and were finally discarded. In the following Figure 10, the final process step is shown and subsequently explained.

Figure 10: Final process of Literature Review (Chapter 1)



Note: Own work

Of the total 146 papers resulting from the keyword combination, only the type "articles" was selected, which resulted in 124 papers. Again, the categories were refined to exclude engineering, telecommunications, energy fuels, computer sciences etc., and to limit the categories to relevant areas (management, transportation science, environmental studies etc.) which resulted in 76 papers. All titles, abstracts, and research areas of the 76 papers were reviewed. 16 papers were excluded due to their scope in other areas. Additionally, 5 proceeding papers were excluded to focus only on articles that are already published. The final 55 papers were cross-checked with previously read papers (during the first and second stage of this process to acquire deeper knowledge), of which 43 papers had already been reviewed, so an additional 12 papers were included as "new". Nevertheless, to complete the Excel file (see Appendix 1) and to ensure accuracy, all papers are thoroughly (re)examined and classified. Two (2) papers were then excluded due to their different scope on autonomous vehicle and fleet optimization, and four (4) were not available on either the WoS or Research Gate platform. Therefore, 49 papers were finally included in this review. For each paper reviewed, the research questions addressed in the papers, the research country, the theoretical framework, other methodological approaches, and main conclusions were noted.

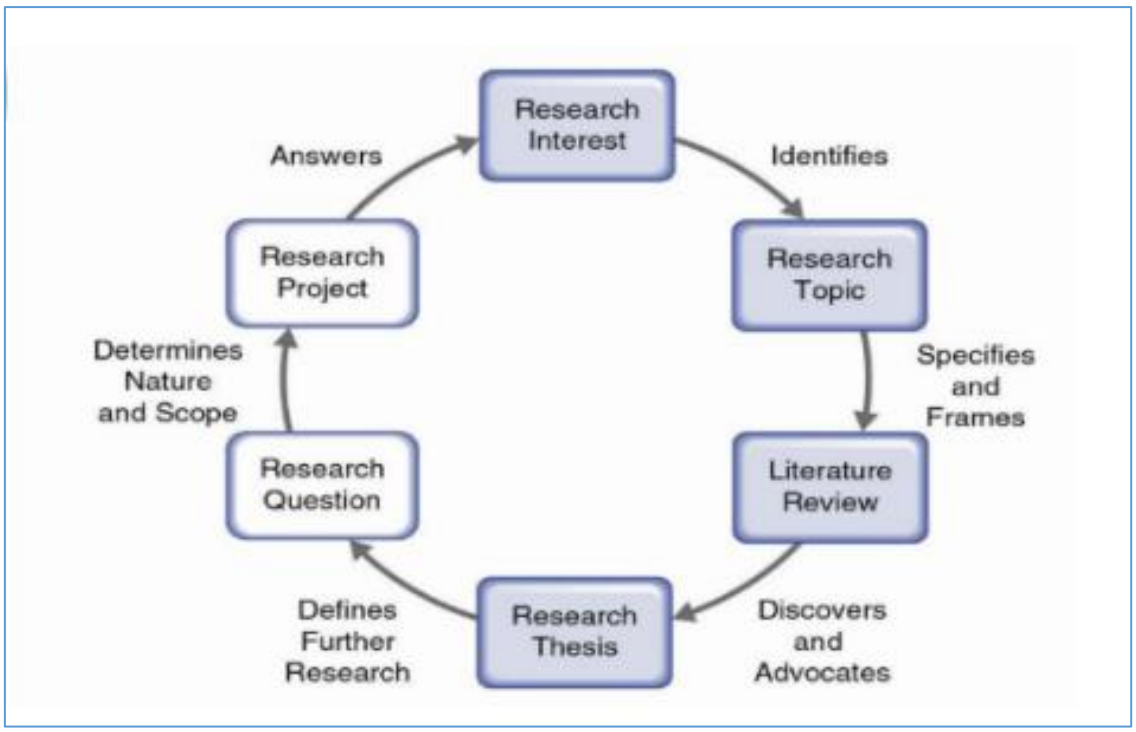
3 Systematic Literature Research

In this chapter, a systematic literature research is applied in line with Machi & McEvoy (2009) who showed in a complete but simple way the so-called research cycle with the different steps to follow (see Figure 11). "*A literature review is a written document that present a logically argued*

case founded on a comprehensive understanding of the current state of knowledge about a topic of study." (Machi & McEvoy 2009, p.4). Based on the initial *research interest* of electric vehicles in the management and marketing area, the *research topic* of consumer's behaviour and consumer adoption on electric vehicles was defined. Then, based on the *Literature Review*, the *research thesis* of this chapter could be identified, which consequently helped to define the following *research questions:*

- What theories are applied in research studies to provide a better understanding about EVs adoption and purchase intention, from a consumer point of view?
- What theory is recommended for future research in this area?

Figure 11: Systematic Literature Review "The research cycle" (Chapter 1)



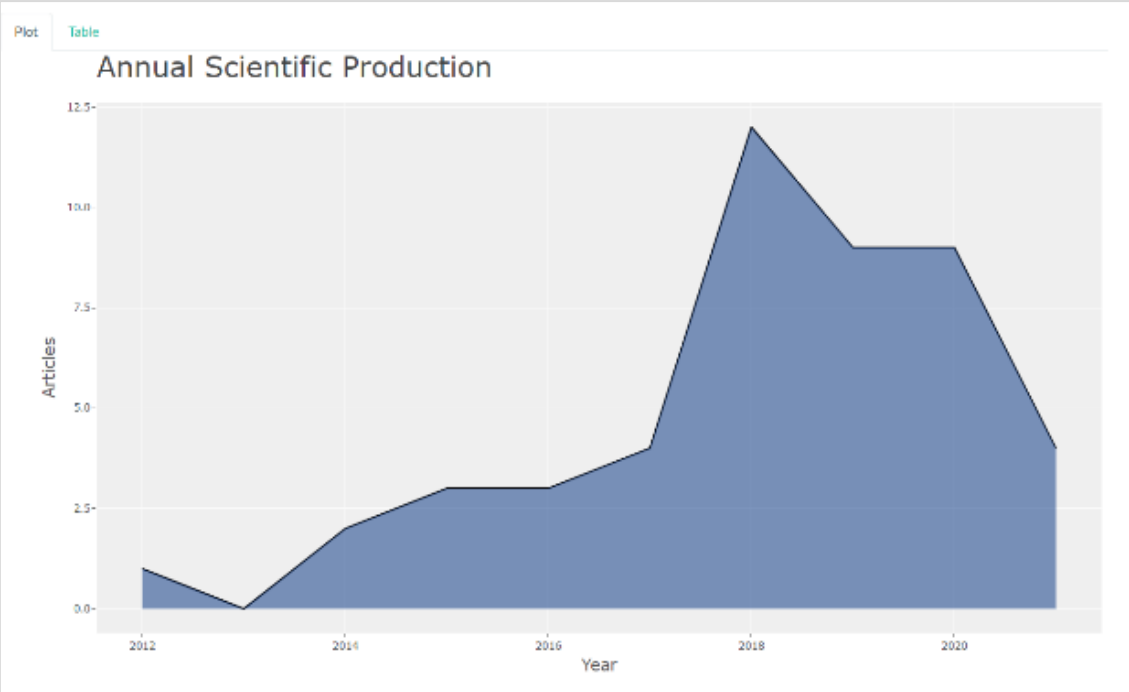
Note: Machi & McEvoy (2016)

3.1 Investigation of final Papers

When analysing the final 49 papers focusing on their research countries, the vast majority refer to China and other Asian countries, the United States of America, and some Nordic European countries. Spain as research country does not even appear in the analysis on the WoS platform; however, there is one of the 49 papers that focuses on Spain as context (see Higueras-Castillo et al., 2019). This reinforces the urge for more research in this area for the country of Spain, as previously explained as problem statement and justification of this research.

By conducting a R-Studio analysis, a deeper investigation is realized. R-Studio, as an integrated development environment, provides the possibility to create statistical graphics, based on the results yielded in the WoS platform. At the same time, it integrates bibliometric, which is a R-tool for comprehensive science mapping analysis. Regarding the annual scientific production, it is noted that more theories were published in 2018 and onwards (Figure 12).

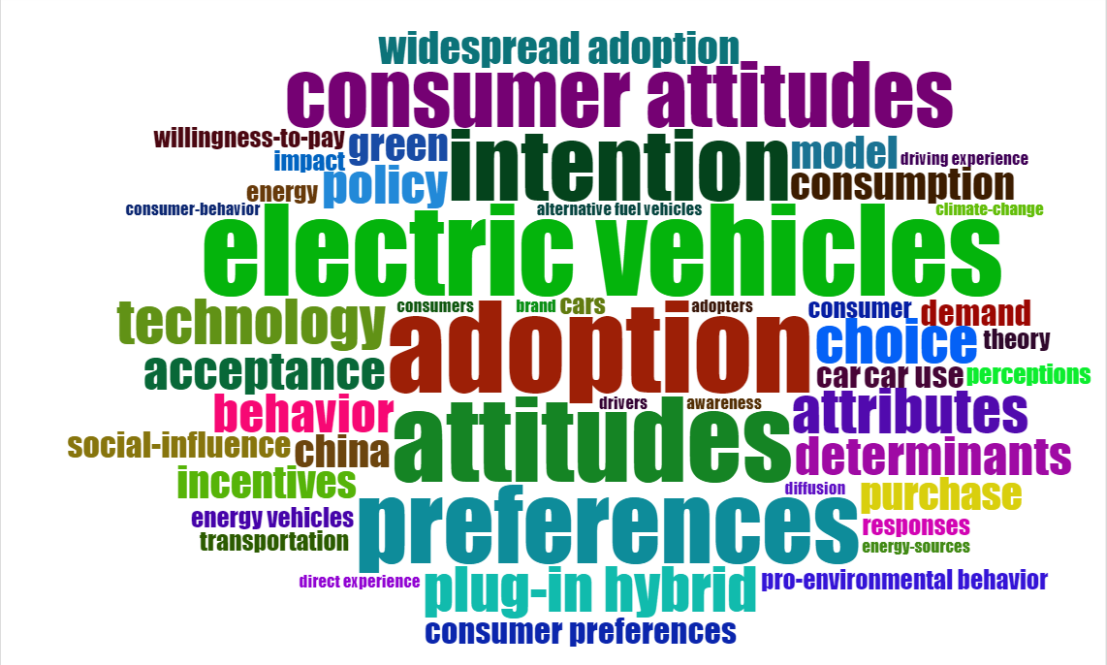
Figure 12: R-Studio - Annual Scientific Production (Chapter 1)



Note: R-Studio Analysis

Furthermore, when conducting an analysis of the most frequently used words in the papers, the result is in line with the final keyword combinations for this chapter. Nonetheless, there are other words that can be taken into consideration for future research (Figure 13).

Figure 13: R-Studio Key words Results (Chapter 1)



Note: R-Studio Analysis

3.2 Overview of final Papers

All papers were saved in an Excel file to analyse their year of publication, their research question(s)/ aim, country context, sample size, hypothesis, theoretical framework, method, and main results. Limitations and future research lines were also included as helpful summary and guideline for the subsequent chapters of this dissertation. In Table 2 the theoretical frameworks and corresponding authors are included. This helps future investigators to find the adequate theory when examining consumers' adoption (of EVs) and is of greatest use for Chapter 2 and 3 of this doctoral thesis. Appendix 1 contains an extended review for further information.

Table 2: Overview Literature Review 49 papers (Chapter 1)

Framework	Authors	Year	Norms/ constructs	Use of theory
Theory of Planned Behavior (extended)	Shalender, Kumar; Sharma, Naman	2020	Attitude/ Subjective norm/ Perceived behavioral control + moral norm/ environment concern	Extended theory of planned behaviour (TPB) to predict adoption intention of electric vehicles
	Bhutto, Maqsood Hussain; Tariq, Beenish; Azhar, Sarwar; Ahmed, Khalid; Khuwaja, Faiz Muhammad; Han, Heesup	2020	Attitude/ Subjective norm/ Perceived behavioral control + price sensitivity	Predicting consumer purchase intention toward hybrid vehicles by moderating role of price sensitivity
	Li, Lixu; Wang, Zhiqiang; Wang, Qiang	2020	Attitude/ Subjective norm/ Perceived behavioral control + policy mix characteristics (consistency, coherence, credibility, comprehensiveness)	Exploring the effects of TPB-related variables and policy mix characteristics on consumers' intention to purchase EVs, as well as the moderating effects of policy mix characteristics.

Liu, Rong; Ding, Zhihua; Jiang, Xin; Sun, Jing; Jiang, Yanling; Qiang, Wei	2020	Attitude/ Subjective norm/ Perceived behavioral control + driving experience	Impact of driving experience on willingness of BEVs adoption
Shankar, Amit; Kunnari, Pooja	2019	Dual factor model. Attitude/ social norm/ Perceived behavioral control + environmental concern, perceived CSR obligation --> intention to adopt. Sunk cost, regret avoidance, inertia, perceived value, switching cost, perceived threat --> resistance to adopt	Exploring the enablers and inhibitors of EV adoption intention from the sellers' perspective using a dual-factor mode
Simsekoglu, Ozlem; Nayum, Alim	2019	Attitude/ Subjective norm/ Perceived behavioral control + Environmental attributes, Knowledge about BEVs, Instrumental attributes, perceived accident risk (+demographics)	Examine the role of perceived accident risk, perceived car attributes, TPB constructs, knowledge about BEVs, and demographic variables in predicting intention to buy a BEV among conventional car drivers.
Haustein, Sonja; Jensen, Anders Fjendbo	2017	Theory of Planned Behavior extended by personal norm, perceived mobility necessities, and BEV experience.	Factors of electric vehicle adoption
Wang, Shanyong; Li, Jun; Zhao, Dingtao	2017	Financial incentive policy measures, information provision policy measures, convenience policy measure + environmental concern	Examining the effects of policy measures and exploring the combined effects of policy measures and consumers' environmental concern on EVs adoption
Schmalfuss, Franziska; Muehl, Kristin; Krems, Josef F.	2017	Attitude/ Subjective norm/ Perceived behavioral control + experience	Role of experience in acceptance of BEVs.
Yan, Qingyou; Qin, Guangyu; Zhang, Meijuan; Xiao, Bowen	2019	Attitude/ Subjective norm/ Perceived behavioral control + positive attributes/ negative attributes	Purchasing Behavior Analysis of Electric Cars
Du, Huibin; Liu, Diyi; Sovacool, Benjamin K.; Wang, Yuru; Ma, Shoufeng; Li, Rita Yi Man	2018	Attitude/ Subjective norm/ Perceived behavioral control + personal norm + Low Carbon Awareness (low-carbon value, low-carbon subjective knowledge, low-carbon objective knowledge)	Investigating the salience of social-psychological factors in explaining why drivers purchase (or fail to purchase) New Energy Vehicles (NEVs)
Mohamed, Moataz; Higgins, Christopher D.; Ferguson, Mark; Requia, Weeberb J.	2018	Attitude/ Subjective norm/ Perceived behavioral control + personal moral norm + environmental concern (+ vehicle body type)	Multi-group structural equation modelling exercise to identify differences in the mindset of individuals towards electric vehicles (EVs)
Adnan, Nadia; Nordin, Shahrina Md; Amini, M. Hadi; Langove, Naseebullah	2018	Attitude/ Subjective norm/ Perceived behavioral control + personal moral norm + environmental concern --> intention (+hyperbolic discounting on actual adoption)	To forecast the customer's intention to adopt PHEVs
Mohamed, Moataz; Higgins, Chris; Ferguson, Mark; Kanaroglou, Pavlos	2016	Attitude/ Subjective norm/ Perceived behavioral control + personal moral norm + environmental concern	To quantify the impacts of personal beliefs on individual adoption intention towards electric vehicles.
Milad Mehdizadeh , Afshin Shariat-Mohaymany	2021	Attitude/ Subjective norm/ Perceived behavioral control + attitudes towards LECZ + socioeconomic variables + travel related and built environment variables	Impact on low emission charging zone (LECZ)
Xu, Yueling; Zhang, Wenyu; Bao, Haijun; Zhang, Shuai; Xiang, Ying	2019	Attitude/ Subjective norm/ Perceived behavioral control + environmental performance + price value + non-monetary incentive policy + monetary incentive policy	To predict Customers' Intention to Purchase Battery Electric Vehicles

TPB + Norm Activation Model	Dong, Xiaoyang; Zhang, Bin; Wang, Bo; Wang, Zhaohua	2020	Attitude/ Subjective norm/ Perceived behavioral control + personal moral norm + feelings and emotions + awareness of consequences + ascription of responsibility + cost factors (price sensitivity)	To explore whether cost factors influence Chinese urban households' purchase intentions for electric vehicles under subsidy contexts
TPB + Extended Model of Goal Directed Behavior (EMGDB)	Stillwater, Tai; Kurani, Kenneth S.	2013	Attitude/ Subjective norm/ Perceived behavioral control + goals (as in-vehicle feedback) Diving context + Energy economy + In-vehicle feedback	Exploring the effects on ecodriving of interaction between drivers and in-vehicle energy feedback. The EMGDB reorients the TPB framework to focus on achievement of behavioral goals rather than intentions to perform specific actions.
TPB + Functional Theory FT and constructive theory CT	Adnan, Nadia; Nordin, Shahrina Md; Rahman, Imran; Rasli, Amran Md	2017	Attitude (interaction, knowledge sharing, response of vehicle owners)/ Subjective norm/ Perceived behavioral control + personal moral norm --> on intention; + environmental concern on actual behaviour	To study the consumer adoption of EVs.
TPB + TAM + IDT	Tu, Jui-Che; Yang, Chun	2019	Planned behavior (TPB), technology acceptance model (TAM) and innovation diffusion theory (IDT): Attitude/ Subjective norm/ Perceived behavioral control + beliefs and evaluation, normative belief and motivation to comply, control belief and perceived facilitation. Perceived usefulness, perceived ease of use, compatibility, personal innovativeness, interpersonal influence, external influence, self-ability control (self-efficacy, facilitating conditions, perceived behavioral control)	To explore the key factors influencing consumers' purchase of electric vehicles
Reasoned Action framework based on TPB and TAM (and TRA)	Thogersen, John; Ebsen, Jonas V.	2019	Attitude/ Subjective norm/ Perceived behavioral control + experience + perceived (un)certainty about Evs, beliefs about Evs, environmental concern traffic, descriptive norm EV, injunctive norm EV --> intention to buy EVs	To understand car owners' intentions to buy an EC.
Theory of Reasoned Action	Costanza Nosi Tommaso Pucci Cecilia Silvestri and Barbara Aquilani	2017	Focus on co-creation. Exploring impact of constructs attitude and subjective norm, perceived importance, co-creation on EV buying intention.	Exploring buying intention with attitude toward the behavior in question (ATT), subjective norm (SN) and, in the case of the TPB, the individual's perceived behavioral control (PBC).
TAM Technology Acceptance Model + Diffusion of Innovation Theory DoIT	Wolff, Stefanie; Madlener, Reinhard	2019	Perceived usefulness and Perceived ease of use on intention to use (TAM). Constructs & variables such as experience, sociodemographics, social norm, attitude, satisfaction, perceived enjoyment, technophilia, EV usage anxiety. Constructs of perceived efficiency and perceived satisfaction	Exploring drivers' acceptance and investigating drivers´ perceived satisfaction of commercial EVs compared to conventional vehicles.
Value-Belief-Norm theory and Norm-Activation Model	Nordlund, A.; Jansson, J.; Westin, K.	2018	Norm-activation process as defined in the Value-Belief-Norm theory and the Norm-Activation Model. Norm-activation process posing an influence on perceived justice, effectiveness and acceptability of policies aimed to stimulate the purchase and use of EVs in three groups of car owners	Investigation if the perceived justice and effectiveness of measures aimed to stimulate the purchase and use of electric vehicles, and subsequent the expressed acceptability of such policies, is related to a norm-activation process
Perceived value and Reasoned action	Higueras-Castillo, Elena; Molinillo, Sebastian; Andres Coca-Stefaniak, J.; Liebana-Cabanillas, Francisco	2019	PERVAL dimensions (e.g., quality, emotional, price and social values) + Acceleration + low engine noise emission + attitude + intention to adopt	Understanding of factors influencing customers' intentions to adopt EM options

Theory of Diffusion of Innovations	Fry, Amy; Ryley, Tim; Thring, Robert	2018	Rogers' Theory of Diffusion of Innovations. Innovation-Decision Process model that focuses on how an innovation decision is influenced by the perceived newness of the innovation and the associated uncertainty that arises as a consequence	Examining the influence of knowledge and persuasion on the decision to adopt or reject alternative fuel vehicles
	Jansson, Johan; Pettersson, Thomas; Mannberg, Andrea; Brannlund, Runar; Lindgren, Urban	2017	To analyze adopters and non-adopters of alternative fuel vehicles (AFVs)	To analyze interpersonal influence on adoption from three social domains: neighbors, family and coworkers.
Veblen's notion of conspicuous consumption + Roger's diffusion of innovation = "conspicuous diffusion"	Noel, Lance; Sovacool, Benjamin K.; Kester, Johannes; de Rubens, Gerardo Zarazua	2019 a	Sociotechnical benefits and barriers of electric vehicles and vehicle-to-grid technology, but both the experts and focus group participants discussed topics relevant to conspicuous diffusion.	In order to better understand how conspicuous diffusion would apply to an innovation; appropriate for the diffusion of vehicle-related technology in general, and specifically electric vehicles
Hirschman's Rhetoric of Reaction (in context of diffusion of innovations)	Noel, Lance; de Rubens, Gerardo Zarazua; Sovacool, Benjamin K.; Kester, Johannes	2019 b	Range Anxiety Construction: Technical, Psychological, Rhetorical/ Hirschman´s theses: Jeopardy, Perversity, Futility	Theory supposes that conservative forces may oppose change by propagating theses related to jeopardy, per- versity, and futility.
multi-level perspective Adoption-diffusion (AD) theories (rather proposal)	Gruber, Mario	2020	System approach allowing researchers to build theory on micro, meso, and macro levels of analysis – as a fitting system perspective to analyze how AD theory is limited and might be adapted with respect to radical innovations.	to propose an understanding of innovation adoption and diffusion that accounts for factors and developments beyond extant theories' typical focus
Stimulus-organism-response" (S-O-R) framework	Xu, Guowei; Wang, Shanyong; Zhao, Dingtao	2021	Stimulus: Driving Experience; Organism: satisfaction and trust; Response: adoption intention	The core idea of S-O-R model is to assume that the effect of external stimulus on individual behavior is mediated by individual cognitive and emotional states.
	Xu, Guowei; Wang, Shanyong; Li, Jun; Zhao, Dingtao	2020	consumers' EV driving experience (S) affects their cognitions and perceptions regarding EVs (O: perceived relative advantage, perceived ease of use, and perceived risk of EVs) and adoption intentions (R).	To explore how consumers' EV driving experience (S) affects their emotions and cognitions regarding EVs
Lifestyle theory and PEV-related behaviours Lifestyle	Axsen, Jonn; Cairns, Josh; Dusyk, Nichole; Goldberg, Suzanne	2018	conceptual framework based on lifestyle theory, which defines lifestyle as engagement in several related practices that inform and convey self-identity. Defining lifestyle as engagement in several related practices that inform and convey self-identity	Lifestyle theory explains consumer behaviour in the context of identity construction, theorizing that self-identity is informed and ex- pressed by engagement in lifestyle practices.
Protection Motivation Theory	Bockarjova, M.; Steg, L.	2014	Items used for measuring perceived severity, perceived vulnerability and perceived response efficacy	To explain which factors predict risk adaptive behavior that can be used for effective risk protection communication aiming at attitude and behavior change.
Automobility, ANT, and UTAUT	Sovacool, Benjamin K.	2017	Performance Expectancy, Effort Expectancy, Social Influence, Facilitating conditions --> on behavioral intention --> use behavior. Focus around users.	Understanding of the facilitators and impediments facing electric mobility. To provide an integrated framework that can explain electric mobility preferences across individual, interpersonal, socioenvironmental and network scales by synthesizing from three theories.

Technological Innovation Systems (TIS) framework + Unified Theory of Acceptance and Use of Technology (UTAUT)	Zolfagharian, Mohammadreza; Walrave, Bob; Romme, A. Georges L.; Raven, Rob	2021	Main feedback loops arise from the various cause-effect relationships between EV adoption, EV-related subsidies, perceived EV legitimacy, learning, and relative availability of charging points. UTAUT variables in different scenarios	To develop a theory-guided and entity-based simulation model to better understand electric vehicle (EV) adoption processes as a specific yet core element driving business innovation. TIS informs the macro-level structure of EV diffusion, whereas UTAUT describes the micro- level structure of an e-mobility system
Grounded Theory + Motivation–Opportunity–Ability (MOA) model	He, Zhengxia; Zhou, Yanqing; Wang, Jianming; Li, Cunfang; Wang, Meiling; Li, Wenbo	2021	six main categories: Pro-environmental behavior motivation, Pro-environmental behavior intention, Residents' characteristics, Pro-environmental behavioral ability, The institutional and technological contexts, Social norm	To expand the MOA Motivation–Opportunity–Ability model, expanding the contextual conditions to include four components: residents' characteristics behavioral ability, social norms, and institutional and technical contexts.
Consumption value theory	Han, Liu; Wang, Shanyong; Zhao, Dingtao; Li, Jun	2017	Consumers' value perceptions of EVs are classified into functional values (monetary, performance and convenience values) and non-functional values (emotional, social and epistemic values).	To explore how consumers' intention to adopt EVs is affected by these two groups of values and how such effects are mediated by their attitude towards EVs.
Optimal Distinctiveness theory + Self-construal theory (level of environmentalism)	Volkan Dogan & Mujdat Ozmen	2017	independent self-construal and an interdependent self-construal suggests	To investigate whether relative level of environmentalism and self-construal jointly predicted degree of interest in and intention to purchase HEVs. to examine how consumers' self-construal and their relative level of environmentalism compared to the level of environmentalism of the people around them predicted the degree of interest in HEVs and intention to purchase HEVs.
Self-Congruity theory + Construal Level theory	Skippon, Stephen M.; Kinnear, Neale; Lloyd, Louise; Stannard, Jenny	2016	Self-Congruity theory + Construal Level theory	Self-Congruity theory proposes that products are preferred whose symbolic meanings are congruent with personal identity. Construal Level theory suggests that only those who are psychologically close to a new product category through direct experience with it can make concrete construals related to their lifestyles
Hofstede's cross-cultural indices	Ashmore, David P.; Pojani, Dorina; Thoreau, Roselle; Christie, Nicola; Tyler, Nicholas A.	2018	Two of Hofstede's cross-cultural indices – power differential and individualism versus collectivism	To develop and strengthen theory on how the differing symbolism of eco cars currently varies between four cultural clusters – and how observed symbolic qualitative differences may influence an individual or group choice to procure eco cars
Push-pull-mooring model and institutional theory	Sajjad, Aqsa; Asmi, Fahad; Chu, Jianxun; Anwar, Muhammad Azfar	2020	Incorporates environmental quality, regulative environment, alternative attractiveness, normative environment, self-(decision)efficacy, and willingness to pay into an integrated framework. The study further analyzes the green behavior of consumers by extending switching intentions for electric vehicles	To explore the switching intentions of people from motorized vehicles to electric vehicles by integrating push-pull-mooring model and institutional theory.
Howard–Sheth theory + "What-If" Scenario	Yang, Ye; Tan, Zhongfu	2019	Consumers experience with following stages: (1) Ignored and Neglected, (2) Proactive Attention, (3) Comparison and Selection of Vehicles and (4) Usage Evaluation + what-if with key input is the historical data on the number of applicants under different policies.	To analyze the changes affecting the purchase decisions and usage characteristics of BEVs. Using the Howard–Sheth theory + to quantify the influence of different policies through "what-if" scenario analysis

Vehicle choice model	Sheldon, Tamara L.; Dua, Rubal	2020	Utility of choosing a vehicle	The choice model is then used to predict PEV market share under alternative policies
Hybrid choice model: variable individual´s peer attitude	Manca, Francesco; Sivakumar, Aruna; Daina, Nicolo; Axsen, Jonn; Polak, John W.	2020	Individual's peer attitude variable is tested in different components of a hybrid choice model	To understand its behavioural implications on the individual's choice
Fuzzy-set qualitative comparative analysis (fsQCA)	Bigerna, Simona; Bollino, Carlo Andrea; Micheli, Silvia	2016	Intensity of knowledge, perceptions, and attitudes toward alternative fuel vehicles	To analyse the decisively positive attitude toward AFV and decisively refusal attitude toward AFVs.
Informational and normative conformity	Cherchi, Elisabetta	2017	Measures of conformity are included as attributes inside a stated choice (SC) experiment, to measure informational conformity: same individual answers the choice tasks before and after he/she has received social information on three specific EV features	To measure the effect of both informational and normative conformity in the preference for electric vehicles (EV) versus internal combustion vehicles (ICV)
Elaboration likelihood model	Rahman, Imran	2017	Items Green cars: Involvement with cars, willingness to pay more, willingness to sacrifice (Scope also on Green Hotels and Organic wines)	To provide a general framework for organizing and understanding the effectiveness of persuasive communications and can be applied to product purchase situations.
Not theory provided, Review and critical assessment of Evs	Jason Henderson	2020	Review and critical assessment of EVs	Review and critical assessment of EVs

3.3 Key Results

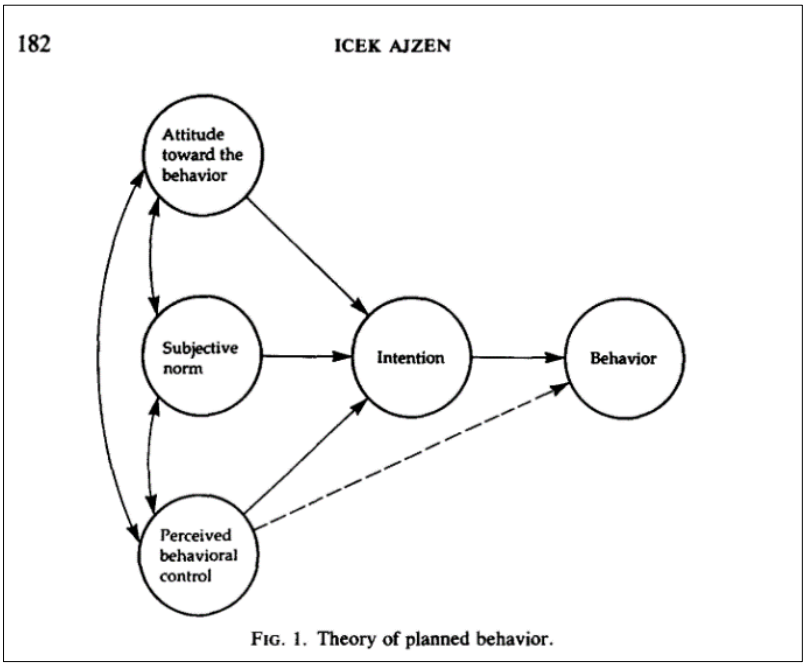
The reviewed 49 papers focus on different theories, although many papers include the Theory of Planned Behaviour (TPB), Technology Acceptance Model (TAM) and Diffusion of Innovation (DoI).

3.3.1 (Extended) Theory of Planned Behaviour

The Theory of Planned Behaviour (TPB) was proposed by Ajzen (1991) based on the Theory of Reasoned Action (TRA) of 1980 with the aim of predicting an individual's intention to exert a specific behaviour over which the consumer has self-control (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). The theory assumes that behavioural achievement depends on motivation (intention) and ability (behavioural control), and that consumers base their decisions on rational evaluations of stimuli. The original model TRA shows limitations in "*dealing with behaviours over which people have incomplete volitional control*" (Ajzen, 1991, p.181) and thus, the theory evolved into TPB. Initially, the TRA assumes behaviours over which the individual has complete control and the TPB is extended by the "perceived behavioural control", which stands for the perceived obstacles and barriers a consumer perceives when performing a specific behaviour, so to say the availability of opportunity and resources to meet one´s behaviour expectations (Ajzen, 1991). Individual decision-making process which forms the perspective of psychology is explained and the individual's intention to conduct a specific behaviour is a central factor within TPB. The theory assumes that real behaviour of a person can be analysed with the proxy of

behavioural intention, this to say, behavioural achievement depends on motivation (intention) and ability (behavioural control), and consumers base decisions on rational evaluations of stimuli. The behaviour attitude, subjective norm, perceived behavioural control jointly impacts and determine the intention which is then translated into the actual behaviour. As Ajzen (1991) explained: "*A general rule, the stronger the intention to engage in a behaviour, the more likely should be its execution*" (p. 181). In the TPB model the actual behaviour can be determined by the behavioural intention and research in social psychology confirm that intention, which is part of the TPB, is the best predictor of an individual´s behaviour (Fishbein and Ajzen, 1975). The following Figure 14 shows the traditional TPB.

Figure 14: Theory of Planned behaviour (Chapter 1)



Note: Ajzen (1991)

According to the TPB, if a consumer perceives a specific behaviour to be a social norm, the more likely he/she adopts the behaviour, so to say the behavioural intention is the immediate determinant of actual behaviour (Wang et al., 2016). Also, important to consider is the availability of opportunity and resources to meet one´s behaviour expectations (Ajzen, 1991). As Ajzen, 1991) explained: "*A general rule, the stronger the intention to engage in a behaviour, the more likely should be its execution*" (p. 181). Attitude is defined as one of the "three conceptually independent determinants of intention" (Ajzen, 1991; p.188), and "*refers to the degree to which a person has a favourable or unfavourable evaluation or appraisal of the behaviour in question*" (Ajzen, 1991; p.188). The subjective norm defines the social pressure to exert or not exert the behaviour, and perceived behavioural control refers to the "*perceived ease or difficulty of performing the behaviour and it is assumed to reflect past experience as well as anticipated*

impediments and obstacles." (Ajzen, 1991; p.188). The stronger attitude and subjective norm are impacted and the greater the perceived behavioural control, the stronger the consumer´s intention to perform a certain behaviour.

In summary, the theory of planned behaviour distinguishes three types of beliefs: 1) behavioural, 2) normative, and 3) control, in relation to attitude, subjective norm, and perceived behavioural control. Again, it is important to consider that Ajzen (1991) showed that adoption intention is predicted more strongly than the actual adoption. The TPB is often used in the psychology domain although its constructs can be arranged according to any field of research.

As shown in the previous Table 2, there are 16 authors applying exclusively the TPB model, mostly in an extended way to include new and/or other constructs. Another five authors combined the TPB with other theories. Shalender & Sharma (2020) applied an extended TPB model to predict adoption intention for EVs by including personal norm and concern for the environment in the framework for the extended TPB model. Wang et al. (2016) extended the TPB with the variable of "personal norm", referring to Achtnicht (2012) who concluded that German buyers are willing to pay higher amounts of money to adopt green vehicles to satisfy their moral norm. Wang et al. (2016) included the construct "environmental concern" to analyse the impact of environmental-friendly behaviour indirectly through other variables of their TBD model. Xu et al. (2019) showed that subjective norm and environmental performance have a significant influence on the intention to purchase BEVs. If customers show a positive attitude towards BEVs, their willingness to purchase BEVs is significantly correlated. Mohamed et al. (2016) extended the TPB to quantify the impacts of personal beliefs on individual adoption intention towards EVs and found that the household´s concern for the environment has an indirect impact behavioural intention, whereas attitude, perceived behavioural control and norms (both moral and subjective) had a significant direct impact. Adnan et al. (2018) showed that subjective norm, personal moral norm, perceived behavioural control and attitude shows an indirect effect towards consumer´s intention to adopt PHEVs, and are significantly predetermined by their respective environmental concern. Shankar & Kumari (2019) applied the TPB in an extended version to explore the enablers and not only the inhibitors of EV adoption from a seller perspective by including EC, ATT, Social Norms, Perceived behavioural control, and Perceived CSR Obligation. Yan et al. (2019) showed that positive attributes have a significant impact on the actual purchase intention of EVs, that to say, the more positive and the stronger the TPB constructs (attitude, subjective norms, perceived behavioural control) are, the more positive is the effect on the purchase intention.

Referring to the study from Bhutto et al. (2020), the TPB is extended with the variable of "price sensitivity" as the extent to which individuals perceive prices and what role prices plays in the buyer choice. Price sensitivity can be referred to the willingness-to-pay. Bhutto et al. (2020) concluded that price sensitivity has a significant positive impact on consumers´ purchase

intention. Dong et al. (2020) combined the TPB with Norm Activation theory and included the "van Westendorp" price sensitivity model to estimate price preferences (acceptable price range) for pure electric vehicles. The "van Westendorp" price sensitivity meter allows to analyse consumers perceptions of a specific product by asking consumers four questions relating to the product being too expensive, too cheap, expensive/ high side and cheap/ good value, resulting in a willingness-to-pay guideline. Xu et al. (2019) highlighted the importance of "environmental performance" on consumers adoption intention and included the variable price-value (reasonable price perception that consumers have for BEVs) based on the assumption that the purchase price is a key driver to purchase or not a BEV. However, the authors found that price value does not have a significant influence on BEV purchase.

Other authors (Haustein & Jensen, 2018; Liu et al., 2020; Schmalfuß et al., 2017; Thøgersen & Ebsen, 2019; Wolff & Madlener, 2019) included the variable of (driving) experience to show the impact of previous experience with EVs on their adoption. The results showed a positive impact of "experience" on the adoption and/or perception of EVs. Liu et al. (2020) divided consumers into two categories for experienced and inexperienced consumers, while analysing the effect of experience on the one side directly on the adoption intention and as mediating effects on the other traditional TPB variables.

Li et al., 2020; Wang et al., 2017; and Xu et al., 2019 analysed policy characteristics in an extended TPB model. Li et al. (2020) extended the TPB model with four items to measure policy mix characteristics and showed that the four policy mix characteristics have a positive impact on EVs purchase intention. Xu et al. (2019) extended the TPB model among others with non-monetary incentives policy and monetary incentives policy and found that that non-monetary incentives policy does not have significant impact on the customer's purchase intention.

In summary, there are several other authors including the variable of "Environmental Concern", which seems to play an important role, as later explained in Chapter 3 of this dissertation (Adnan et al., 2017; Mehdizadeh & Shariat-Mohaymany, 2021; Mohamed et al., 2016; Shalender & Sharma, 2020; Shankar & Kumari, 2019; Thøgersen & Ebsen, 2019; Wang et al., 2016; Xu et al., 2019). Several authors included sociodemographic variables to complete their investigation (Mehdizadeh & Shariat-Mohaymany, 2021; Mohamed et al., 2016; Simsekoglu & Nayum, 2018; Wolff & Madlener, 2019). Further information and empirical evidence about different sociodemographic variables will be provided in Chapter 2 of this dissertation.

Other authors combined the TPB model with other theoretical framework to better demonstrate their research objective. Dong et al. (2020) included the Norm Activation Model to create a new theoretical framework that includes different psychology variables (altruistic/ non-altruistic factors) such as feelings and emotions, personal norms, awareness of consequences, and

ascription of responsibility. Stillwater & Kurani (2013) combined the TPB with the Extended Model of Goal Directed Behaviour to reorient the TPB framework towards the achievement of behavioural goals instead of focusing on intentions to perform specific actions, as it is believed that the inclusion of a personal goal is an important factor in "driver motivation". Adnan et al. (2017) included both functional theory and constructive theory in the TPB model, with a special focus on attitude which in constructive theory is stated to be influenced by external information and direct experience. Tu & Yang (2019) integrated three models: TPB, TAM and IDT. The TPB supported with the constructs of attitude, subjective norm, self-control ability, while the TAM included the perceived usefulness and perceived ease of use. The IDT is based on the belief that "*the innovation decision-making process will be influenced by the decision-making subject, which means that the individual's or organization's perception of the innovation characteristics greatly affects the acceptance of innovation (…).*" (Tu & Yang, 2019, p.6). Thøgersen & Ebsen (2019) included the TPB model with the Reasoned Action Framework, which is explained in the following chapter.

In summary, there are different variables and constructs used to extend the original TPB model. As Ajzen (1991) showed, the TPB can reflect the dispositional prediction of human behaviour. The utility of the TPB to examine consumers behaviour for adopting EVs is demonstrated in many papers. It is a theory that has been and can be applied in very diverse domains. The results concluded by applying the TPB model verifies the suitability of this theory to analyse and predict environmental-friendly behavioural intentions. However, as a general limitation of the TPB, is the fact that most studies of psychological antecedents of the adoption of EVs focus on intentions to adopt EVs rather than on actual adoption (Rezvani et al., 2015). Further information about the TPB, will be provided in Chapter 3 where an empirical research based on an extended TPB model is applied.

3.3.2 Theory of Reasoned Action

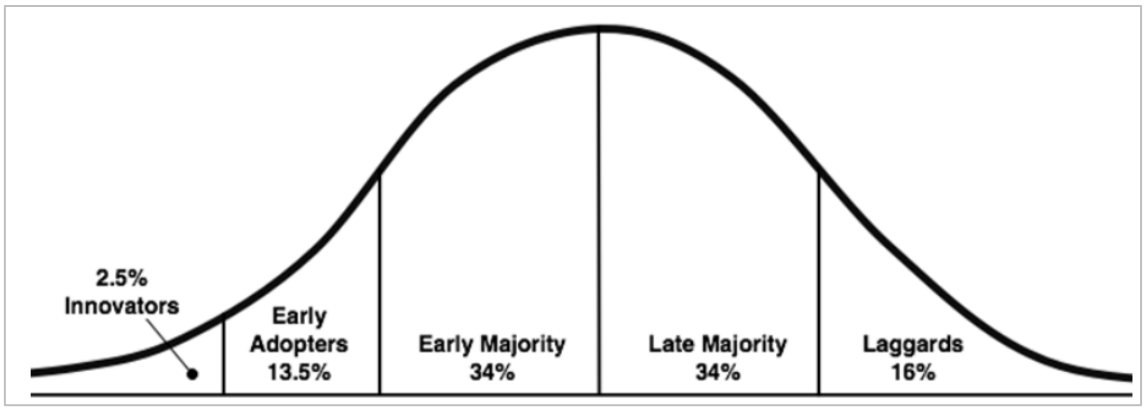
The Theory of Reasoned Action (TRA) is a predecessor of the TPB and explains the relationship between attitudes and consumer behaviour. The TRA was revised and was extended into the TPB model to overcome certain limitations by including the perceived behavioural control dimension and is a widely studied model especially from social psychology area (Ajzen and Fishbein, 1980). The TRA includes two unique factors to determine behavioural intention: attitude toward the behaviour (ATT) and subjective norm (SN). The constructs of attitude, behavioural intention, actual behaviour analyse its relationship toward behaviour. In line with the TPB model, the TRA model assumes that the different constructs can be used to measure a specific behaviour (Ajzen and Fishbein, 1980). Nosi et al. (2017) applied the TRA while focussing on millennials aged 18-35 and confirmed previous results that attitude and subjective norm positively impact on EV purchase intention, whereas the EV´s attributes such as new technology showed no importance to

the millennials in the decision-making. Higueras-Castillo et al. (2019) included the TRA which suggest that attitude positively impacts on consumer´s behavioural intentions, and thus, to consider the effect of perceived outcome on individuals' intention to buy an EV. Thøgersen & Ebsen (2019) showed that the reasoned action model is an adequate framework for studies including psychological antecedents of the intention to buy an EV. The deliberately formed intention is thought to be the immediate psychological antecedent of behaviour (Fishbein & Ajzen, 2010). This explains its focus on understanding intentions to adopt an innovation or a certain behaviour rather than the actual adoption, especially when this behaviour is rare and difficult to study in practice (so to say, for rather new and rarely used products such as EVs). Nevertheless, under the assumption that consumers will adopt more frequently EVs in a near future, it is recommended to focus on the actual behaviour rather than only intention, which is one of the main limitations of the TRA and TPB models. In summary, the TRA is an appropriate theory to investigate EV adoption and purchase intention. However, it is recommended to directly use the TPB as a more comprehensive and extended theory.

3.3.3 Innovation Diffusion Theory

Technology adoption is a complex process and there are different adoption theories. Several authors use the Innovation Diffusion Theory (IDT) to identify and profile early EV adopters (Fry et al., 2018; Jansson et al., 2017). The Roger´s Diffusion of Innovation (DoI) theory, published in 1963, is used based on its simplistic and pragmatic approach (Fry et al., 2018). Fry et al. (2018) applied the IDT process to analyse the decision-making for adoption or rejection of AFV for early adopters and explained that alternative fuel vehicles are product innovations that are still considered "new" to consumers. The authors bring better understanding of the *"(...) Innovation-Decision Process model that focuses on how an innovation decision is influenced by the perceived newness of the innovation and the associated uncertainty that arises as a consequence.*" (Fry et al., 2018, p. 2). According to Roger´s adoption distribution curve (see Figure 15), the first people to adopt a new product are called "innovators" and represent a very small percentage of the population. The next consumer group is the so-called "early adopters", followed by the group of "early majority", then "late majority" and ultimately comes the consumer group called the "Laggards". The definition of the consumer groups depends on the fastness with which they adopt new product ideas, while Laggards are the last consumer group in adopting a product. The DoI framework is used extensively to understand not only early adopters, but also consumer perceptions towards new innovations.

Figure 15: Theory of Diffusion of Innovation by Rogers (Chapter 1)



Note: Rogers' DoI theory (Fry et al., 2018)

Wang et al. (2016) explained that current adopters of HEVs in China are early adopters. Jansson et al. (2017) used the DoI theory to show the impact of interpersonal influence of adoption of AFVs, with results showing that adoption is higher if primarily neighbours have adopted AFVs. The rate of consumer adoption is influenced by the innovation, communication channels, time, and the social system, according to Rogers (2003). Therefore, Jansson et al. (2017) showed the importance of having a social system in place to influence consumer adoption for AFVs. Noel et al. (2019b) examined driver's range anxiety and applied the "Hirschman's Rhetoric of Reaction" to individuals in the context of diffusion of innovation theory, with the aim of providing a better understanding of why individuals would show an "anti-innovation reaction" in the diffusion process. The authors gave evidence that consumers reactions to a certain innovation change over time. Range anxiety seems to be the most common (however not only) factor against EVs adoption (Noel et al., 2019b). Mohamed et al. (2016) focused on the Theory of Planned Behaviour, and characterized the Early Adopters into Typical Early Adopters, Emerging Early Adopters, and Interested Retirees, based on socioeconomic and demographic variables. In a recent paper by Gruber (2020), Adoption Diffusion Theory is analysed for EV adoption and the author concluded that "adoption-specific factors, e.g., the "*perceived benefits" of radical innovations, emerge and change over time, and are thus influenced by higher-level interactions in culture, policy, and industry.*" (Gruber, 2020, p.539). The paper demonstrated the importance of considering different settings of culture and system that might impact on the diffusion of new technologies, whereby the adoption and diffusion of new technologies such as EVs is influenced on how user preferences, technology, and policy evolves (Gruber, 2020). Noel et al. (2019a) explained that the role of status is not adequately anchored and installed in the theory of diffusion of innovation, and the authors explained that diffusion of innovation is connected to conspicuous consumption. The authors highlighted that the success of the diffusion and adoption of an innovation is positively related to the innovation´s observability as perceived by society. The research studies including the DoI Theory often refer to the fact that EVs are mainly considered

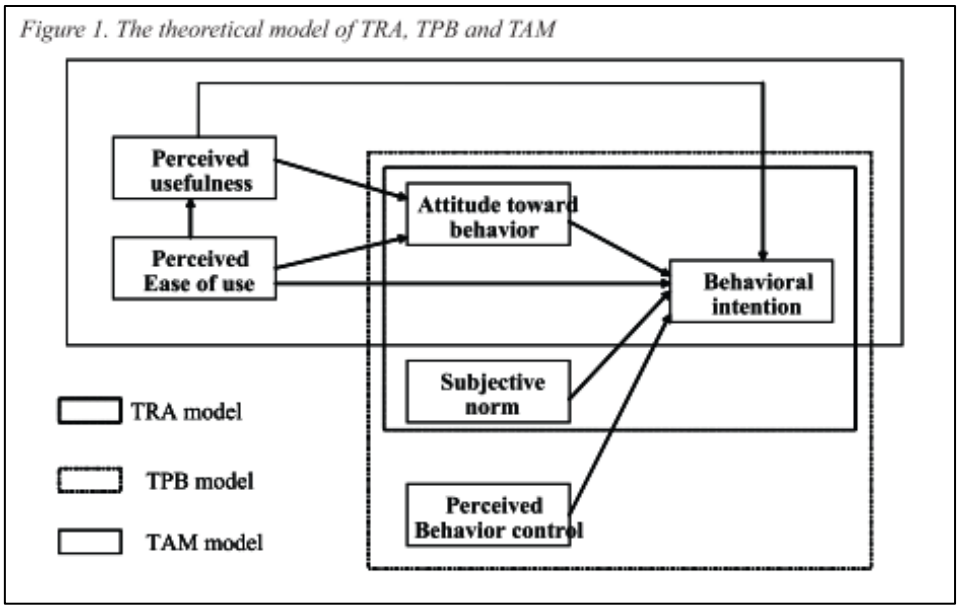
by early adopters. It is also important to consider the cultural context and influence of society that might differ from country to country.

3.3.4 Technology Acceptance Model TAM

In literature, the Technology Acceptance Model (TAM) has been employed in several research studies on the adoption of EVs. The theory was developed by Davis (1989) based on the TRA model (Tu & Yang, 2019). It suggests that the attitude of an individual is determined by two beliefs, the perceived usefulness (PU) and perceived ease of use (PEOU), whereas the PU based on the individual´s belief how much will improve his or her job performance when using the innovation, and to what extent this individual perceives the innovation as free of effort. This model is often applied on new technology innovations. Tu & Yang (2019) analysed the TAM model based on the TRA and TPB model and focussed mainly on the usage behaviour of information technology users. As dependent variables, this model consider user attitude, behavioural intention, and usage behaviour. Also, and very importantly, it assumes that the perceived usefulness and the perceived ease of use affects the attitude towards using technology and thus, influences in the actual use. Li et al. (2017a) summarized: "*The technology acceptance model (TAM) is a theory used for analysing how users come to accept and use a technology.*" (p.325). Wolff & Madlener (2019) extended the original TAM model in combination with the Diffusion of Innovation Theory to create the UTAM model, "Unified Technology Acceptance Model", as "*hybrid model of technology acceptance that connects two well-established technology acceptance and diffusion models (…)*" (Wolff & Madlener, 2019, p. 263). Thøgersen & Ebsen (2019) applied a reasoned action framework based on TPB and TAM with perceived difficulty vs. perceived ease of using the new technology.

In summary, TPB, TRA and TAM are three well known models available to analyse technology adoption (see Figure 16): the Technology Acceptance Model by Davis (1989), the Theory of Planned Behaviour by Ajzen (1991), and the Theory of Reasoned Action by Ajzen and Fishbein (1980). Fishbein and Ajzen (2010) defined these three theories and other related theories as "reasoned action theories" which can be adapted to create new frameworks defined as "reasoned action framework" (Thøgersen & Ebsen, 2019). In conclusion, the TAM is considered an adequate model to extend one´s theoretical framework to study consumers' behaviour of purchasing an EV.

Figure 16: Framework TRA, TPB and TAM model (Chapter 1)



Note: Rouibah et al., 2009

3.3.5 Other Theories

In the following, other theories which are examined in this literature review are shortly explained. The frequency of these theories in literature is less than the previous ones explained with more detail (the majority appears only once in the selected papers).

The Value Believe Norm (VBN) theory was first established by Stern et al. (1999) to explain the influence of human values on behaviour in a pro-environmentally context. The theory investigates the relationship between values, beliefs, norms, and behaviours. The VBN posits that there are more factors affecting the relationship between values and actual behaviour, such as fundamental values: behaviour specific beliefs; and personal moral norms of each individual. According to VBN theory, pro-environmental behaviour is more likely to occur when certain values, beliefs or norms are applied. Nordlund et al. (2018) applied both VBN theory and Norm-Activation model (by Schwartz 1977) in their study, explaining that *"(…) a personal norm is of utmost importance for an intention and a behavioural choice to occur and is related to both general factors such as values and more specific factors such as beliefs*." (Nordlund et al., 2018, p.206). Taking into consideration some other foundations of modern cognitive psychology, the stimulus-organism-response (S-O-R) model suggest that the effect of external stimulus on consumer´s behaviour is mediated by individual cognitive and emotional reactions. to explain the predictive influence of external environmental characteristics on individuals´ emotional reactions and behaviours. It is used to better describe the relationship between stimulus experienced by the consumer, the internal assessment, and the subsequent response by the consumer. Xu et al. (2020, 2021) applied

the SOR framework and suggested that it provides a good explanation for the psychological changes and purchasing behaviour of consumers. The authors analysed how consumers EVs driving experience (S - stimulus) impacts on their cognitions and perceptions, where O (O – Organism) stands for perceived relative advantage, perceived ease of use, and perceived risk of EVs and R (R – Response) for the adoption intentions. Wolff & Madlener (2019) applied the Unified Technology Acceptance Model (UTAM), which is a hybrid model of technology acceptance TAM and DOI theory. Axsen et al. (2018) applied the Lifestyle theory "*which defines lifestyle as engagement in several related practices that inform and convey self-identity*" (Axsen et al., 2018, p. 17) and "*to understand how (PHEV) purchase and usage develop along with consumer identify and lifestyle*" (Axsen et al., 2018, p. 18). This theory helps to understand how consumers behave and perceive EV technology in the context of social practices and identity construction. The Protection Motivation theory applied by Bockarjova & Steg (2014) explained pro-environmental choices by including different predictors such as costs and benefits of maladaptive behaviour, which refers to the current behaviour, and prospective adaptive behaviour. It is based on the idea that existing risks and the perception of one´s ability to deal with these risks influences the individual´s motivation. The Unified Theory of Acceptance and Use of Technology (UTAUT) combines eight different theories to explain the adoption of technologies, including among others the TPB, TAM, DoIT and is applied by Sovacool (2017) who included the theory of mobility (Automobility) and the Actor Network Theory to explain social acceptance and user adoption. Zolfagharian et al. (2021) included the UTAUT with the Technological Innovation Systems framework to include both macro-level for EV diffusion and micro-level structure. He et al. (2020) applied the Grounded Theory and Motivation–Opportunity–Ability model to show that behaviour motivation, behaviour intentions, residential characteristics, social norms, behaviour ability, and institutional and technological context. Han et al. (2017) based their research on Consumption Value Theory, while classifying consumers' value perceptions of EVs functional values (and non-functional values). Dogan & Ozmen (2019) combined both Optimal Distinctiveness Theory and Self-construal theory to include the relative level of environmentalism depending on their surroundings. The authors explained that previous research about interest and intention of adopting HEVs was done from an isolated perspective since they just concluded that "*the higher the absolute level of environmentalism the higher the consumer´s interest and intention to purchase HEVs*" (Dogan & Ozmen, 2019, p. 1465). Here, self-construal included the feelings, thoughts, and actions of individuals as they are perceived. Skippon et al. (2016) applied the Self-Congruity Theory which supports "*that products are preferred whose symbolic meanings are congruent with personal identity*" (Skippon et al., 2016, p. 26). The authors conducted a randomized controlled trial to analyse the impact of experience on the willingness to consider a BEV and found that users in high self-congruity who consider BEVs as a strong symbol of personal identity consider BEVs with low range, whereas other users

showed a declining willingness after the experience of a BEV especially when range was considered low. Ashmore et al. (2018) included two of Hofstede´s cross-cultural dimensions as power differential and individualism vs. collectivism to analyse the difference of symbolism of eco cars. Sajjad et al. (2020) included both PPM (push-pull-mooring) model and institutional theory in a framework with the objective to investigate "*green behavior of people in the face of air pollution*" (Sajjad et al., 2020, p. 39776). The study included the regulative environment as effects of rules and regulations and the Normative Environment as the effect on informal settings by North´s institutional theory (1990) to predict "green switching intentions". Yang & Tan (2019) applied the Howard-Sheth theory to explore the purchase decision and usage characteristics of EVs, and to analyse the whole purchase process of EVs, which is divided into four stages: (1) "Ignored and Neglected", (2) "Proactive Attention", (3) "Comparison and Selection of Vehicles" and (4) "Usage Evaluation". As the authors explained: "*Howard and Sheth proposed "Howard–Sheth" consumer behavioral analysis theory in 1963, and the theory holds that input factors and external factors are the stimuli of purchasing that provide the information on various options by evoking and forming motivations, and that affect the psychological activities of purchasers (intrinsic factors)*" (Yang & Tan, 2019, p.5). Manca et al. (2020) applied a hybrid choice model with the focus on individual´s peer attitude to understand behavioural implications on one´s choice. Sheldon & Dua (2020) applied the Vehicle choice model with the utility of choosing a vehicle to predict market share of PEVs under alternative policies. Bigerna et al. (2016) applied the Fuzzy-set qualitative comparative analysis to examine the decisively positive and negative attitude towards AFVs. Cherchi (2017) applied measures of Informational and Normative Conformity to investigate the effect of both types of conformity for the preference of EVs. Rahman (2018) focused on its study not only on green cars but also on green hotels and organic wine, and applied the Elaboration likelihood model, to understand better the effectiveness of persuasive communication in different "green" purchase situations.

4 Conclusion and Recommendations

In this Chapter 1, different theoretical approaches and frameworks examining consumer behaviour, purchase intention or/and actual adoption for EVs are investigated within a systematic literature review. The systematic literature review included in total 49 publications according to the explained process selection. The number of articles dealing with EVs consumers adoption has considerably increased from 2018 on. Selected studies, mainly executed in China, America, or European Nordic countries, give a profound understanding and proposal for different theories that can be applied. Importantly and in line with several of the analysed studies, consumer perceptions of EVs highly affect their behaviour and consequently their acceptance towards EVs.

4.1 Discussion and Research Agenda

Consumer adoption has been argued with different theoretical frameworks which are all analysed and explained in more depth in this chapter. This research with its knowledge sharing helps future researchers to focus directly on an adequate theory depending on its research objective. The literature review of the theories available for consumers' adoption for EVs should motivate other research to focus on this research area, and the conceptual frameworks and research methodologies of the reviewed studies should serve as a basis.

There are various theories available to investigate on consumers purchase intention and adoption of EVs, however the main approaches focus on the Theory of Planned Behaviour, established by Ajzen (1991). Several authors have extended the TPB with new constructs to comply with their research scope, and the results verified the relevance of the (extended) TPB, demonstrating that it has a good explanatory power to predict consumers´ intention to adopt EVs. Although there are limitations of this theory, its applicability is recommended for studies that focus on pro-environmental (new) products. However, since the TPB focusses mainly on the intention to adopt as proxy for the actual adoption, on medium-term once EVs are more broadly adopted and considered as mainstream products a different theory and/or approach should be used to focus directly on the real adoption.

If the objective is to further enrich the literature on exploring the effects on consumers' intention to adopt EVs and/or especially BEVs, with solid constructs that are well-known in different research areas and that provide the possibility to extend with additional constructs and variables, the extended model of the TPB is recommended. This theory can also be combined with other theories such as TAM or IDT or TRA in case a more global framework with different focuses is required. The TAM model is especially recommended for new technology products. To better understand the consumers' intentions and analyse the impact of attitude, the TRA is highly recommended. The Value Belief Norm theory of environmentalism is recommended to shed light on the values, self-beliefs, and personal norms, awareness of the consumers have in predicting pro-environmental behaviour. If the focus is mainly on cultural differences, it is recommended to include Hofstede´s dimensions in the research and if the objective is to focus on external stimulus, then the SOR framework would be adequate.

In general, all studies share the opinion that there is a strong concern for the environment and a strong believe that a different behaviour is required from consumers, politicians, and production industries to solve the environmental problems societies all over the world are facing. Many studies prevail that consumers are rather looking for image and reputational reasons than truly caring for the environment when adopting EVs.

The objective of this Chapter 1 was a systematic literature review of different theories applied for the purchase intention and adoption of EVs and referring to the initial research questions it can be summarized that the research objectives are fulfilled.

4.2 Policy Recommendations

As several studies demonstrated, the adoption of EVs is likely to be limited without significant governmental incentives. Given the low market penetration of EVs, incentives are believed to be a prerequisite for finally changing the environmental behaviour of consumers. The current political promotions in several European countries, partially due to Covid-19 impact towards the automotive industry, may help to increase EV market penetration, and take away consumers' remaining hesitation.

Also, as EVs are often associated with worse performance, information diffusion and information availability are required both by government and industry, and ideally, more test drives are offered to show the real potential of these vehicles and make consumers acquiring driving experience of EVs, which is one of the drivers to adopt EVs (as shown in Chapter 2 and 3).

4.3 Limitations and Future Research

The present literature review provides a global overview yielded with the keyword combination "electric vehicles", "theory" and "adoption". Some other studies with the same or a similar objective but instead of using "adoption" rather than "behaviour" or "purchase", might not be included in this search result. Future research might apply a different keyword combination to overcome this limitation. Also, the focus on "EV" as keyword might exclude more specific studies that directly introduce a different type of electric vehicle such as PHEV, BEV or HEV. At least for empirical research it is recommended to clearly distinguish between the different vehicle types and ideally focus on pure BEV as an innovation (more innovative compared to conventional hybrid vehicles). It might be treacherous to generalize results from AFV towards BEV.

At the same time, the research focuses on the WoS platform only and there might be different results yielded on other academic platforms which should be taken into consideration. Also, most of the studies have focused on the intention instead of the actual adoption of EVs and for future research it is recommended to focus on the actual adoption if possible. Nevertheless, this can be explained due to the low market share, especially for pure BEVs.

In addition, the student likes to highlight that the raise of EVs adoption is not free of criticism; there are some papers analysing the negative impact that the use and production of EVs might have on the environment, and the harms of EVs electricity consumption. One of the scholars summarizing such critics is Henderson (2020) in the paper "EVs are not the answer". Henderson (2020) cited other authors concluding that vehicle-to-grid charging, which refers to using the EVs

battery as storage for electricity, might rather incentive more than less driving. Based on the literature review, Henderson (2020) suggested to pause and evaluate other green mobility alternatives such as walking, cycling, public transport or compact, car-free cities. The author proposed for future research more critical analysis, closer interrogation of the resources, emissions, and energy claims for EVs, and examination of the politics. In addition, it is important to consider the resources needed for producing EVs which again can be critically outlined.

And finally, to provide full information, it is worth noticing that EVs are not an innovation from recent years but has its initial years already more than a century ago. Thus, the new interest and demand in EVs can be defined as revival. At the same time, it is important to conduct cross-country comparisons to generalize results. Countries from Southern Europe, such as Spain, suffer short-comes of research in this field.

For the subsequent Chapter 2, a more detailed analysis of factors and barriers for EVs adoption based on different variables such as experience, range anxiety etc. will be included. Also, it is of importance to understand the different typology of EVs and certainly a pure BEV shows a different purchase behaviour than, for example, mild hybrid vehicles with less technological difference from a consumer point of view. Therefore, in order to provide more value with focus on the TPB, the focus should be mainly on BEVs or at least PHEV. This will be taken into consideration in Chapter 3. Future research is recommended to analyse the impact of different kind of incentives provided for environmental friendly cars, which will be proven in Chapter 2 of this doctoral thesis.

II) Chapter 2: Empirical Study

Chapter 2

Study on Consumer Behaviour for Electric Vehicles assuming different and equal prices: Are consumers rather reputation-driven than environmental-driven?

1 Study on Consumer Behaviour

Chapter 2 focuses on the following title: “Study on Consumer Behaviour for Electric Vehicles assuming different and equal prices: Are consumers rather reputation-driven than environmental-driven?” In this approach, the different factors and motivational reasons behind the adoption decision for EVs are analysed.

1.1 Abstract

This chapter examines factors and consumer’s behaviour that influence Electric vehicles’ (EVs) adoption and aims to obtain a deeper insight into perceptual and motivational reasons, as well as the barriers for the slow adoption of EVs and therefore to understand better consumer behaviour. EVs represent an important innovation with positive environmental consequences to lower greenhouse gas emissions and to mitigate the causes of climate change on a global level. The study offers an empirical approach with a wide sample (n> 2.000) to understand the factors for EVs adoption. A multiple logit regression model was developed to explore factors that influence the likelihood of buying an EV, applying different aspects such as demographic variables, car attributes and external environmental factors. It is found that age, being male and having children, higher education and living in urban areas, having had previous experience with EVs influence positively to the adoption of EVs. If prices for all types of vehicles were the same, adoption for EVs seems less attractive especially for image and reputation driven individuals, which highlights the importance of having economic power to buy the more expensive EV in comparison to other vehicles. Therefore, social status plays a more important role than expected in consumer behaviour for sustainable manners. Better infrastructure and information availability help to promote further EVs. The paper can guide governments to establish effective policy measures. In summary, this study adds new insights into the adoption of EVs from a consumer behavioural perspective and confirms certain earlier findings, while implementing new empirical approaches.

1.2 Keywords

- Electric Vehicles
- Buying intentions
- Motivation
- Factors
- Behaviour
- Spain

1.3 Introduction

In order to promote EVs sales, it is critical to understand consumers' perception and behaviour. As previously explained, in recent years, Plug-in Hybrid Electric Vehicles (PHEVs) and Battery Electric Vehicles (BEVs) have become more prominent in the field of sustainable transportation. However, despite the growing demand, the market share of EVs is still limited, counting for only 2.7% for BEV and 4.9% for PHEVs of all cars registered in Spain in 2021 (MSI Iberia, 2022). Consequently, it is of interest to analyse the factors and motivations behind the adoption decision for EVs from a consumer perspective. Therefore, this chapter aims to investigate on consumer behaviour towards EVs based on an own primary data set.

As previously explained, consumer behaviour is shaped by social, economic, and environmental concerns that lead to new consumer demands and therefore require different strategies for companies (Hofenk et al., 2019). More and more attention is being paid to sustainable consumer research; however, it is still underrepresented, and more research is needed. The present chapter contributes to the literature by obtaining insights into consumer behaviour for EVs and to uncover factors and barriers for its adoption. It identifies the socio-demographic characteristics of the EV consumers while applying a structured and global approach to include environmental aspects and car attributes. Additionally, the study analyses consumer behaviour when all vehicles cost the same. The explanatory research is based on a strong, theoretical foundation about consumers' behaviour. The empirical study is carried out in Spain in 2021. Based on the theoretical framework and the empirical study, corporate and governmental interventions targeting psychological barriers to the adoption of an EV are discussed.

In detail, this paper addresses the following main research questions:

1. In line with previous literature, what are the factors that influence the preference and adoption of EVs? By answering this question, this research can answer the following:
    a. What does a Spanish consumer of EVs look like (sociodemographic variables)?
    b. What effect do experience, governmental incentives, information availability, and other car attributes have on EV preference?

In this case, the dependent variable focuses on a variable that includes whether a consumer prefers to buy an electric or others, more traditional cars (1= Yes, EV; 0= No EV). This research question adds further evidence to the existing literature on potential consumers in Spain, a Southern European country where such profiling is lacking. Moreover, it compares previous results and fulfils future research recommendations for the "experience" variable.

2. In order to shed light on the importance of consumer behaviour, are consumers' status, reputation, and image driven when adopting EVs?

a. With respect to the different technologies of a car, if all types of car technology cost the same, would a consumer prefer to buy an electric or gasoline/diesel car?
b. Are consumers rather driven by reputation when purchasing an EV?

In this case, the dependent variable focuses on consumer preferences if EVs cost the same as other cars if all cars have the same purchase price, regardless of technological differences. This research question helps to obtain results on the importance of status and reputation.

The present study contributes to the literature by gaining insights into consumer behaviour for EVs, especially by analysing consumers' behaviour and preferences with equal and different prices for EV compared to Internal Combustion Engine Vehicles (ICEVs). Consistent with previous literature, it also identifies the sociodemographic characteristics of EV consumers, focusing on experience while applying a structured and comprehensive approach to include environmental aspects and car attributes.

The explanatory research is based on a solid theoretical foundation related to consumer behaviour. Based on the theoretical framework and the empirical study, car attributes and external attributes, environmental settings that could influence the preference for EVs are discussed. Current literature has analysed the factors of EV adoption and their motivators and barriers; however, this paper provides a holistic overview of different factors for EV adoption and a better understanding of consumer behaviour and car preferences if EVs cost the same as other cars. The results show clear policy implications, indicating the importance of the availability of information on EVs, a better infrastructure to charge EVs, and governmental incentives to promote EVs.

To accomplish the aforementioned objectives, the rest of the paper is organized as follows. Firstly, a review of the literature is presented, then the conceptual model guiding this research is presented, followed by the hypotheses. Section 3 explains the variables extracted from the survey and section 4 shows the empirical results of both research questions. In this section, special emphasis is placed on consumer behaviour in relation to status- and reputation-driven factors. Finally, section 5 shows the main conclusions as well as the limitations of the current research and future lines of research.

2 Literature Review, Conceptual Model and Hypotheses

2.1 Past Research, Theoretical Framework and Respective Hypotheses

With the aim of identifying relevant studies that help to achieve the objective of this paper, a literature review was conducted. The knowledge acquired in the previous Chapter 1 helped to complete the study. In total, for this Chapter 2 55 articles are reviewed and referred to.

According to previous literature, consumer behaviour plays an important role in the adoption of new technologies, such as EVs. An increasing amount of research on consumers' purchase

intentions and preferences is found as well as the role of self-image when purchasing green products (e.g., Griskevicius et al., 2010; Hafner et al., 2017; Hahnel et al., 2014; Herberz et al., 2020; Hur et al., 2013; Lane & Potter, 2007; Ozaki & Sevastyanova, 2011).

This paper distinguishes itself from other papers in its approach of systematically applying a comprehensive analysis of EV consumers with respect to three subcategories and then by comparing the model to a second model with another dependent variable representing the impact of **consumer preferences** if EVs cost the same as other cars. The three pillars that we have identified aggregate different variables that influence the preference for EVs: (1) the consumer, (2) car attributes, and (3) environmental settings. By doing so, we aim to answer the research questions stated above via a holistic approach. Li et al. (2017a) applied a systematic structured approach and divided their systematic literature review also into three types: (1) demographic, (2) situational, and (3) psychological factors. Likewise, Lane and Potter (2007) illustrated the factors for the adoption of EV with situational and psychological factors, whereby situational factors include environmental settings, such as regulations or infrastructure, and psychological factors include attitudes, symbols, influences, etc. Our results highlight the importance of symbolic attributes, such as status, **reputation,** and image, in opting for EVs. This paper distinguishes from other papers in its approach of systematically applying a global analysis of the consumer for EVs with three subcategories, and then by putting the model in comparison to a second dependent variable that analyses the impact of consumer's behaviour if all cars cost the same.

Rezvani et al. (2015) realized a systematic literature review for articles from 2007 and 2014 and is recommended for further information search about relevant papers in this area. Li et al. (2017a) identified 40 studies related to the consumers´ reasons to adopt BEVs and to explore factors that influence the intentions to adopt BEVs. Turcksin et al. (2013) reviewed 53 publications to summarize consumers´ attitudes and preferences towards AFVs. These studies helped to select additional papers relevant for the present study.

2.1.1 Consumers' Variables

In general, the literature shows contradictory results of demographic variables for consumers for EVs. Previous studies have provided evidence that **females** are more environmentally concerned than men are and thus more willing to buy green products (Jansson et al., 2017; Johansson-Stenman & Martinsson, 2006; Knez et al., 2014; Prakash et al., 2014; Simsekoglu & Nayum, 2018; Yang et al., 2019). Sovacool et al. (2019) explained, based on "gendering of (electric) mobility" references going back to 1880, that the gender discussion was already prevalent in the earliest discussions about automobiles when EVs were more common and had a larger market share. Plötz et al. (2014) found that it is rather men who are the first buyers of EVs.

H1: Females are more likely to prefer EVs than men.

Regarding the variable **age**, the results of the current literature are inconsistent. On the one hand, the existing literature shows evidence that green consumers are rather young (Hackbarth & Madlener, 2016; Hidrue et al., 2011; Knez et al., 2014; Laroche et al., 2001; Mukherjee & Ryan, 2020; Sanitthangkul et al., 2012). In contrast, other authors have found that older consumers are willing to purchase an EV (Jansson et al., 2017; Zhang et al., 2011). Plötz et al. (2014) and Peters & Dütschke (2014) found that middle-aged men are the most likely group of private EV buyers. Johansson-Stenman & Martinsson (2006) concluded that age had a positive influence, claiming that older people buy this type of green product.

H2: The younger the consumer, the higher the likelihood of preferring an EV over an ICEV.

There is evidence in the literature that individuals with **higher education** are more environmentally concerned and thus more willing to purchase an EV (Hidrue et al., 2011; Jansson et al., 2017; Mukherjee & Ryan, 2020; Olson, 2013.; Sanitthangkul et al., 2012). Nayum & Klöckner (2014) found that higher education had a positive impact on the purchase of more fuel-efficient cars. However, there are also research studies that show a negative influence of education on EV adoption, meaning that less educated consumers are more likely to purchase EVs (Hackbarth & Madlener, 2016; Johansson-Stenman & Martinsson, 2006; Zhang et al., 2011).

H3: Higher education leads to an increased probability of preferring an EV over an ICEV.

For the variable **income**, different effects have been found in different studies. Bjerkan et al. (2016) concluded that income levels matter only when consumers compare the usage costs of BEVs and ICEVs. When the purchase cost of a BEV and ICEV is similar, people with lower incomes favour the option with lower usage costs. In line with this, Plötz et al. (2016, 2017); Junquera et al. (2016), and Erdem et al. (2010) found that consumers with higher incomes were more likely to adopt an EV. In contrast, Nayum & Klöckner (2014) found that household income had a negative effect on purchasing a fuel-efficient vehicle. In accordance with this, Gleim & Lawson (2014) found through cluster analysis that the group with the highest average income did not have the highest purchase intention toward green products. Sanitthangkul et al. (2012) found no significant influence of income in determining the attitude toward eco-cars, which is in line with the studies by Egbue & Long (2012), Knez et al. (2014), Hidrue et al. (2011).

H4: Higher income leads to an increased probability of preferring an EV.

With reference to the **living area** of consumers, Mukherjee & Ryan (2020) showed that BEV owners tended to live in urban centres with very high population densities. In contrast, Plötz et al. (2014) found that the most likely group of EV buyers lived in rural or suburban areas. However, as is later stated in the limitations section, it is important to consider whether more educated

people rather live in urban areas and less educated people in rural areas, which could also affect whether or not they own an EV. In addition, there are more cities that limit access to the city centre to cars with reduced or no CO2 emissions, which could also affect the decision concerning which car technology to buy.

H5: Living in urban areas leads to an increased probability of preferring an EV.

It is also of interest whether having children, that is to say a family with **more family members**, increases the preference for an EV (Nayum & Klöckner, 2014; Zhang et al., 2011).

H6: Having children leads to an increased probability of preferring an EV.

Furthermore, **car ownership** seems to positively influence the purchase intention toward EVs. Zhang et al. (2011) showed that the number of vehicles owned by a family increased the willingness to purchase an EV. Nayum & Klöckner (2014) showed that a higher number of cars in the household positively impacted the purchase of more fuel-efficient cars. Hidrue et al. (2011) investigated the fact of owning multiple cars and found that it decreased the probability of being in the groups supporting EVs. It is also important to consider that nowadays the younger generation tends not to purchase a car of their own. This fact could influence the later results of the research as younger people do not necessarily own cars anymore.

H7: Possessing a car (independent of model) leads to an increased probability of preferring an EV.

Another important factor to consider is the impact of **experience** on EV uptake. As Liu et al. (2020) summarized, there are several studies analysing the impact of experience on the adoption of BEVs but without consensus. There are several studies that have investigated the role of direct BEV experience for its adoption or purchase intention (Bühler et al., 2014; Günther et al., 2020; Jensen et al., 2013; Liu et al., 2020; Peters & Dütschke, 2014; Schmalfuß et al., 2017). Individuals with BEV experience accepted higher purchase prices and showed a higher willingness to pay more for a BEV compared to individuals who had no experience (Larson et al., 2014; Peters & Dütschke, 2014). Hahnel et al. (2014) summarized from other authors that previous experience positively influenced the willingness to drive an EV. Herberz et al. (2020) concluded that first-hand experience with an unfamiliar technology helps to incentivize the purchase of sustainable products. The study by Xu et al. (2020) showed that consumers' EV driving experience had a significantly positive effect on consumers' intention to adopt EVs. Skippon et al. (2016) analysed the influence of having had experience with a BEV and found that willingness to consider a BEV declined after experiencing this type of car in a controlled trial. Bühler et al. (2014) found a positive significant effect of experience on the general perceptions on EVs but not on purchase

intentions for EVs. Rauh et al. (2020) showed that practical driving experience, together with range-related knowledge, reduced so-called range anxiety or stress, resulting in experience as a means to overcome range anxiety as a barrier.

H8: Having had previous experience leads to an increased probability of preferring an EV.

As previously mentioned, **consumer behavior and attitudes** toward sustainable behavior are gaining more attention, and studies highlight the importance of **self-image** when purchasing green products. Hahnel et al. (2014) explained that consumers use products to define and express their self-image and match it with the "*value-expressive attributes of the products*." (p. 318) Johansson-Stenman & Martinsson (2006) explained that individuals often want others to have a good impression of them with social approval and esteem, in other words, to use products to make people believe that they are more environmentally friendly and socially responsible than they really are. Individuals focus more on positive self-image than they care to admit, as "*being motivated largely by status concerns is perceived to be an unfavorable character trait.*" (Johansson-Stenman and Martinsson, 2006, p.131). The authors defined this behavior as self-deception and explained that pretending to be very concerned about the environment can lead to a better self-image, as others value the fact of "being" environmentally friendly. Rahmani & Loureiro (2019) showed that consumers buy EVs more for reputational issues rather than for environmental reasons. Ozaki & Sevastyanova (2011) had given evidence that people focus on their identity, image, values, and norms when adopting green technology, which is consistent with the study by Laroche et al. (2001). Moreover, Lane & Potter (2007) highlighted the importance and role of a car as a status symbol, and found evidence that consumers want others to know about their green vehicle, which should positively affect their image. Hur et al. (2013) explained that green products can represent the consumer´s image or socially responsible values, and their use can show to which consumer group they belong. Hahnel et al. (2014) showed that the activation of pro-environmental values leads to lower price sensitivity to higher purchase prices of EVs. However, as Herberz et al. (2020) mentioned, it is important to keep in mind that "*changing consumer behavior can be difficult, especially in conservative, slow-changing sectors such as the transportation domain*" (p.102). Interestingly, Griskevicius et al. (2010) showed the interrelations of environmental behavior and status and found that *"(…) a desire for status can spur self-sacrifice [that] also presents a powerful tool for motivating prosocial and proenvironmental action.*" (Griskevicius et al. 2010, p.402).

H9: Reputation- and status-driven consumers are more likely to prefer EVs.

2.1.2 Car Attributes

There is a common understanding that a **high purchase price** is one of the main reasons why consumers hesitate to adopt EVs. The initial purchase price of EVs is usually higher than that of

conventional cars, and the market share and diffusion of EVs may not increase if the purchase price does not decrease (Bjerkan et al., 2016; Cecere et al., 2018; Egbue & Long, 2012; Knez et al., 2014; Lane & Potter, 2007; Lieven et al., 2011). Ozaki & Sevastyanova (2011) have explained that individuals see green alternatives as too expensive, and Lieven et al. (2011) confirmed that "*price is the top priority for both conventional and the electric vehicles (…)*" (p. 139). Bjerkan et al. (2016) concluded that purchase cost reduction is the strongest incentive to promote BEV adoption.

H10: A higher list price for EV lowers the preference for EVs.

At the same time, **lower consumption and lower maintenance costs** can offset a higher purchase price (Egbue & Long, 2012; Gallagher & Muehlegger, 2011; Lane & Potter, 2007).

H11: Lower consumption and lower maintenance costs compensate for the higher purchase price of EVs and leads to an increased probability of preferring an EV.

In terms of car attributes, it has been shown that a **higher range** leads to higher acceptance of EVs and that a limited range has a negative impact on EV adoption, distribution, acceptance and usage (Barkenbus, 2020; Cecere et al., 2018; Egbue & Long, 2012; Günther et al., 2019; Hackbarth & Madlener, 2016; Hidrue et al., 2011; Hoen & Koetse, 2014; Lieven et al., 2011; Schneidereit et al., 2015). Here, range refers to the distance an EVs can travel before the battery needs to be recharged. Cecere et al. (2018) have suggested that manufacturers improve the quality of EVs' batteries to increase driving range to achieve greater diffusion of EVs. Franke & Krems (2013a) have shown that, in particular, experienced EV drivers seek average and maximum range, while inexperienced drivers show weak affect towards range needs. Range anxiety is associated with higher range preferences, according to the trial study conducted by Franke & Krems (2013b). Range anxiety here refers to the fear of running out of battery before reaching a charging station.

H12: A higher range of EVs, leads to an increased probability of preferring an EV.

2.1.3 Environmental Settings

Several authors have shown the importance of the development of **charging infrastructures** to promote EVs and have concluded that the availability of a functioning charging infrastructure is significantly related to BEV markets (Barkenbus, 2020; Hardman et al., 2018; Li et al., 2017b; Sierzchula et al., 2014). Oliveira et al. (2019) also pointed out the importance of including charging/ fuelling infrastructure in future research for EV. Martínez-Lao et al. (2017) illustrated the need for "*structured implementation strategies*" (p.970) with public charging stations to improve electric mobility. Hoen & Koetse (2014) demonstrated that charging potential and recharge time are limiting factors for preference choices for Alternative Fuel Vehicles (AFVs). Harrison and Thiel (2016) concluded that minimal infrastructural objectives could be

advantageous; however, in their scenarios, the provision of charging points appeared to be weaker than other vehicles subsidies.

H13: Better infrastructure (charging stations, wallbox installations) the context shows leads to an increased probability of preferring an EV.

There are several studies showing the importance of **governmental supports** to further promote EV (Cordera et al., 2019; Gallagher & Muehlegger, 2011; Hardman et al., 2017; J. Li et al., 2019; Turcksin et al., 2013). Wang et al. (2017) divided policy measures into three categories, such as financial incentives, information provision, and convenience policy measure and displayed that all three catalogues are significantly related to EV adoption intention. Hackbarth & Madlener (2016) found that governmental purchase price subsidies were not sufficiently valued by consumers, although non-monetary government incentives and vehicle tax exemptions could increase the likelihood of choosing an AFV. Similarly, Mukherjee & Ryan (2020) showed that financial incentives can especially encourage younger consumers with lower savings and demonstrated the positive impact of exclusive bus lanes or free parking while recharging. Zhang et al. (2011) found a negative influence of government policies on EV adoption.

H14: Governmental support for EVs leads to an increased probability of preferring an EV.

With the aim of overcoming other barriers for EV adoption, it is necessary to improve the **availability and diffusion of information** about low emission cars. Some authors have shown that consumers are often resistant to new technologies because of their novelty, unfamiliarity, and uncertainty (Egbue & Long, 2012; Hidrue et al., 2011; Ozaki & Sevastyanova, 2011; Turcksin et al., 2013). Rezvani et al. (2015) showed that so-called “engaged green” consumers pursued a more technology-oriented lifestyle and were open to change. Rahmani & Loureiro (2018) found mistrust and misconceptions about this technology to be other reasons for a lack of interest.

H15: More available information combined with the know-how of dealers, leads to an increased probability of preferring an EV.

This literature review provides a comprehensive overview of existing studies that analyse the variables that motivate or hinder EV adoption. As stated by Nayum & Klöckner (2014), it is important not only to include sociodemographic factors but also psychological factors to avoid misguidance for industry and policy decisions.

2.1.4 Others

As general fact to consider, it is important to reduce the energy and resources necessary to manufacture BEVs compared to ICEs, especially regarding their batteries, to preserve the

ecological advantage of BEVs (Günther et al., 2019). Franke & Krems (2013a) explained that positive effects of EVs for reducing CO2 emissions or utilizing excessing energy from renewable sources depend on how the electric mobility system is used. Referring to Olson (2013) manufacturing firms typically employ two strategies for selling green products and showed that higher costs are not only a problem for consumers, but also for manufacturers. Olson (2013) showed that a Toyota retailer receives a lower margin with a hybrid car (Toyota Prius) than with a conventional car. Ambec & Lanoie (2008) explained that environmental friendly behaviour has been often associated with additional costs for firms, but highlighted that any kind of green products and attitude bring better economic performance, competitiveness, access to certain markets and image. Martínez-Lao et al. (2017) highlighted the importance of a better battery management for EVs and storage capacities which would help for wider development of EVs. Barkenbus (2020) concluded as one of the intrinsic shortcomings of EVs the following: "*The fundamental problem relates to the state of battery development*." (Barkenbus, 2020, p.5), which is also related to the driving range of EVs.

2.2 Hypotheses and Model

Following the literature review, our hypotheses refer to the following categories: (1) demographic factors including individual variables and experience, and consumer behaviour; (2) car attributes, such as range, price, etc.; and (3) situational factors, such as environmental settings. Table 3 shows the hypotheses with the respective study references.

Table 3: Overview hypotheses with respective references (Chapter 2)

Category		Hypothesis	Authors (Literature Review)	In contrast
Consumer	H1	Females are more likely to prefer EVs than men.	Johansson-Stenman & Martinsson, 2006; Knez et al., 2014; Prakash et al., 2014; Jansson et al., 2017; Simsekoglu & Nayum, 2018; Yang et al. 2019; Sovacoola et al., 2019;	Ploetz et al., 2014
	H2	The younger the consumer, the higher the likelihood of preferring an EV over an ICE vehicle.	Laroche et al. 2001; Hidrue et al., 2011; Sanitthangkul et al., 2012; Knez et al., 2014; Hackbarth & Madlener, 2016; Mukherjee & Ryan, 2020	Johansson- Stenman and Martinsson, 2006; Zhang et al. 2011; Ploetz et al., 2014; Peters & Dütschke, 2014; Jansson et al., 2017 *no signficance:* Egbue and Long, 2012
	H3	Higher education leads to an increased probability of preferring an EV over an ICE vehicle.	Hidrue et al., 2011; Sanitthangkul et al., 2012; Olson, 2013; Jansson et al., 2017; Mukherjee & Ryan, 2020; Nayum and Klöckner, 2014	Johansson-Stenman and Martinsson, 2006; Zhang et al., 2011; Hackbarth & Madlener, 2016.
	H4	Higher income leads to an increased probability of preferring an EV.	Bjerkan et al., 2016; Ploetz et al., 2016; Ploetz et al., 2017; Junqueras et al., 2016; Erdem et al., 2010	Nayum and Klöckner, 2014; *no significance*: Sanitthangkul et al., 2012; Egbue and Long, 2012; Knez et al., 2014; Hidrue et al., 2011. Green products: Gleim and Lawson (2014)

	H5	Living in urban areas leads to an increased probability of preferring an EV.	Mukherjee & Ryan, 2019	Ploetz et al., 2014
	H6	Having children leads to an increased probability of preferring an EV.	Zhang et al., 2011; Nayum and Klöckner, 2014; Plötz et al., 2014. *household size*	-
	H7	Possessing a car (independent of model) leads to an increased probability of preferring an EV.	Zhang et al., 2011; Nayum and Klöckner, 2014: *number of cars*	Hidrue et al., 2011
	H8	Having had previous experience leads to an increased probability of preferring an EV.	Jensen et al., 2013; Schmalfuß et al., 2014; Peters & Dütschke, 2014; Hahnel et al., 2014; Larson et al., 2014; Peters & Dütschke, 2014; Nayum et al., 2016; Schmalfuß et al. 2017; Günther et al., 2019; Rauh et al., 2020; Herberz et al., 2020 ;Xu et al., 2020; Liu et al. (2020)	Skippon et al., 2016; Bühler et al., 2014
	H9	Reputation- and status-driven consumers are more likely to prefer EVs.	Hahnel et al., 2014 ;Johansson-Stenman & Martinsson, 2006; Rahmania & Loureirob, 2019; Ozaki, 2011; Laroche et al., 2001; Lane & Potter, 2007; Hur et al., 2013	-
Car attributes	H10	A higher list price for EV lowers the preference for EVs.	Egbue and Long, 2012; Knez et al., 2014; Lane and Potter, 2007; Bjerkan, et al., 2016; Ozaki 2011; Lieven et al., 2011; Cecere et al, 2018;	-
	H11	Lower consumption and lower maintenance costs compensate for the higher purchase price of EVs and leads to an increased probability of preferring an EV	Potter and Lane, 2007; Gallagher and Muehlegger, 2011; Egbue and Long, 2012	-
	H12	A higher range of EVs, leads to an increased probability of preferring an EV.	Hidrue et al. 2011, Lieven et al., 2011; Egbue & Long, 2012; Hoen & Koetse, 2014; Schneidereit et al. 2015; Hackbarth & Madlener, 2016; Cecere et al., 2018; Günther et al., 2019; Barkenbus, 2020	For unexperienced drivers: Franke & Krems, 2013
Environ-mental settings	H13	Better infrastructure (charging stations, wallbox installations) the context shows leads to an increased probability of preferring an EV.	Sierzchula et al., 2014; Hoen & Koetse, 2014; Li et al., 2017a; Martinez-Lao et al., 2017; Hardman et al., 2018; Oliveira et al., 2019; Barkenbus, 2020	Weaker than other incentives: Harrison & Thiel, 2017
	H14	Governmental support for EVs leads to an increased probability of preferring an EV.	Gallagher & Muehlegger, 2011; Turcksin et al., 2013; Hardman et al., 2017; Wang et al., 2017; Cordera et al. 2018; Li et al., 2019	Zhang et al., 2011; Hackbarth & Madlener, 2016; For younger consumers: Mukherjee & Ryan, 2019
	H15	More available information combined with the know-how of dealers, leads to an increased probability of preferring an EV.	Hidrue et al, 2011; Ozaki, 2011; Egbue and Long, 2012; Turcksin et al., 2013; Rahmani & Loureiro, 2019	-

2.2.1 Final Model

Figure 17 shows the final model, which is a logit regression, for this research in a visual approach. This study differs from previous studies by not only offering a complete overview of demographic variables of consumers but also by taking into consideration car attributes and environmental settings in the same model, with the objective of analysing the factors that influence consumer intention to adopt EVs. Additionally, and more importantly, it analyses the impact on consumer

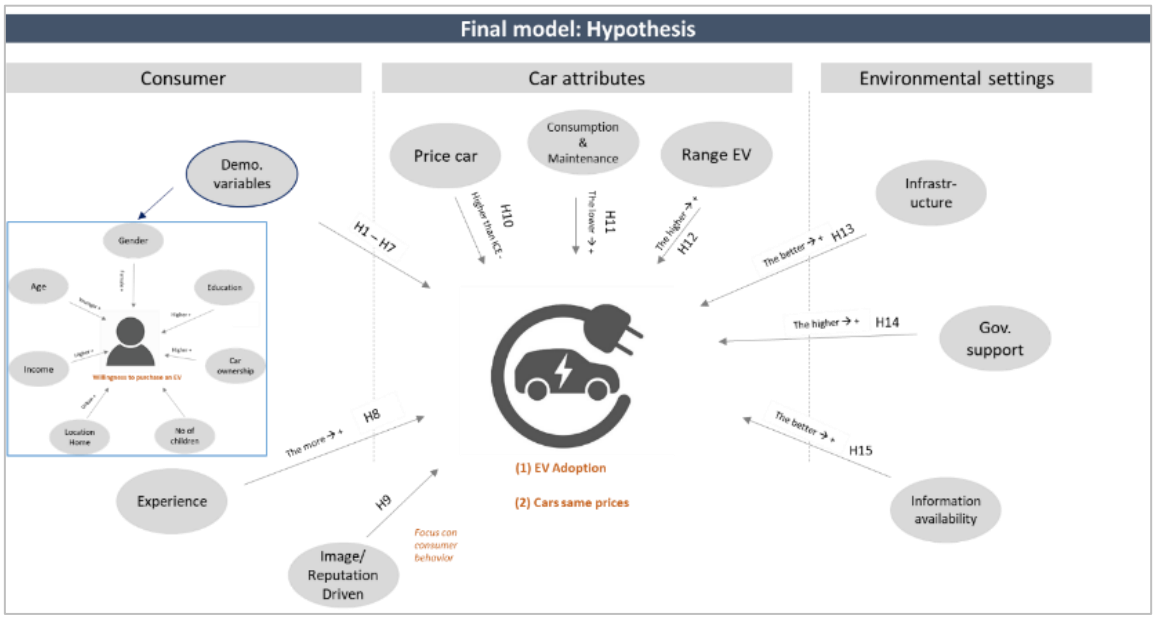
behaviour if EVs cost the same as other cars, namely if EVs are not more expensive than traditional vehicles.

The model is built on the following:

- Dependent variables: “EV Adoption” and “Cars same price”.
- Independent variables: Demographic variables, car attributes, environmental settings

$$EV = b_0 + b_1\,Age + b_2\,Educ + b_3\,Gender + b_4\,Income + b_5\,Owncar + b_6\,Area + b_7\,Children + b_8\,Exper + b_9\,Image + b_{10}\,Pricecar + b_{11}\,Consump + b_{12}\,Range + b_{13}\,Infrastructure + b_{14}\,Govsupport + b_{15}\,Infoavail + e$$

Figure 17: Final Model Overview (Chapter 2)



Note: Own work

3 Empirical Analysis: Introduction

In this section, we focus on the data set with which we worked, and the analyses performed. The main techniques are: (i) factor analysis, which helps to reduce variables, and (ii) logit to determine the relevance of the factors for increasing the probability of considering purchasing an EV.

3.1 Data Collection: The Survey

Data were collected via a web-based survey (Survey Monkey Platform, Premium member) through an online questionnaire (see Appendix 10). Distribution of the survey and participation were completely anonymous and without any remunerative aspects. Before issuing the final survey, an intense check-control process was carried out. The survey was sent to six experts from

the automotive industry and four other persons, who were invited to comment. This improved the quality of the survey. The common method of online invitations sent via email was applied. The study was sent out from Barcelona, Spain and was conducted online during the months of March until May 2021. After passing several evaluation committees at the University of Autònoma de Barcelona, the survey was finally approved to be sent in both English and Spanish to the UAB´s data set. This data set consists of students, professors, and administrative employees.

The survey was not distributed through a paid-based platform due to lack of funding. Throughout the entire process, the utmost attention was paid to a careful sample design with a focus on controlling sampling errors and avoiding biases that could be introduced unconsciously. Subsequently, sample validation was also conducted to ensure that the sample was representative of the population, as explained in the following.

Regarding the sampling method, a quota sampling approach was developed for contacting people from the University Autònoma of Barcelona with the goal of obtaining a "quota" of each stratum of the population, according to gender and age (sampling people between 18 and 87 years old), to be more representative of the population of interest (Barcelona, Spain). Based on official sources from the National Institute of Statistics (INE, 2022) and focusing on the gender and age of the population for Barcelona from 18 years until 87 years with a sample of 4,46 million habitants, 48,4% were male and 51,6% were female. In order to determine the sample size, we considered an infinite population, a confidence level of 95%, with p = q = 0,5 and a sampling error of +2%, which supposed a theoretical sample size of 2,400 observations.

The questionnaire consisted of two parts: the first part gave information on the profile of the respondents, including gender, age, education, income, and residential location, and the second part contained measurement items of additional variables of experience, preferences in cars, etc. In total, 2.198 answers were collected. With the aim of ensuring the quality of the sample, 50 answers were excluded due to missing values for variables that will be used later to perform the two different factor analyses to be applied, resulting in a total sample of 2.148 responses.

The overall sample ranged in age from 18 to 87, with an average age of 31 years, which is a fairly young sample. When tabulating the sample by gender and age, we obtained 45,67% males and 54,32% females based on 2.115 valid answers. The majority had an income of less than 20.000€ and up to 35.000€. Referring to official sites of population distribution in Spain (INE, 2022), the majority lived in urban areas, with 56% living in urban areas/ city areas and 31% in sub-urban areas, for a total of 87%. Comparing this figure to the Spanish Urban population (INE, 2022) an 80% of the population lives in urban areas in 2020. The difference with respect to the proportions in the population is + 2,7%. This sampling error is slightly above the theoretical one, so we consider that the sample obtained is an acceptable representation of the population of interest.

3.2 Data and Description of Variables

For the purpose of achieving the objectives of this work, the variables as found in Table 4 were defined.

Table 4: Overview Variables (Chapter 2)

Variable	Question	Definition	Descriptive
Yes_EV_1_0	Based on the variable Future_EV: Would you rather buy an electric or Diesel/Gasoline car as your next future car? (Dummy variable)	0-50% = 0 --> No EV 51%-100% = 1 --> Yes EV	0=64%/ 1=36% Std deviation: 30.23524 Min: 0 Max: 100
Car_sameprice	With regard to the different technologies of a car, if all types of cars cost the same, would you rather buy an electric or Diesel/ Gasoline car?	1= Electric vehicle, 0= Traditional vehicle (Diesel or Gasoline. ICE - internal combustion engine)	1=82%, 0=18%
Driver_License	Do you possess a driver's license?	1= Si/Yes, 0 =No	90% Yes/ 10% No
Age	How old are you?	indication of age	Min: 18/ Max. 87 Average 31 Std deviation: 13.00326
Gender	What is your gender?	0=female, 1=male	0 = 54% 1= 46%
Own_Car	Do you have a car (independently if it is a leasing, financed, property)?	0=No, 1= Yes, Petrol car, 2= Yes, Diesel Car, 3=Others	0= 26%/ 1=36%/ 2=30% 3=8%
Type_car	What type of car would you like to buy as your next one?	1=Gasoline/Gasolina, 2= Diesel, 3= Battery Electric car/ Vehículo eléctrico de batería (BEV), 4= Plug in Hybrid/Vehículo hibrido enchufable (PHEV), 5=Others	1=21%/ 2=13%/ 3=17%/ 4=21%/ 5=28%
Future_EV	How likely (in %) is it that you buy an electric vehicle (EV) as your next vehicle (0% not likely at all, 100% certain)?	Indication in %	mean=46%
Area	What area do you live in?	1=City Center (urban area) / 2= suburban area/ 3= rural area	1=56%/ 2=31%/ 3=13%
Edu	What is your highest level of education?	2= High school (Abitur), 3=Bachelor Degree, 4= Master Degree, 5=Doctor and above	2=18%/ 3=38%/ 4=27%/ 5=17%
Salary	What is your annual salary? (gross income)	1= less than 20.000€, 2=20.000€-34.999€, 3=35.000€-49.999€, 4=50.000€-64.999€, 5=65.000€ or more	1=61%/ 2=14%/ 3=9%/ 4=6%/ 5=10%
Children	How many children do you have?	0= none; 1=1; 2=2; 3=3; 4=4; 5=5 or more	0=79%/ 1=7%/ 2=11%/ 3=3%/ 4=0,14/ 5= 0,05
PrevExp2	Have you had previous experience with electric vehicles (EVs)? Response	0= No. No experience at all./ 1= Yes	0=78%/ 1=22%

The dependent variable "Yes_EV" asked about the preference for an EV or "other" and was changed into a binary variable for the sake of simplicity, with 1 as opting for an EV as a future car, and 0 for opting for "other". Interestingly, 64% would rather buy an "other" vehicle than an EV. If all vehicles cost the same, 82% would opt for an EV (variable "car_sameprice"). Ninety percent of respondents possessed a driver's license, and 26% did not possess their own vehicle.

4 Empirical Results

4.1 Most important Factors when buying a new Car

When analysing the direct question "What are the most important factors when buying a new car? Indicate on a scale from "1 = not important at all" to "10 = most important," the factors price, driving range, and consumption (refers to fuel consumption) showed the highest importance (see Appendix 2). Interestingly, social acceptance had the lowest importance. This is an important finding for the following analysis when prices are assumed to be the same for all vehicles.

4.1.1 Exploratory Factor Analysis

Due to the relationships among the explanatory quantitative variables, and with the purpose of avoiding future problems of collinearity in the explanatory analysis, we first conducted an Exploratory Factor Analysis (EFA) with all quantitative predictor variables (33 variables in total). These included those that loaded on factors listed in Appendix 4, with a total of nine car-factor importance items (measured on a 10-point Likert scale in response to the question, "What are the most important aspects when buying a new car?") and another 22 EV opinion items (measured on a 5-point Likert scale of agreement/disagreement). Additionally, the quantitative variables "age" and "children" were included in the EFA. Principal component factor analysis with varimax rotation was implemented. We considered only factors with an eigenvalue >1 (number# of factors was 10). With 10 factors, we captured 60,31% of the total information contained in the original variables (kMO value: 0,753 and Bartlett's test for sphericity Chi-squared =16470.16***, df = 528), and thus we are confident to work with the reduced number of variables caused by factor analysis. The 10 factors are found in Table 5. In Appendix 5, we show the rotated factor loadings, eigenvalues, and the percentage of variance explained by each factor obtained through factor analysis.

Table 5: 10 Factors defined through factor analysis (Chapter 2)

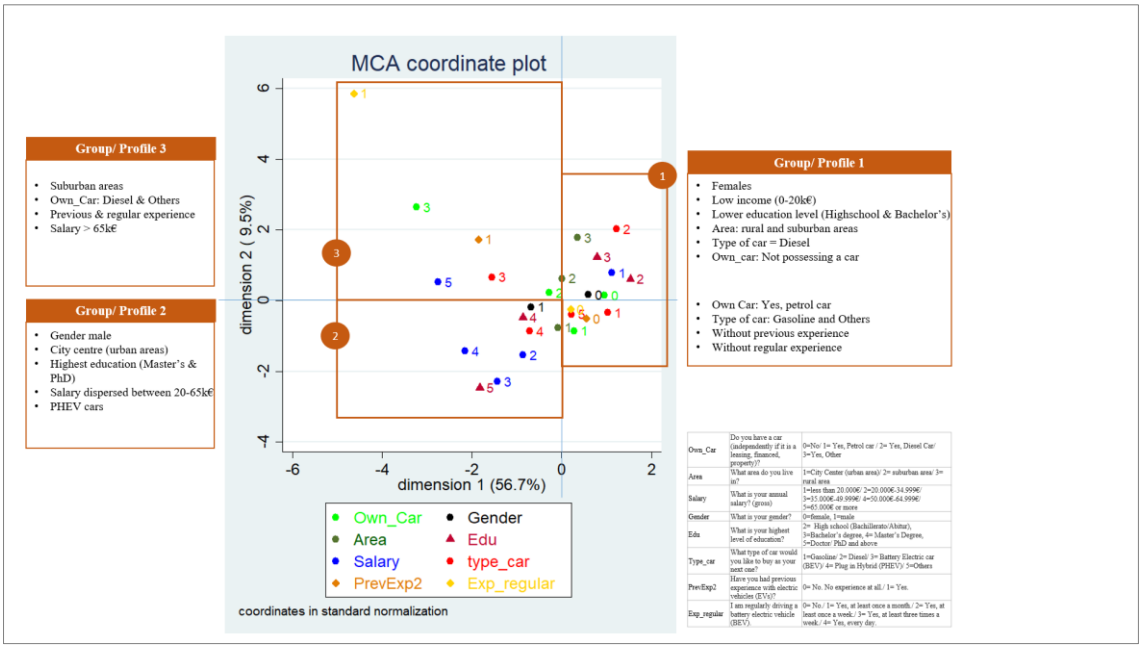
Factor	Variables	Definition Variables	Question Survey	Definition Factor
Factor 1	Factor_Brand	Brand	What are the most important factors when buying a new car? Please indicate on a scale from "1 = not important at all" to "10 = most important".	Reputation driven
	Factor_Design	Design		
	Factor_SocAccept	Social Acceptance		
	Factor_Reput	Reputation		
Factor 2	Scale_personalnecess	An electric vehicle fits my personal necessities.	Please indicate on a scale from 1 (completely disagree) to 5 (completely agree) with the following. (EV = electric vehicle. ICE = internal combustion engine; traditional vehicle)	Fitting necessities
	Scale_professionalnecess	An electric vehicle fits my professional necessities.		
	Scale_lessemiss	For the purchase of an EV, I am motivated by a lower contamination of an EV (compared to an ICE).		
Factor 3	Scale_image_socialstatus	Driving an electric vehicle would improve my image and social status.	Please indicate on a scale from 1 (completely disagree) to 5 (completely agree) with the following. (EV = electric vehicle.	Social Status

	Scale_ecofriendlyimage	For the purchase of an EV, I am motivated by an eco-friendly image towards others (others will think that I care about the environment).	ICE = internal combustion engine; traditional vehicle)	
	Scale_statussociety	Individuals who purchase an EV have a better status in society.		
Factor 4	Factor_Drive	Driving Range (distance your car can drive before recharging/refueling)	What are the most important factors when buying a new car? Please indicate on a scale from "1 = not important at all" to "10 = most important".	Performance
	Factor_Consum	Consumption		
	Factor_Perf	Performance (HP, kwH)		
	Factor_Emiss	Emissions		
Factor 5	Scale_lowerconsumhigherprice	The lower consumption (cost) of an electric vehicle can compensate for a higher initial price of EVs vs. traditional cars.	Please indicate on a scale from 1 (completely disagree) to 5 (completely agree) with the following. (EV = electric vehicle. ICE = internal combustion engine; traditional vehicle)	Price compensation
	Scale_lowrunningcosts	The lower running costs for workshop, parts, maintenance etc. can compensate for the higher initial price of electric vehicles vs. traditional cars.		
Factor 6	Age	quantitative variable	How old are you	Life Stage
	Children		How many children do you have?	
Factor 7	Evless_lessinfo	… the little information provided about electric vehicles.	Electric vehicles are not sold more often due to…. Please indicate from a scale from 1 (completely disagree) to 5 (completely agree) for the following assumptions of why electric vehicles are not sold more often.	Lack of knowledge
	Evless_knowledgeDealer	…the lack of knowledge about electric vehicles of sales advisors in dealerships		
Factor 8	Evless_wallbox	… the fact of not having a private parking space to install chargers (Wallbox).	Electric vehicles are not sold more often due to…. Please indicate from a scale from 1 (completely disagree) to 5 (completely agree) for the following assumptions of why electric vehicles are not sold more often.	Missing infrastructure
	Evless_infrastr	…the lack of public chargers.		
	Evless_installprivatecharger	…the effort (approval by community) to install a private charger in a shared parking space.		
Factor 9	Factor_Price	Price, cost of car	What are the most important factors when buying a new car? Please indicate on a scale from "1 = not important at all" to "10 = most important".	Price/ Financial aspects
	Evless_price	Electric vehicles are not sold more often due to……the high purchase price.	Electric vehicles are not sold more often due to…. Please indicate from a scale from 1 (completely disagree) to 5 (completely agree) for the following assumptions of why electric vehicles are not sold more often.	
Factor 10	Evless_perfor	…the performance of the electric vehicle.	Electric vehicles are not sold more often due to…. Please indicate from a scale from 1 (completely disagree) to 5 (completely agree) for the following assumptions of why electric vehicles are not sold more often.	Range Anxiety
	Evless_range	…the limited range of electric vehicles.		

4.1.2 Multiple Correspondence Analysis (MCA)

Due to possible relationships between the qualitative variables and to avoid future problems of collinearity in the explanatory analysis, we performed a Multiple Correspondence Analysis (MCA) for the qualitative variables (see Figure 18). We worked with two dimensions because graphing is more intuitive. Furthermore, the principal inertia of dimension 1 was 0,024, and the principal inertia of dimension 2 was 0,004. The percentages of original information captured by these two dimensions were, respectively, 56,74% and 9,53%, with the cumulative percentage being 66,27%. For the MCA all qualitative variables were selected to check the possible dimensions and to provide a first interpretation.

Figure 18: Results MCA Analysis (Chapter 2)



Note: Own work based on MCA Analysis

In the upper right in Figure 18 as "Group/Profile 1," we find the gender "female" and the income category 0-20k€, combined with a lower education level (2) with High School (Bachillerato) and Bachelor. These individuals live in rural and suburban areas and do not own a car. In the same dimension of the coordinate plot < 0 are grouped individuals who own a gasoline car and would choose gasoline or others as future cars and who do not have any EV experience yet. On the left-hand side dimension, we find individuals who can be grouped into "Profile 2," that is, males living in the city centre with the highest education level (master's and PhD) and a dispersed income level of 20k€ - 65k€. Individuals who are grouped into "Profile 3" are those living in suburban areas, owning diesel cars & others, with previous and regular EV experience and the highest salary at >65k€. Although MCA helps to detect and represent underlying structures of categorical

variables in order to define groups of individuals with a similar profile, it is possible that the groups included individuals who did not fit 100% into the profile definition.

In summary, MCA helped to reduce qualitative variables in only one variable "profile" with three subcategories (see Table 6). Later, in the regression analysis, the categories represented the initial variables.

Table 6: Categories of New Variable "Profile" (Chapter 2)

New variable "Profile"		**Description**	
Category 1 Females with low income, low education level living in suburban and rural areas	profile = 1 if d1>0	• Females • Low income (0-20k€) • Low education level (Highschool and Bachelor´s Degree) • Area: rural and suburban areas • Type_car = Diesel • Own_car: Not possessing a car • Own Car: Yes, gasoline car • Type_car: Gasoline + Others • Without previous experience • Without regular experience	Frequency 1.244 58%
Category 2 Males with high education in city center and higher income	profile = 2 if d1<0 and d2<0	• Males • City center • Highest education (Masters and PhD) • Income dispersed between 20-65k€ • PHEV cars	Frequency: 583 27%
Category 3 Male with highest income living in suburban areas with experience	profile = 3 if d1<0 and d2>0	• Suburban areas • Own_Car: Diesel and Others • Previous and regular experience • Income > 65k€	Frequency: 323 15%

4.1.3 Relationship among Profiles and Factors

As the factors were quantitative variables and profile was a qualitative variable with three categories, through one-way ANOVA, we tested whether the population means of the new quantitative variables (which were the factors obtained) were equal for the categories of the variable "profile" (see Table 7).

Table 7: Oneway factors (Chapter 2)

oneway (factorX) ANOVA profile, tab	**F**	**Prob>F (p-value)**	**Variances homogeneity Prob>chi2**
Factor 1: Reputation-Driven	6.32	0.0018	0.528
Factor 2: Fitting necessities	10.26	0.0000	0.137
Factor 3: Social status	6.29	0.0019	0.279
Factor 4: Performance	0.70	0.4946	0.068
Factor 5: Price compensation	0.75	0.4702	0.147
Factor 6: Life Stage	283.048(a)	0.0000	0.0000
Factor 7: Lack of knowledge	21.98	0.0000	0.578
Factor 8: Missing infrastructure	2.305 (a)	0.1002	0.024
Factor 9: Price of EV	19.19	0.0000	0.564

Factor 10: Range Anxiety	4.10	0.0167	0.301

(a)F value of applying fstar option. Based on the fact that variances homogeneity is not given for the factor "Life Stage" and "Missing infrastructure", the F-value represents the one obtained through fstar command in Stata.

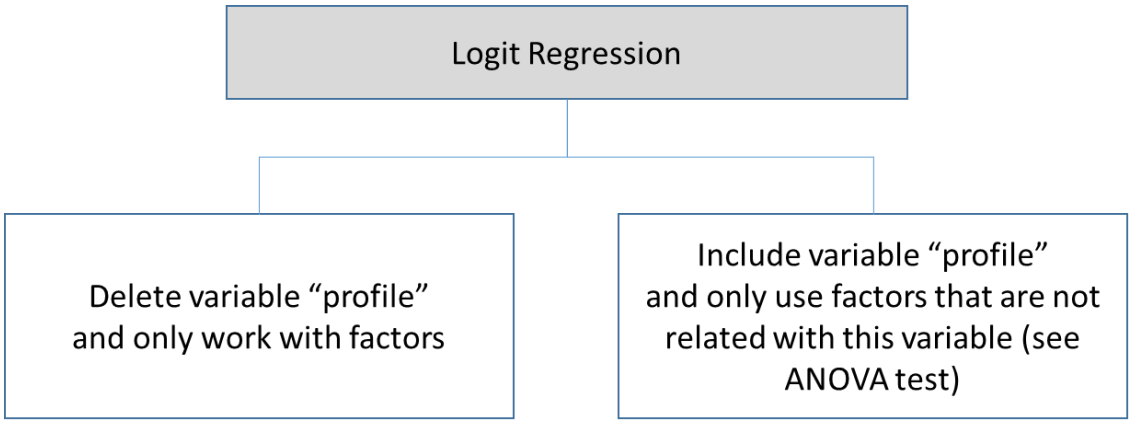
All factors except "performance," "price compensation," and "missing infrastructure" showed a statistically significant difference in the means corresponding the three categories of "profiles." Therefore, only these factors, each unrelated to the variable "profile," were selected for the logit regression that included the profile variable to avoid potential collinearity. The close relationship between the profiles and Factor 6 (life stage) probably arises because both represent socio-demographic differences.

4.2 Estimation of the Explanatory Model: Analysis and Results

After defining the factors and the new categorical variable "profile," we checked their relations with the other variables before estimating the model. To overcome multicollinearity, we tested the variables for possible correlation problems between them. We related and hypothesized the factors obtained through EFA that did not show any multicollinearity with the variable "profile" and the preference for EV in the future. The analysis of this study includes robustness assessments, factor analysis, and multivariate logit analyses of the individuals' attitudinal and behavioural opinion towards EV.

In order to determine how the obtained factors and the profiles impacted on the dependent variable, attending to the nature of this variable, logit regression was implemented. There were two different approaches due to the relationship identified between "factors" and "profile", as demonstrated in Figure 19: Option (1) used only the factors as explanatory variables and Option (2) worked with "profile" and factors not related to profile as explanatory variables. Option (2) helped us to verify and strengthen the results of Option (1) at least for the factors which were not related to profile. It is noteworthy to highlight that the survey asked about preferences and beliefs, so the interpretations were limited to the relationship between opinions and preferences.

Figure 19: Logit Regression Approach 2 Models (Chapter 2)



Note: Own graph

4.2.1 Model 1 Option 1: Logit Regression Only with Factors

In a first assessment, a logit regression was performed only with the factors defined above. The Pseudo R-squared shown in the following tables refers to McFadden´s R^2 and is a measure of goodness of fit. The overall fit of the model was significant, and the correctly classified observations were 72,80% (66,17% "yes" and 75,28% "no"). All factors except the factors "reputation-driven", "lack of knowledge," "missing infrastructure" and "range anxiety" showed a significant effect (see Table 8). The more the EV fit the personal and professional "necessities," the higher the probability of preferring an EV as their next car. If consumers perceived that an EV could fit their professional and personal necessities, the higher the probability of purchasing one. "Social status" represented the understanding that an EV improves social status and image in society. The greater the attention paid to social status, the higher the probability of preferring an EV over a gasoline/ diesel vehicle as the next future car. Thus, status-driven consumers were more akin with one another in preferring and purchasing EVs compared to non-status-driven consumers. The "performance" factor included car attributes, such as range, performance, consumption, and emissions, and the better these data were for the vehicle, the higher the probability of preferring an EV. The factor "price compensation" showed a positive coefficient and included variables that defined that lower consumption and lower maintenance compensated the higher purchase price of the EV. Consumers were more willing to purchase EVs if they perceived that the lower maintenance and consumption compensated for the initial purchase price. The "life stage" factor included the consumer´s age and number of children, and the positive coefficient indicated that the older and the more children the consumer had, the higher the preference for an EV. The "price" factor included aspects related to the higher price for EVs and showed a negative coefficient, which means that the higher the price for EV, the lower the probability of purchasing an EV as their next car.

Table 8: Logit regression Model 1 Option 1 (Chapter 2)

Model 1 Option 1: Dependent Variable EV

Definition Factor	Coef	Std. Err.	P>|z|	Lower limit ci 95%	Upper limit ci 95%
Factor 1: Reputation-Driven	,0844426	,0540744	0,118	-0,0215	0,1904
Factor 2: Fitting necessities	1,012105	,0661058	0,000	0,8825	1,1416
Factor 3: Social status	,1690223	,0535709	0,002	0,0640	0,2740
Factor 4: Performance	,4864028	,0588977	0,000	0,3709	0,6018
Factor 5: Price compensation	,4599024	,056502	0,000	0,3491	0,5706
Factor 6: Life Stage	,2579496	,0519183	0,000	0,1561	0,3597
Factor 7: Lack of knowledge	-,0025247	,0543732	0,963	-0,1090	0,1040
Factor 8: Missing infrastructure	-,0412599	,0535949	0,441	-0,1436	0,0637
Factor 9: Price of EV	**-,1288551**	**,0556772**	**0,021**	**-0,2379**	**-0,0197**
Factor 10: Range Anxiety	,0311045	,0531473	0,558	-0,0730	0,1352
_cons	-,7759184	,0560567	0,000	-0,8857	-0,6660

Log likelihood: -1073,1354
Number of observ: 1985
LR chi2(10): 448,26
Prob>chi2: 0,0000
Pseudo R2: 0,1728

4.2.2 Model 1 Option 2: Logit Regression with "Profile" and not Related Factors

The global fit of the model considering the factors and profile was significant, and the correctly classified observations were 67,51% (58,75% "yes" and 69,72% "no"). As for the newly introduced variable "profile," we can see that belonging to profile 2 or 3, instead of profile 1, increased the preference for an EV as the next car compared to an ICEV (see Table 9). As explained above, profile 1 was made up of females with lower education levels and lower income, while profile 2 and 3 were made up of men with higher salaries and who owned cars. We can see that all categories were statistically significant, which means that profile 2 and 3 individuals were more likely to prefer an EV than the Group of individuals assigned to profile 1.

In order to analyse the impact on the dependent variable, only the factors not related to profile were introduced: "performance," "price," and "missing infrastructure" (see Table 9). Two of these three factors were statistically significant. "Performance" showed statistical significance with a positive coefficient, so the better the technical data of an EV, the higher the preference for this type of technology. This coincided with the positive, significant results of the factor "price compensation".

Table 9: Logit Regression Model 1 Option 2 with "profile" (Chapter 2)

Model 1 Option 2

Yes_EV_1_0	Coef	Std. Err.	P>|z|	Lower limit ci 95%	Upper limit ci 95%
_Iprofile_2 (Male city center)	, 8744242	,112426	0,000	0,6540	1,0947
_Iprofile_3 (Male highest salary)	, 8970386	,1370168	0,000	0,6284	1,1655
Factor 4: Performance	, 3974305	,053762	0,000	0,2920	0,5028
Factor 5: Price compensation	, 3600625	,0513426	0,000	0,2594	0,4606

Factor 8: Missing infrastructure	-,0329299	,0496488	0,507	-0,1302	0,0643
_cons	-1,011134	,0683952	0,000	-1,1451	-0,8770

Log likelihood: -1199,7339
Number of obs = 1985
LR chi2(5) = 195,06
Prob>chi2 = 0,0000
Pseudo R2 = 0,0752

4.3 Further Analysis: Consumer Behaviour when assuming equal Prices

In the interest of deepen the analysis of consumer attitudes, the hypothetical situation that EVs cost the same as other cars was introduced. Therefore, a new dependent variable "car_sameprice" was introduced in the model, which refers to the question that if EVs cost the same as other cars, which car would the consumer prefer. As previously explained, the variable "price" has a statistical significance impact on the purchase intention of EV and is therefore important to be analysed. This approach helped to provide evidence on consumer behaviour and to shed further light on the importance of reputation and image when adopting an EV.

Car_sameprice	With regard to the different technologies of a car, if all types of cars cost the same, would you rather buy an electric or Diesel/ Gasoline car?	1= Electric vehicle/ vehículo eléctrico, 0= Traditional vehicle (Diesel or Gasoline. ICE - internal combustion engine), vehiculo tradicional	2nd Dependent variable	1=82%, 0=18%

4.3.1 Model 2 Option 1: Logit Regression only with Factors

For Model 2 Option 1, a logit regression was conducted (see Table 10). The global fit of the model considering nine factors (factor price was excluded) was significant and the correctly classified observations were 85,71% (87,67% "yes" and 68,02% "no"). The factor "price" was excluded from this model as the dependent variable itself supposed that EVs cost the same as other cars. Factors "fitting necessities," "social status," "performance," "price compensation," and "lack of knowledge" showed statistical significance with positive signs. The factors "reputation-driven", "missing infrastructure" and "range anxiety" were statistically significant with negative coefficients. The factor "life stage" was not statistically significant in this model.

The factor "reputation driven," which had not shown a significant effect on the preference for EV in the first model, was significant in the second model with a negative coefficient, meaning the more consumers were driven by reputation (based on the vehicle´s brand, design, social acceptance, and reputation), the less they opted for an EV in the situation that EVs cost the same. This is in line with the significance level of the factor "social status" in the first model. Considering the situation that all cars cost the same and the significance level of this factor, it showed that reputation-driven consumers were influenced by the higher price of an EV. Thus, reputation-driven consumers seemed to prefer higher-priced EVs to increase their status and

reputation. As previously shown, this is in line with the study by Griskevicius et al. (2010), explaining that status motives increased the desirability of green products when they cost more than non-green products.

The factors “fitting necessities,” “social status,” “performance,” and “price compensation” can be interpreted in the same way as in Model 1. The factor “life stage”, representing age and having children, showed a positive effect on the preference for an EV, without statistical significance if we assumed that car prices were the same. “Lack of knowledge,” which had no significant effect on the probability of increasing one´s preference for EVs according the first model, now became positive and significant. Therefore, if EVs cost the same as other cars, and the more information and knowledge about EVs was provided, it seems that consumers had a higher probability of preferring EVs over other cars. Factor “missing infrastructure” now showed a negative coefficient, which was interpreted as if infrastructure was lacking, consumers showed a decreasing probability of preferring EVs, assuming that the car prices were the same. The same happened for “range anxiety,” which showed no significant effect on the probability of preferring EVs according to the first model, but when the assumption about the same price for all cars was introduced, “range anxiety” showed a negative coefficient, which led to the assumption that the worse the range, the lower the probability of preferring an EV. In summary, the results of the first option of the second model give additional information on factors that were not statistically relevant in the first model.

Table 10: Logit Regression Model 2 Option 1 “Car_sameprice” (Chapter 2)

Model 2: Dependent Variable: Car_sameprice

Car_sameprice2	**Coef**	**Std. Err.**	**p-value**	**Lower limit ci 95%**	**Upper limit ci 95%**
Factor 1: Reputation-Driven	-,4422998	,0741533	0,000	-0,5876	-0,2969
Factor 2: Fitting necessities	1,369866	,0856904	0,000	1,2019	1,5378
Factor 3: Social status	,4801909	,0733781	0,000	0,3363	0,6240
Factor 4: Performance	,3579716	,06851	0,000	0,2236	0,4922
Factor 5: Price compensation	,4091105	,0711792	0,000	0,2696	0,5486
Factor 6: Life Stage	,0783293	,070079	0,264	-0,0590	0,2156
Factor 7: Lack of knowledge	,2137138	,0676224	0,002	0,0811	0,3462
Factor 8: Missing infrastructure	-,2510928	,0717101	0,000	-0,3916	-0,1105
Factor 10: Range Anxiety	-,2778786	,0743539	0,000	-0,4236	-0,1321
_cons	2,152514	,0894543	0,000	1,9771	2,3278

Log likelihood: -656,81695
Number of observ: 1981
LR chi2(9) = 546,18
Prob > chi2 = 0,0000
Pseudo R2 = 0,2937

Info: Factor 9 not included in this model (Price)

4.3.2 Model 2 Option 2: Logit Regression with "Profile" and not related Factors

In line with the previous approach in Model 1 Option 2, the new dependent variable was also compared with the created variable "profile" and the factors "performance," "price compensation," and "missing infrastructure," which were factors not related to profile (see Table 11). The overall fit of the model considering the three factors and "profile" was significant, and the correctly classified observations was 82,23% (82,28% "yes" and 66,67% "no"). Category 2 of the newly created variable "profile" showed statistical relevance, meaning that male consumers living in the city centre showed a higher probability of buying an EV compared to female consumers with lower income and education, living in suburban and rural areas. However, category 3 of the variable "profile," which referred to male consumers with the highest salary living in suburban areas and having had previous experience with EV, showed no statistical significance; thus, the coefficients tended to suggest that for this consumer group there was no influence on the preference for EV if these types of cars cost the same as the others.

In contrast to Model 1, "missing infrastructure" now showed statistical significance with a negative coefficient in both logit options, assuming that consumers´ preferences for EVs were lower with a missing infrastructure for recharging. "Price compensation" was interpreted to mean that lower consumption and lower maintenance costs can compensate for the higher purchase price for EVs. "Performance" referred to technical data, such as range and performance, and the better these data were, the higher the preference for an EV.

Table 11: Logit Regression Model 2 Option 2 "Car_sameprice" with "profile" (Chapter 2)

Car_sameprice	**Coef**	**Std. Err.**	**P>|z|**	**Lower limit ci 95%**	**Upper limit ci 95%**
_Iprofile_2 (Male city center)	,3754224	,1471205	0,011	0,0870	0,6637
_Iprofile_3 (Male highest salary)	,1087161	,1722673	0,528	-0,2289	0,4463
Factor 4: Performance	,2885597	,0565134	0,000	0,1777	0,3993
Factor 5: Price Compensation	,3249849	,0583146	0,000	0,2106	0,4392
Factor 8: Missing infrastructure	-,2060537	,0620898	0,001	-0,3277	-0,0843
_cons	1,488456	,0775327	0,000	1,3364	1,6404

Log likelihood: -892,87321
Number of obs = 1981
LR chi2(5) = 74,07
Prob>chi2 = 0,0000
Pseudo R2 = 0,0398

In summary, when comparing all four models, the price comparable models showed slightly better prediction accuracy, which strengthens the present approach of conducting a second model with the control variable of prices. In the following, the pseudo R2 and accuracy of the four models are summarized.

- Model 1 Option 1: pseudoR2 = 0,17, accuracy (correctly classified preferences) = 72,80%

- Model 1 Option 2: pseudoR2 = 0,08, accuracy (correctly classified preferences) = 67,51%
- Model 2 Option 1: pseudoR2 = 0,29, accuracy (correctly classified preferences) = 85,71%
- Model 2 Option 1: pseudoR2 = 0,04, accuracy (correctly classified preferences) = 82,23%

4.4 Results of Hypotheses for both Models

In comparison to the first model (assuming different prices), the second model (assuming equal prices) provided further statistical relevance. It is noteworthy that reputation-driven consumers showed negative statistical relevance in the second model based on Factor 1 "reputation-driven," meaning that if prices were the same for all vehicles, the probability of preferring an EV over an ICE vehicle would decrease. Griskevicius et al. (2010) also found that status motives increased the preference for green products, especially when these products cost more than non green products. Griskevicius et al. (2010) and Hafner et al. (2017) have suggested that people might not agree that image matters when adopting EV when asked directly. Therefore, the role of image and reputation is highly complex, and consequently consumer´s responses regarding those variables might not reflect the real attitude. This is an important finding for further research on consumer behaviour. For five of our hypotheses, we found statistical evidence in only one of the two models, which raises the possibility that the positive tests may have been "false positives" due to the increased probability of getting a positive result when conducting multiple hypothesis tests. Intending to overcome this issue, we applied the Bonferroni test as the technique when conducting multiple analyses on the same dependent variable with the chance of increasing error rate, and thus increasing the probability of incorrectly rejecting the true null hypothesis by coming about a significant result by chance. However, we found no concerning impact.

4.4.1 Consumer Hypotheses

Regarding Hypothesis 1, "Females are more likely to prefer EVs than men," this assumption can be rejected in both models, as profiles 2 and 3, which included male consumers, showed a positive sign compared to group 1 in which women were prevalent; thus, in this sample men seemed more likely to prefer EVs. As previously explained, it is important to consider that not each individual who responded to the survey fit 100% the definition of the different groups created from MCA. If this result is accepted with some caution, Hypothesis 1 is to be rejected, and this outcome is in line with Plötz et al. (2014). As for the variable age, our result suggests rejecting Hypothesis 2 based on Model 1, as the factor "life stage," which included the variable "age," showed a positive sign, meaning that the older the consumers were, the higher the probability of preferring an EV. This result supports the findings by Johansson-Stenman & Martinsson (2006), Zhang et al. (2011), Plötz et al. (2014), Peters & Dütschke (2014) and Jansson et al. (2017). As previously explained, this hypothesis was confirmed in the first model, and statically was not significant in the second model. Hypothesis 3 can be accepted with the different profile categories created through MCA

that showed a positive impact of belonging to profile 2 or 3 (higher education) compared to profile 1 (lower education). Thus, a higher level of education led to a higher probability of preferring an EV, which is in line with the current literature (Hidrue et al., 2011; Jansson et al., 2017; Mukherjee & Ryan, 2020; Nayum & Klöckner, 2014; Olson, 2013; Sanitthangkul et al., 2012). The same applies for Hypothesis 4, according to which a higher income leads to a higher probability of preferring an EV, in accordance with Bjerkan et al. (2016), Plötz et al. (2016, 2018), Junquera et al. (2016), Erdem et al. (2010). Hypothesis 5 is to be accepted based on the different profile categories, which showed that people living in urban areas (profile 2) were more likely to purchase an EV than those living in rural areas (profile 1). This result is in line with Mukherjee & Ryan (2020) and adds further evidence concerning this variable. Hypothesis 6 states that consumers who have children (more household members) are more likely to buy an EV, as the results of Zhang et al. (2011), Nayum & Klöckner (2014), Plötz et al. (2014) showed. This was confirmed in both models, based on the positive significance of factor 6. Also, the fact of owning a car, as Hypothesis 7 assumes, can be accepted in both models, and provides further evidence for what Zhang et al. (2011) and Nayum & Klöckner (2014) found. As for Hypothesis 8, having had previous experience seemed to increase the preference for EVs and therefore, Hypothesis 8 can be accepted based on the result of the previously defined profiles. The positive impact of having had previous experience confirms former findings found for this variable, among others by Xu et al. (2020), Liu et al. (2020), Schmalfuß et al. (2017) and Jensen et al. (2013). Hypothesis 9 deals with the question of whether reputation- and status-driven people have a higher probability of preferring an EV, aiming to provide further contribution to the literature especially based on the research by Hahnel et al. (2014), Johansson-Stenman & Martinsson (2006), Rahmani & Loureiro (2019), Ozaki & Sevastyanova (2011), Laroche et al. (2001), Lane & Potter (2007), and Hur et al. (2013). This can be accepted based on the significant level of the factor "social status" in Model 1 Option 1. Consumers believe that an EV improves their image, reputation, and social status. The result regarding the impact of status was reinforced in Model 2 Option 1, where "social status" again showed a positive statistical significance. More interestingly, the factor "reputation-driven" now in Model 2 Option 1 showed a statistical significance with a negative coefficient, leaving room for interpretation that reputation-driven consumers only prefer EVs if these types of vehicles are more expensive. Once EVs cost the same as other vehicles, they seemed not to be a preferred option for this consumer group. This is an interesting result and can serve as useful evidence for future research.

4.4.2 Car Attributes Hypotheses

Hypothesis 10 states that a higher purchase price for EV decreases the preference for EVs, and this is to be accepted based on Model 1 due to the statistical significance of the factor "price of EV." This outcome strengthens the results of Egbue & Long (2012); Knez et al. (2014), Lane &

Potter (2007), Bjerkan et al. (2016), Ozaki & Sevastyanova (2011), Lieven et al. (2011) and Cecere et al. (2018). As mentioned above, the factor "price" was not included in Model 2, based on the model´s assumption that all cars cost the same. Hypothesis 11, stating that lower consumption and lower maintenance of an EV can compensate for the higher purchase price, represented by the factor "price compensation" was validated in both models. This evidence is in line with the research conducted by Lane & Potter (2007), Gallagher & Muehlegger (2011), Egbue & Long (2012). Hypothesis 12 concerns whether a higher driving range, in the form of the distance the vehicle can drive before recharging, increases the preference for an EV. Several authors (see e.g., Barkenbus, 2020; Egbue & Long, 2012; Hackbarth & Madlener, 2016; Hidrue et al., 2011; Lieven et al., 2011) have supported this assumption with their research results. In our analysis, the driving range was represented by both the factors "performance" and "range anxiety," and based on the statistical significance of the factor "performance," Hypothesis 12 is to be accepted in both models. Although the factor "range anxiety" did not show statistical significance in Model 1, it still can be confirmed by the factor "performance" in Model 1. In Model 2, both "range anxiety" and "performance" showed statistical significance. All in all, the hypotheses about the different car attributes helped to better understand consumer behaviour and the factors that influence their preferences for EVs.

4.4.3 Environmental Settings Hypotheses

Hypothesis 13 analyses the impact of an EV charging infrastructure, which was represented by the factor "missing infrastructure." Several authors found a significant, positive impact of a good infrastructure for charging on the preference for EVs (Barkenbus, 2020; Hardman et al., 2018; Hoen & Koetse, 2014; Li et al., 2017a; Martínez-Lao et al., 2017; Oliveira et al., 2019; Sierzchula et al., 2014). Our results for this variable showed no statistical significance in Model 1 but a statistical significance with a negative coefficient in Model 2 in both logit options. Therefore, Hypothesis 13 is to be accepted based on Model 2. Hypothesis 14 concerns whether governmental supports increase the preference for an EV, which had been investigated in several research studies with positive affirmation (Cordera et al., 2019; Gallagher & Muehlegger, 2011; Hardman et al., 2017; Li et al., 2019; Turcksin et al., 2013; Wang et al., 2017). We showed that people who consider EV prices important (Factor 9) are less likely to intend to buy an EV. The 'subventions' variable ("The purchase of an electric vehicle should be incentivized by financial advantages") has a rotated factor loading of 0,490 on Factor 9, as shown in Appendix 7 ("Scale_subv-s" for Factor 9). This indicates that the two are associated and, hence, that that price-conscious car buyers may also tend to support subventions for EVs. This is consistent with the hypothesis that governmental supports would increase the preference for an EV through their tendency to reduce the initial purchase price. Since the factor "price of EV" showed statistical significance in Model 1, Hypothesis 14 can be accepted, according to which government support contributes to

increasing the preference for an EV. Hypothesis 15 analysed the impact of information availability reflected in the factor "lack of knowledge," in order to support the positive relationship between information availability and EV preference, as found by Hidrue et al. (2011), Ozaki & Sevastyanova (2011), Egbue & Long (2012), Turcksin et al. (2013) and Rahmani & Loureiro (2019). In Model 1, the factor was not significant; however, it was statistically significant in Model 2 and therefore can be confirmed based on the Model 2.

Comparing both models proved the robustness of the first model and yielded good performance. The second model provided additional validity and improved interpretation and understanding of consumer behaviour, showing that reputation-driven consumers are interested in EV as a sustainable product only when prices are more expensive compared to other vehicles. The model revealed that reputation-driven consumers prefer EVs due to their higher purchase price, as they apparently provide some kind of exclusivity. This fact is of great interest and is explained in more detail in our conclusions, Section 5, below. The approach of running two models with two different dependent variables is acceptable to provide greater interpretation and a deeper understanding of consumers of EVs when assuming the same price for all vehicles. However, and as stated as a limitation in the last section, future research should focus on different prices within hypothetical choice experiments. Table 12 provides an overview of the hypotheses and the respective results for both models.

Table 12: Results Hypotheses (Chapter 2)

Category		**Hypothesis**	**Results Model 1 (assuming different prices)**	**Results Model 2 (assuming equal prices)**
Consumer	H1	Females are more likely to prefer EVs than men.	Rejected (Profile category 2 and 3 are males)	Rejected (Profile category 2 are males)
	H2	The younger the consumer, the higher the likelihood of preferring an EV over an ICE vehicle.	Rejected (Factor 6)	not significant (Factor 6)
	H3	Higher education leads to an increased probability of preferring an EV over an ICE vehicle.	Accepted (Profile)	Accepted (Profile)
	H4	Higher income leads to an increased probability of preferring an EV.	Accepted (Profile)	Accepted (Profile)
	H5	Living in urban areas leads to an increased probability of preferring an EV.	Accepted (Profile)	Accepted (Profile)
	H6	Having children leads to an increased probability of preferring an EV.	Accepted (Factor 6)	Accepted (Factor 6)
	H7	Possessing a car (independent of model) leads to an increased probability of preferring an EV.	Accepted (Profile)	Accepted (Profile)
	H8	Having had previous experience leads to an increased probability of preferring an EV.	Accepted (Profile)	Accepted (Profile)
	H9	Reputation- and status-driven consumers are more likely to prefer EVs.	Accepted (Factor 3) Not significant (Factor 1)	Accepted (Factor 3 and **Factor 1**)
Car attributes	H10	A higher list price for EV lowers the preference for EVs.	Accepted (Factor 9)	Not included

	H11	Lower consumption and lower maintenance costs compensate for the higher purchase price of EVs and leads to an increased probability of preferring an EV	Accepted (Factor 5)	Accepted (Factor 5)
	H12	A higher range of EVs, leads to an increased probability of preferring an EV.	Accepted (Factor 4)	Accepted (Factor 4)
			Not significant (Factor 10)	Accepted (Factor 10)
Environ-mental settings	H13	Better infrastructure (charging stations, wallbox installations) the context shows leads to an increased probability of preferring an EV.	not significant (Factor 8)	Accepted (Factor 10)
	H14	Governmental support for EVs leads to an increased probability of preferring an EV.	Accepted (Factor 9)	(Factor 9 not included)
	H15	More available information combined with the know-how of dealers, leads to an increased probability of preferring an EV.	not significant (Factor 7)	Accepted (Factor 7)

4.5 Comparison of both Models

Comparing both models, the robustness of the first model is verified and yielded for good performance. The second model provides new insights for the literature under the assumption that all vehicles cost the same. In doing so, it becomes clear that status and reputation driven consumers buy EVs because of their higher purchase price. Once they are equal to other cars in terms of purchase price, they do not seem to be as attractive. This fact is of high interest and is recommended for a future line of research. The approach of running two models with two different dependent variables is recommended to provide further interpretation and deeper understanding of consumers of EV.

The following shows the comparison of both models and the different approaches to easily interpret the results.

Table 13: Results of both Models with Option 1 and Option 2 (Chapter 2)

Option 1	**Model 1**		**Model 2**	
	Yes_EV_1_0		Car_sameprice2	
	Coef.	P>|z|	Coef.	P>|z|
Factor 1	,0844426	0,118	-,4422998	0,000
Factor 2	1,012,105	0,000	1,369866	0,000
Factor 3	,1690223	0,002	,4801909	0,000
Factor 4	,4864028	0,000	,3579716	0,000
Factor 5	,4599024	0,000	,4091105	0,000
Factor 6	,2579496	0,000	,0783293	0,264
Factor 7	-,0025247	0,963	,2137138	0,002
Factor 8	-,0412599	0,441	-,2510928	0,000
Factor 9	-,1288551	0,021		
Factor 10	,0311045	0,558	-,2778786	0,000

Option 2	**Model 1**	**Model 2**

	Yes_EV_1_0		Car_sameprice2	
	Coef.	P>|z|	Coef.	P>|z|
_Iprofile_2	,8744242	0,000	,3754224	0,011
_Iprofile_3	,8970386	0,000	,1087161	0,528
Factor 4	,3974305	0,000	,2885597	0,000
Factor 5	,3600625	0,000	,3249849	0,000
Factor 8	-,0329299	0,507	-,2060537	0,001

5 Discussion and Conclusion

In conclusion, this paper presents, in a comprehensive and systematic way, the impact of different variables influencing the preference for EVs with a strong emphasis on consumer behaviour. It includes (1) consumers' sociodemographic variables with an additional focus on experience and consumer behaviour, (2) car attributes, and (3) environmental settings, such as governmental support schemes and infrastructure development on the preference for EV, additional to the findings of how consumer preferences would change if purchase prices were the same for both BEV and ICE vehicles. Based on this structural approach, the findings and recommendations help validate the present research literature to improve the utility of future studies. This study explores the role of reputation, status, and image as factors related to whether an individual will prefer an EV over other vehicles. By highlighting the importance of reputation, it gives valuable information about consumers' behaviour. Regarding socioeconomic factors, there are contradictory results in the current literature. At the same time, there is a common understanding that sociodemographic variables exert significant influence. In summary, we could show that a higher education and higher salary, as well as having children and living in urban areas, rather than rural areas and owning a vehicle are positively reflected in the preference for an EV.

At the outset, we asked, "What effect does EV experience have on potential EV adoption?" Previous research has shown that experiences can encourage EV adoption (Bühler et al., 2014; Hahnel et al., 2014; Jensen et al., 2013; Liu et al., 2020; Rauh et al., 2020; Schmalfuß et al., 2017; Xu et al., 2020). We found that experience was more common in a particular socio-demographic group: men with higher salaries who live in suburban areas tended to have EV experience. Compared to a reference group of women with less education, lower income, and living in rural or suburban areas, these men in our sample set had more intention to purchase EVs but did not show a clear difference in EV preference (at equal prices with other vehicles). This could be interpreted as showing that lower-income groups tend not to have experimented with EVs (perhaps due to price barriers) but may share preferences for EVs with those who have. However, given those previous research findings that indicate the encouraging effect of EV experiences it may also be the case that intervening to provide EV experiences to individuals who tend to be

women with less education and income might encourage EV adoption in this group, particularly as prices of EVs and non-EVs begin to equalize.

Furthermore, our study suggests that the more consumers are driven by reputation, the less they opt for an EV in the situation that EVs cost the same, which is an interesting finding. It is worth considering whether "reputation drive" does not capture the socially desirable aspects of cars other than EVs once "social desirability" is controlled statistically within the model and "purchase price" is removed from the equation (since high-status cars are usually more expensive). A possible follow-up is a moderated multiple regression approach allowing the two variables reputation and price to together explain more, or less, variance than they might do each individually.

Overall, the study addresses environmental and sustainability research by focusing on consumer behaviour. The hypotheses are tested with two different dependent variables. In doing so, the present study is one of the first to investigate the consumer´s behaviour and preference for EVs using different dependent variables while contrasting previous results concerning sociodemographic variables. The second model highlights the importance of reputation for consumers, when adopting an EV. Being reputation-driven positively influences the preference for EVs only if these cars are more expensive. This result leads to the interpretation that inexpensive sustainable products might undermine a consumer´s ability to signal their wealth and purchasing power, and therefore green products are only preferred if they are more expensive. This research can lead to the conclusion that people tend to care more about reputation and social acceptance than about environmental issues. In summary, this study adds value and insights for EV adoption from a consumer perspective and confirms earlier findings while applying new empirical approaches. The research provides a comprehensive analysis of consumers' demographic variables when adopting EVs, car attributes, and external environmental settings, and applies an additional model to analyse consumer behaviour by assuming the same prices for all vehicles.

5.1.1 Policy Recommendations

Analysis of the heterogeneity of a driver´s willingness to purchase an EV is important and useful for public decision-makers, such as governments, to implement correct measures by understanding the market and consumers. Although the study sample is representative of the population of Barcelona with respect to age and gender, it is still useful to take the results into account for policy and decision-making. As other studies have shown (e.g., Gallagher & Muehlegger, 2011; Hardman et al., 2017; Li et al., 2019; Wang et al., 2017), the adoption of EVs is likely to be limited without significant governmental incentives. The potential impact of governmental incentives was validated in both models of this study. Given the low market

penetration of EVs, incentives are believed to be a prerequisite to eventually change consumers' environmental behaviour. As for the Spanish market, the government put in place the "MOVES III" support in 2020, which is an aid program to encourage the purchase of electric, plug-in hybrid and fuel cell vehicles; however, it needs certain improvements, on which automotive associations are working. Governments should encourage the availability of information on EVs to clarify misunderstandings about their performance. Additionally, a good infrastructure system should be promoted and implemented.

As previously stated, it is helpful that governments push information availability of EVs to clarify misunderstandings regarding worse performance. As EVs are often associated with worse performance, information diffusion is required and ideally, test drives are offered to show the real potential of these vehicles. The government should encourage information availability, infrastructure, and incentives. Referring to the latter, the MOVES plan in Spain shows it first positive earnests since EV sales in 2021 increased significantly. The current-in-place greenhouse gas emissions limits for sure will also help to sell EVs on a broad scale. In general, it is important that the government helps to eliminate any kind of barriers that could hinder people from buying electric cars, for example to introduce more stations to recharge the cars and thus, a better infrastructure. The market share of sustainable technologies is still rather small, but it is important to yield a sustainable environment and different perception of green products, and therefore, also a better charging infrastructure for EVs is needed. Consumers are more likely to buy green cars when they witness their true benefits and positive consequences of green cars (Ozaki & Sevastyanova, 2011). It appears that many potential adopters of EVs in Spain are unaware of or are not convinced by the recent improvements in EC technology and charging infrastructure. Consequently, they hold negative expectations of hassle and inconvenience from owning an EC, which strongly reduce their intention to buy one.

5.1.2 Limitations, Implications and Directions for Future Research

Although this research shows interesting findings and consequently applicable measures for higher EV adoption, some limitations must be considered when interpreting the results. Overall, it should be taken into consideration that it is a study of the relationships between different questionnaire answering patterns and not a study of cause and effect, such as an experiment trial. For future studies, an experiment trial could be applied. Regarding environmental concern, this study included statements to be answered on a Likert Scale, such as "It is important to care for the environment," "For the purchase of an EV, I am motivated by lower contamination compared to an ICEV," etc.; however, future research should focus more on environmental measurements and use as reference the items of the NEP Scale by Dunlap and Van Liere (1978). In relation to consumer attitudes and behaviour, further research on the connection between EVs and environmental concerns is essential for future research.

The study focuses on EV in general, which includes HEV and PHEV, where psychological barriers to adaptation are easier to overcome than for pure BEVs, which run on electricity only and have clearer technological differences. It might be treacherous to generalize results from AFVs to BEVs. Therefore, to enrich the literature and focus on the most innovative technologies, future studies should focus mainly on BEVs. In line with the study by Noppers et al. (2014), it is critical to keep in mind that people do not necessarily highlight and recognize the importance of symbolic self-attributes, such as the impact on self-identity and social status, when asked directly about important factors for the adoption of sustainable innovations, such as an EV. Consistent with Herberz et al. (2020) and Gleim & Lawson (2014), consumers may admit the importance of a sustainable approach to green products, but they do not always translate this attitude into actual behaviour. Future research should further analyse the psychology of consumers to examine whether consumers underestimate the importance of symbolic attributes. The present paper applied factor analysis (EFA) and MCA, which implied data reduction to create and label different factors and dimensions. This approach helps to reduce correlation between variables; however, it must be acknowledged that original hypotheses cannot be evinced unambiguously.

It is also important to consider that consumer behaviour may change over time, and it would be interesting to know how status- and image-focused behaviour will change as EVs become more accessible to all consumers (see Adnan et al., 2017 for further information). It is critical to deal with consumers´ attitudes and preferences to be more successful in adopting sustainable means, such as green vehicles. At the same time, it is important to conduct a cross-country comparison to generalize the results. Southern European countries, such as Spain or Italy, suffer a shortfall of research in this field. Regarding sociodemographic variables, future research should take into consideration the change in transportation patterns in society, e.g., decreasing car ownership and increasing car-sharing options, especially for younger generations (see Efthymiou et al., 2013). At the same time, it is interesting to analyse the relationship between vehicle ownership and household relocations, such as moving to suburban geographies (see Schouten, 2022).

Future research could also analyse in depth the role of the different automotive brands. In the present study, the variable “brand” is included in the factor analyses, but it would be of interest to know whether consumers prefer EVs of a specific brand when adopting luxury brands that might convey social status (is consumer’s behaviour different when adopting luxury brands, such as Porsche, Mercedes, Audi compared to VW, Renault, KIA, etc.).

Despite these limitations, the study does point out a path toward fruitful future research that can be built up from this paper´s outcome.

III) Chapter 3: Theory of Planned Behaviour

Chapter 3

Using extended theory of planned behaviour (TPB) to predict consumers´ intention to adopt electric vehicles. An empirical research study from Spain.

1 Theory of Planned Behaviour

1.1 Abstract

Societies worldwide are under great pressure to reduce carbon footprint. Battery Electric vehicles (BEVs) are considered as sustainable transportation solution to reduce the carbon footprint of countries and therefore have the potential to alleviate environmental problems. The demand for BEVs has increased the last years, however consumers still seem reluctant and adoption rates are still low. A sample of more than 2.000 consumers was collected to predict the consumers' intention to adopt BEV, applying an extended version of the Theory of Planned Behaviour Theory (TPB) to analyse the impact of attitude, subjective norm, perceived behavioural control, moral norm, and environmental concern. In addition, and based on previous research stating the importance, the variable "experience" is introduced while creating a new dimension of consumers profile formed of experience, education, and gender. Data was collected with an online survey and the hypotheses are validated with partial least square structural equation modelling with Smart PLS4. With this research, we aim to reveal the impact of extended TPB constructs on BEV adoption in Spain with an empirical application and SEM analysis. The empirical analysis shows that the constructs "Attitude", "Perceived behavioural control", "Subjective Norm", and "Moral Norm" do exert a direct impact on adoption intention, whereby Attitude shows the strongest relationship. "Environmental concerns" show a positive indirect impact on the adoption intention, whereas no direct relationship of EC towards adoption intention could be found. The variable "profile" impacts positively on the relationship of the constructs towards adoption intention. The results confirm previous findings and serve as a guideline for government and manufacturers. Based on the study's results, the appropriateness of the TPB model is confirmed and it has a good explanatory power in predicting consumers' intention to adopt BEVs.

1.2 Keywords

- Battery Electric vehicles
- Extended Theory of Planned Behaviour
- Environmental concern
- Personal moral norm
- Attitude towards adoption EV
- Subjective norm

1.3 Introduction

After analysing consumers' behaviour of EVs in Spain with focus on sociodemographic factors and the role of status and reputation when assuming equal prices for all types of vehicles in Chapter 2, and based on the conclusions of Chapter 1, the present research study applies the Theory of Planned Behaviour (TPB) by Ajzen (1991) while extending the traditional model with new constructs. As explained in Chapter 2, the general focus on theories that analyse consumer behaviour is important and helpful to better understand what consumers thrive toward environmental friendly products. While Chapter 1 provided useful theoretical knowledge about the TPB based on a systematic literature review, and Chapter 2 gave empirical evidence for different factors that influence the consumers' adoption intention for EVs, in Chapter 3 we now apply the TPB model on our empirical, primary data set. The previous realized literature review is updated with the newest academic papers until 2022.

As explained in Chapter 1 and 2, there are several studies in present literature that analyse consumer´s demographic variables, external environmental settings, and the impact of "experience" on consumer´s adoption for EVs. This chapter combines the different insights of previous literature with the extended TPB model to analyse consumer purchase behaviour for BEVs based on a Spanish sample set. Since real BEV drivers are still a minority, the TPB with its focus on intention rather than real adoption is justified (Ajzen, 1991) and allows for a wider sample basis. As Kalafatis et al. (1999) summarized, there are a variety of explanatory theories about consumer behaviour that evolved among others from social sciences as psychology, sociology, or economics. The TPB model allows to investigate constructs as attitudes, subjective norms and perceived behavioural control by consumers to buy environmental friendly products. As Ajzen (1991) stated, "*explaining human behaviour in all its complexity is a difficult task*" (p.179) and therefore, it is of research interest for this present study. Contingent upon TPB, and based on the traditional TRA model, the factors of "attitude", "subjective norm" and "perceived behaviour control" are analysed, extended with "moral norm" and "environmental concern". Both the direct and indirect impact of environmental concerns towards the adoption intention of BEVs will be analysed. Additionally, and as added value to present research, this study analyses the variable "experience" within a newly created variable "profile" which includes gender, education and experience to see their impact on the relationships of the different constructs towards adoption intention.

With the aim of addressing the Theory of Planned Behaviour for Chapter 3, a Structural Equation Modelling (SEM) estimated with SmartPLS4 is applied and further developed. Structural equation modelling is a multivariate statistical analysis technique that is often used to analyse structural relationships as it is the case here. For this study, a questionnaire survey was conducted with the aim of investigating consumer´s intention to adopt BEVs in Spain. We explore the

behavioural constructs that influence in the adoption of BEVs in the country. In detail, this paper addresses the following main research questions to help explaining BEV adoption decision.

3. What impact do the extended TPB constructs “Attitude” (ATT), “Perceived behavioural control” (PBC), “Subjective Norm” (SN), “Moral norm” (MN) and “Environmental Concerns” (EC) have on the consumer adoption intention (AI) of BEVs based on a Spanish sample set? What behavioural patterns can be concluded?
4. What role play experience, gender, and education in the TPB model?

In this context, this research presents the framework of the Extended TPB by incorporating the constructs of “Moral Norm” and “Environmental Concern”, while analysing the variable “Experience” to predict the adoption intentions of consumers. By applying this framework, the study makes a contribution to the literature gap for research study in environmental friendly research based on a Spanish sample. The present study focusses on purely BEVs and adds value to the literature by focussing on a technology which is considered different and more complex compared to traditional vehicles or Plug-in vehicles, such as many other research studies do. Additionally, this study concludes practical contributions based on empirical findings to provide valuable insights for politicians and industry to promote EVs adoption intention.

To the best of the authors knowledge there is a lack of Spanish-based research studies focussing on TPB. The study by Higueras-Castillo et al. (2019) is based on a Spanish sample, however, it is built on the theories of perceived value and reasoned action, while focussing on Electromobility vehicles and applying a model with the construct “Attitude” and its possible antecedents of Quality, Emotional, Price, Social, Acceleration and Low noise towards the intention to adopt. As reference paper, the studies by Wang et al. (2016) and Mohamed et al. (2016, 2018) are used. Table 14 provides a detailed overview of all studies used for this research paper, and it is noteworthy to explain that there are other studies extending the TPB by moral norm and environmental concern, too; however, our study differs and add value to the present literature based on (1) its focus on pure BEVs, (2) by analysing the impact of EC both as direct and indirect construct and (3) by introducing the variable “profile” consisting of the variables gender, experience and education. In addition, the study is based on a (4) Spanish sample where a literature gap has been noted. The focus on pure BEV is in response to what pointed out Mohamed et al. (2018) as one of their own study’s limitations as they did not apply the distinction between Plug-in hybrid vehicles (PHEVs) and BEVs and ask future research to address this issue. Mohamed et al. (2016) focused on “economy cars” based on a Canadian sample and pointed out that the "*EV market is dynamic, and it is expected to evolve rapidly in the near future (…). Accordingly, the characteristics of these market segments is a snapshot in time and should be expected to evolve as well*.” (p.109). In summary, our study with a Spanish sample of 1.816

answers conducted in 2021 and its focus on BEVs and the variable "profile" differs from present literature and fills a literature gap.

To accomplish the mentioned objectives, the rest of the chapter is organized as follows: in the next section, a review of the literature until the year 2022 related to the extended theory of planned behaviour is presented. Based on this review, the conceptual SEM guiding this research and the hypotheses are proposed. The "Data and Methodology" section focuses on the research methods and contains explanation about the empirical results of the SEM based on Smart PLS4. Finally, the last section shows the main conclusions and recommendations, as well as limitations and future research lines. The result of this present study confirms the appropriateness of the extended TPB model and verifies that the extended TPB model has good explanatory power in predicting consumers' intention to adopt BEVs.

2 Literature Review

In Chapter 2, the sociodemographic profile of potential EV consumers was analysed. Accordingly, being male, older, and having children, higher education and living in urban areas, having had previous experience with EVs influence positively to the adoption of EVs. If prices for all types of vehicles were the same, adoption for EVs seems less attractive especially for reputation-driven individuals, which highlights the role of status and reputation. Reputation-driven consumers seem to enjoy specific exclusivity by having higher economic power to buy the more expensive EVs, which might decrease once the prices equal for all vehicles. Reputation and social status seem to play a more important role than expected in consumer behaviour for sustainable manners. Thanks to the valuable results concluded in Chapter 2, Chapter 3 continues with its focus on consumer behaviour based on the TPB model, while investigating the importance of experience. The TPB can be applied in different research areas and there are studies applying TPB to investigate the purchase intention for other environmental friendly products, such as Zhou & Thøgersen (2013) did about organic food. Nevertheless, in this literature review we focus on studies applying TPB especially for analysing the purchase intention for EVs.

2.1 Theory of Planned Behaviour

As explained in Chapter 1, the Theory of Planned Behaviour (TPB) was proposed by Ajzen (1991) and is based on the Theory of Reasoned Action (TRA) of 1980 with the aim of predicting an individual's intention to exert a specific behaviour over which the consumer has self-control. The TPB is widely used for investigating behavioural intention for sustainable matters. As Wang et al. (2016) explained there are more and more scholars using the TPB model to explore the environmental-friendly behaviour of consumers. Haustein & Jensen (2018) defined the TPB as "*probably the most frequently and successfully applied behavioral theory for predicting pro-*

environmentally transport choices" (p.2). The traditional TPB includes three variables which determine the strength of the intention to perform the behaviour when opportunities come up. Individual behaviour is believed to be the result of behavioural intention and can therefore be used as proxy for the actual behaviour, while intention is based on behavioural attitude, subjective norm and PBC (Ajzen, 1991). According to the theory, if a consumer perceives certain behaviour to be a social norm, the more likely he/she adopts the behaviour. In the TPB model the actual behaviour can be determined by the behavioural intention, which is influenced by the attitude toward the behaviour, the subjective norm and perceived behavioural control (Ajzen, 1991). Haustein & Jensen (2018) summarized that the TPB sees intention as the central determinant of behaviour, and the intention to adopt a specific behaviour in turn is composed by attitude, subjective norm and perceives behavioural control. Davis et al. (1989) explained that both behavioural intention and actual behaviour has the same determinants, however the intention is generally more strongly predicted than actual behaviour. Ajzen (1991) confirmed that behavioural intention is seen as immediate determinant of actual behaviour and it provides the most accurate prediction of behaviour. The TPB model has been applied in several studies to explore the intentions to purchase EV, as shown in Chapter 1 in Table 2.

To understand more comprehensively the factors that influence the EV adoption intention and decision, psychological factors are necessary to include. Therefore, psychological factors are included in different constructs that might impact the EV adoption intention in this chapter. The decision for adopting BEVs not only depends on situational such as demographic factors as analysed in Chapter 2, but also on psychological factors as they can influence the adoption decision directly. In Spain, the fully BEV is still in its infancy although an increase has been noted the last two years, and therefore it is appropriate to measure adoption intention instead of the actual adoption, in line with the TPB model. Furthermore, to overcome the lack of empirical evidence regarding consumers' purchase intention for EV into the market of Spain, where the adoption/purchase of BEVs is still not on levels as Northern European countries, the impact of the variables "driving experience", "gender" and "education" are analysed and introduced in the model with a newly created variable "profile". This provides a noticeable research potential for the underlying study to fill the knowledge gap in existing literature.

In the following Table 14, 24 research studies with their (extended) TPB constructs are listed. The overview helps to understand the different constructs that are used in literature and gives a first glimpse of the results of other authors. Additionally, the papers helped to define the present research study with its SEM approach. In Figure 20 some theoretical TPB models from other scholars are listed to provide a better comparison with the present research model.

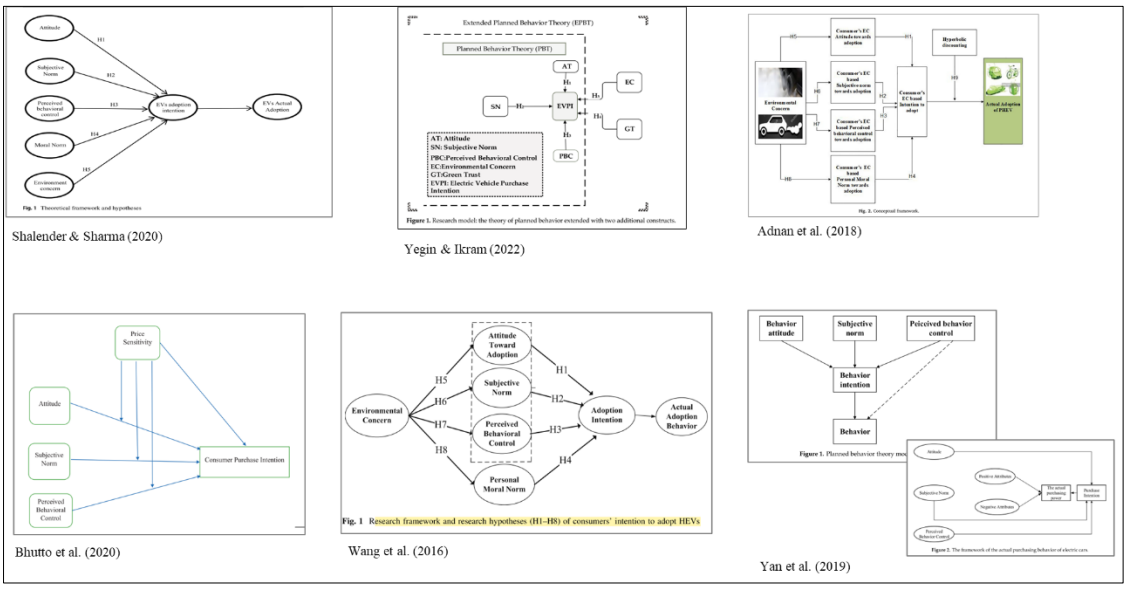
Table 14: Literature Review Research Studies and their constructs (Chapter 3)

Study's Authors	Year	Context	Veh. Type	Sample	Constructs TPB Traditional	Extended or Modified	Impact/ Results
Yegin & Ikram	2022	Turkey	EVs	626	Subjective Norm (SN), Attitude (AT), Perceived behavioral control (PBC)	Environmental Concern (EC) and Green Trust (GT)	Att, PBC, EC and GT: positively correlated with EV purchase intentions (+). Direct impact of EC. SN: negative effect (-)
Shalender & Sharma	2020	India	EVs	326	Attitude, subjective norm, perceived behavioural control	Moral norm, Environmental concern	Att, SN, PBC, MN and EC: positive relation with AI (+). Direct impact of EC.
Bhutto et al.	2020	Pakistan	HVs	266	Attitude, Subjective Norm, and Perceived Behavioral Control	Price Sensitivity (PS)	Att, SN, PBC and PS: direct positive impact on AI (+) PS as moderator: no statistical significance
Dong et al.	2020	China	BEVs	1.021	Subjective Norm, Perceived behavioral control	Feelings and Emotions + Norm Activation Model: Awareness of Consequences, Personal Norms, Ascription of Responsibility + Cost Factors	SN, feelings and emotions, personal norms, PBC: positive impact (+)
Liu et al.	2020	China	BEV	347	Attitudes, Subjective norm, Perceived behavioral control	Driving experience Attitudes: Charging convenience, cruising range, economic benefit, battery life, low emission, low noise	SN, PBC, Att and adoption willingness of experienced consumers are higher (+) than of unexperienced consumers. Adoption willingness (+) through direct and indirect paths.
Yan et al.	2019	China	EVs	537	Attitude, Subjective Norm, Perceived behavioral control	Positive Attributes Negative Attributes	Positive attributes: positive impact (+) negative attributes: negative impact (-)
Eneizan	2019	Jordan	EVs	250	Attitude, Subjective Norm, Perceived behavioral control	-	Att, SN, PBC: positive impact (+)
Higueras-Castillo et al.	2019	Spain	EM (Electro mobility ; electric and hybrid)	404	-	Building on the theories of perceived value and reasoned action: Attitude with antecedents: Quality, Emotional, Price, Social, Acceleration, Low noise	Emotional issues, Price, Acceleration, Low noise: positive impact on attitude (+) Quality, Social value: no statistical significance
Shankar & Kumari	2019	India	EVs	278	Attitude, Social Norms, Perceived Behavioral Control	Environmental Concern, Perceived CSR obligation	Att, SN, PBC, EC, CSR: positive impact (+) Direct impact of EC.
Simsekoglu & Nayum	2019	Norway	BEV	205	-	Perceived accident risk, Knowledge about BEVs, Instrumental attributes, environmental attributes	Environmental-economic attributes, SN, PBC: positive impact (+) being male: negative (-) Perceived acc. Risk, knowledge: no direct impact, but indirect through perceived attributes of BEVs.

Tu & Yang	2019	China	EVs	300	Attitude, Subjective Norm	Self control ability with self-efficacy, facilitating conditions, perceived behavioral control. Items for Attitude: Perceived Usefulness, Perceived ease of use, Compatibility, Personal Innovativeness. Items for Subjective Norm: Interpersonal and External Influence	Att: perceived usefulness, perceived ease of use, compatibility: positive attitude (+) SN: interpersonal influence: no significance; external influence: positive (+)
Xu et al.	2019	China	BEVs	382	Attitude, Perceived Behavioral Control, Subject Norm	Environmental Performance, Price Value, Non-Monetary Incentive Policy, Monetary Incentive Policy (MIP)	Att, PBC, SN, Environmental performance, MIP: positive (+) Direct impact of E-Performance
Mohamed et al.	2018	Canada	EVs	15.392	Attitude, Subjective Norm, Perceived Behavioural Control	Environmental Concern (impact on constructs), Personal Moral Norm	Att, PBC: strongest impact (+) EC, Att, personal MN: (+)
Haustein & Jensen	2018	Denmark and Sweden	BEV and CV (conventional)	2.467	Perceived functional barriers (PBC), Subjective norm (SN), Attitude: symbolic Attitude: affective	Busy lifestyle (PMN), Personal Norm (PN), other control variables (a.o. Experience)	Comparing BEV users and conventional car users: BEV users perceive less functional barriers towards BEV and have more positive attitude and norms. Symbolic attitudes most important factor.
Adnan et al.	2018	Malaysia	PHEVs	403	Attitude, Subjective Norm, Perceived behavioral control	Environmental concern, Personal moral norm, Hyperbolic discounting on actual adoption	Att, SN, MN, PBC: indirect positive impact (+); constructs are significantly predetermined by EC
Zhang et al.	2018	China (Beijing)	EVs	124	Attitude, Subjective Norm, Perceived behavioral control	Policy supporting	PBC, SN: positive impact (+) Att: insignificant Policy support: positive effects on Att and SN
Du et al.	2018	China (Tianjing)	NEVs new energy vehicles	811	Attitudes, subjective norms, perceived behavioral control,	personal norms, low-carbon awareness and policy, social demography, government policy	SN, Att, personal norms, PBC: positive impact (+) government policy: (+) low-carbon awareness: (-)
Wang et al.	2017	China	EVs	324	-	Financial Incentive policy measures, Information provision policy measures, Convenience policy measures, Environmental Concern	All policy measures: (+) EC play moderating role between financial incentive and convenience policy measures
Adnan et al.	2017	Malaysia	EVs	391	Attitude, Subjective Norm, Perceived behavioral control	Personal moral norm, Environmental concern. Impact on Attitude: Interaction, Knowledgesharing, Response Vehicle owners	Dimensions of att: (+) impact on attitude EC: indirect positive impact on Att, SN, PBC and personal norm. EC and AI not directly proportional.
Degirmenci & Breitner	2017	Germany	EVs	40 interviews, 167 test drives	Attitude	Environmental Performance Price Value Range Confidence Control variables (Gender, Age, Profession, Experience)	E-Performance is stronger predictor of attitude and thus AI, than price value and range confidence.

Mohamed et al.	2016	Canada	EVs	3.505	Attitude Subjective Norm Perceived Behavioural Control	Environmental Concern, Personal Moral Norm; control variables	Att, SN, PBC, personal MN: (+) impact EC: indirect (+) impact Age, employment: (+)
Wang et al.	2016	China	HEVs	433	Attitude, Subjective Norm, Perceived behavioral control	Personal moral norm Environmental concern	Att, SN, PBC, Personal MN: mediate effect of EC towards AI EC: indirect (+) impact on AI
Kaplan et al.	2016	Austria, Denmark, and Germany	ECVs	1.443	Positive attitudes, Subjective norms favorable to ECVs, Perceived operational ease of using ECVs, Perceived familiarity with ECVS	Fleet manager socio-economic characteristics, firm characteristics and industrial sector, vehicle fleet characteristics and use patterns, country context (Germany, Austria, Denmark)	Focus on Fleet: positive attitudes and subjective norms (+), familiarity (+), perceived operational ease (+)
Sang and Bekhet	2015	Malaysia	EVs	750	-	Evs Acceptance Model: Usage Intentions Performance Attributes, Social Influences, Financial Benefits, Demographic, Infrastructure Readiness, Government Intervention, Environmental Concerns	Social influences, performance attributes, financial benefits, environmental concerns, demographics, infrastructure readiness, government interventions: (+)

Figure 20: TPB Examples Literature Review Other Models (Chapter 3)



Note: Own work based on Literature Review

2.2 Determinants of (Extended) TPB

As shown in Table 14 many research studies about adopting pro-environmental products have applied and extended the Theory of Planned Behaviour with additional factors to provide a complete and bigger picture. The present study considers the three original components (attitude toward the behaviour, the subjective norm and perceived behavioural control) and includes "Moral Norm" (MN) and "Environmental Concern" (EC) as additional constructs to explain BEVs adoption intention. Whereof MN is included in the same relation as the three other traditional constructs with a direct impact towards AI, EC is included both as a direct impact on AI and as an indirect impact via the other (mediating) constructs. Additionally, the TPB is extended with a newly created (moderator) variable "profile" that includes education, gender, and experience. In the following, we explain first the concept of BEVs adoption intention, then the impact of the three original constructs (attitude toward the behaviour, the subjective norm and perceived behavioural control) on the EVs adoption intention, and finally we focus on the effect of "Moral Norm" (MN) and "Environmental Concern" (EC) on BEVs adoption intention.

2.2.1 BEVs Adoption Intention

The BEV adoption intention is the dependent variable in our study and is defined in the TPB model as the willingness to make an effort to adopt a specific behaviour (Ajzen, 1991). Therefore, in line with Ajzen (1990), the adoption intention is a direct predictor of behaviour and a result of the traditional TPB constructs ATT, PBC, and SN.

2.2.2 Attitude

The first of the "*three conceptually independent determinants of intentions*" (Ajzen, 1991, p.188) is attitude, defined as "*the attitude toward the behaviour and refers to the degree to which a person has a favourable or unfavourable evaluation or appraisal of the behaviour in question*." (p.188). Attitude reveals the negative or positive evaluation of the consumer's adoption behaviour (Wang et al., 2016), so to say the degree to which the performance of behaviour is positively or negatively valued. Fishbein and Ajzen (1975) highlighted the importance of attitude as an indispensable concept in social psychology. Haustein & Jensen (2018) explained: "*Attitude is the degree to which the performance of a behavior is positively or negatively valued; subjective norm is the perceived social pressure to engage in a behavior; and perceived behavioral control refers to the perceived ability to perform a behavior. TPB assumes perceived behavioral control to be a direct predictor of both intention and behavior*." (Haustein & Jensen, 2018, p.3). In line with Fishbein and Ajzen (1975), Bhutto et al. (2020) summarized the following: "*Attitude is a result of internal assessment and association process that directs the development of positive or negative intentions*.". Ajzen (1991) showed that perception and attitude influence significantly the buying behaviour of individuals. A specific-attitude is considered as stronger predictor of a specific-

behaviour e.g., purchasing green products, while the general-attitude shows the general-predisposition towards a behaviour (Ajzen and Fishbein, 1977). Therefore, a specific-attitude in a given context is considered as the attitude towards green products in ecological consumer research. Consumers have precise feelings towards eco-friendly products, thus, supporting environmental well-being (Riethmuller & Buttriss, 2008). Several other studies have validated the applicability of attitude in the TPB to analyse purchase intention towards environmental friendly products (Adnan et al., 2018; Bhutto et al., 2020; Eneizan, 2019; Haustein & Jensen, 2018; Higueras-Castillo et al., 2019; Mohamed et al., 2016, 2018; Shalender & Sharma, 2020; Wang et al., 2016, 2017; Yan et al., 2019; Zhang et al., 2018). Higueras-Castillo et al. (2019) put focus on attitudes and give evidence for its positive impact on purchase intentions, and is influenced by emotional issues, product price, vehicle acceleration, and low engine noise. Klöckner et al. (2013) analysed psychological determinants as attitudes and norms and proved that they have significant effect on the adoption of green cars. Tu & Yang (2019) included different items for attitude, such as perceived usefulness, perceived ease of use, compatibility, personal innovativeness, and showed a positive impact on the adoption of EVs when consumers believe that this technology is more beneficial on an individual level or when they perceive its use as easier and more convenient, which then impacts positively their attitude towards EVs.

Based on previous studies and taking into consideration the importance of ECs we analyse the mediating relationship of attitude between EC toward EV adoption intention in the following manner:

H1: Consumers' attitude (ATT) toward BEVs has a significant direct and positive impact on the adoption intention of BEVs.

2.2.3 Subjective Norm/ Social Norm

The second predictor of the traditional TPB Model is the "subjective norm" that refers to the social pressure individuals perceive whether to perform a particular behaviour based on the acceptance of such social pressure; hence, it refers to a person´s social context (Ajzen, 1991). Depending on the situation, social pressure can be more influential than one´s own attitude towards the behaviour (Ajzen and Fishbein, 1980). People in society tend to comply with other´s motivation to achieve recognition and acceptance. As Kalafatis et al. (1999) resumed, the "*subjective norm controls that behaviour that is instigated by the desire to act as others think you should act*" (p.444). Li et al. (2017a) defined societal influence as "(…) *the degree of importance an individual attaches to the approval of his or her actions by others (such as family members and friends). Such actions include adopting a specific innovation or technology*." (p.325). As Tu & Yang (2019) explained, there is a greater impact on the behavioural intention when the subjective norm is strongly influenced. Therefore, the social norm can be a "mental

representation" of what the consumer believes to be expected from him/herself by others. Based on previous studies, we hypothesize the following:

H2: Consumers' subjective norm (SN) has a significant direct and positive impact on the adoption intention of BEVs.

2.2.4 Perceived Behavioural Control

The third independent determinant of intention of the traditional TPB model is the "perceived behaviour control" (PBC) which refers to the individual's perception of difficulties and obstacles to perform a certain behaviour and is based on the individual´s past experiences (Ajzen, 1991). From a psychology perspective, the perception of the behavioural control is of higher interest than the actual control (Ajzen, 1991). The TPB differs the prior TRA in this variable of "perceived behavioural control". As Ajzen (1991) explained: "*The theory of planned behaviour places the construct of self-efficacy belief or perceived behavioural control within a more general framework of the relations among beliefs, attitudes, intentions, and behaviors*" (p.184). The PBC is used in the TPB model directly to prognosticate behavioural achievement. It is important to consider that the PBC varies across situations and across different behaviours. The degree of the perceived behavioural control "*refers to the perceived ease or difficulty of performing the behaviour and it is assumed to reflect past experience as well as anticipated impediments and obstacles*" (Ajzen, 1991, p.188). Zhang et al. (2018) defined PBC as the primary factor to positively impact the EV adoption. Kalafatis et al. (1999) explained that PBC is based on so called control beliefs that "*can be measured as the product of two measures: the power (p) of a factor to assist the action and perceived access to the factor (c)*." (p.445).

In summary, the stronger attitude and subjective norm is impacted and the greater the behavioural control is perceived, the stronger the consumer´s intention to perform a certain behaviour. In line with the literature, we hypothesize the following:

H3: Consumer´s perceived behavioural control (PBC) has a significant direct and positive impact on the adoption intention of BEVs.

2.2.5 Moral Norm/ Integrated Personal Norm

The moral norm is defined as the fourth determinant in the extended TPB model and stands for the obligation an individual feel to perform a certain kind of action (Beck and Ajzen, 1991). Ajzen (1991) found that in certain context decision-making, individuals are influenced by their moral norm. An integrated personal norm which is defined as "moral norm" or "(integrated) personal norm" is the feeling of the moral obligation to act in a certain way. It is rooted in the personal value system of a person (Ajzen, 1991). The moral norm stems from the Norm Activation Model by Schwartz (1977). The importance of considering and extending the model by feelings of moral

responsibility or moral norms in the TPB explanatory power has already been highlighted by Beck and Ajzen (1991). Achtnicht (2012) showed with a German sample the willingness of paying a substantial amount of money to adopt green vehicles to satisfy the own moral norm and responsibility. Wang et al. (2016) extended the TPB by personal moral norm to predict behavioural intention towards HEVs and highlighted that "*the main feature of personal norm is internalization*" (p.127). There are several research studies investigating the role of moral norm within the extended TPB model (Adnan et al., 2017; Du et al., 2018; Haustein & Jensen, 2018; Mohamed et al., 2016, 2018; Shalender & Sharma, 2020; Wang et al., 2016).

The difference between moral norm and subjective/ social norm is that the first concept refers to the internalized rules or values the individual has, whereas social norm refers to the external pressure the individual feel (Adnan et al., 2017; Wang et al., 2016). Therefore, in our research TPB is extended including moral norm at the same level than the three other traditional components, and we assume the following:

H4: Consumer's moral norm (MN) has a significant direct and positive impact on the adoption intention of BEVs.

2.2.6 Environmental Concern

In addition, the construct called "environmental concern" (EC) is introduced in the traditional TPB model as psychological factor. It is assumed that consumers who are environmentally aware are more willing to realize environmentally conscious behaviour (Bamberg, 2003). Hahnel et al. (2014) showed that activating environmental values increases the consumer´s willingness to accept and pay a higher purchase price for EVs and thus, highlighted the influence of consumer´s pro-environmental motives based on their own evaluations and perceptions which depends on the information availability of EVs. There are several authors (Mohamed et al., 2016, 2018; Shalender & Sharma, 2020; Shankar & Kumari, 2019; Wang et al., 2016, 2017; Yeğin & Ikram, 2022) who included EC in their TPB model to analyse its impact on EV adoption. Already in 1999, Kalafatis et al. (1999) analysed the importance of EC and showed that consumers with higher level of EC showed a higher intention to purchase environmental friendly products. Xu et al. (2019) extended the TPB by the construct "Environmental Performance" which "*refers to people´s awareness and their contribution towards environmental protection by purchasing and using BEVs*" (p.6) and found a significant positive influence on the intention to purchase BEVs. Sang & Bekhet (2015) applied a "EVs Acceptance Model" in reference to the TPB and included also EC. The authors defined EC "*as the degree to which people are aware of problems regarding the environment and support the effort to solve them or indicate the willingness to contribute personally to the solution*." (p.77). Sang & Bekhet (2015) included EC with a direct relationship towards Usage Intention. Jensen et al. (2013) concluded that individuals with higher environmental concern also

have a greater preference for EVs, and consequently EC has a positive effect on the preference for EVs. It is suggested, as Simsekoglu & Nayum (2018) stated, that environmental-economic attributes of BEVs, subjective norm and perceived behavioural control are positively related to the intention. Shankar & Kumari (2019) found that attitude, subjective norm, perceived behavioural control, environmental concern, and perceived corporate social responsibility obligation have a direct significant positive impact on the intention of adopting EVs. The positive direct impact of EC towards AI by Shankar & Kumari (2019), Shalender & Sharma (2020) and Yeğin & Ikram (2022) strengthens our following assumption, although Shankar & Kumari (2019) investigated from a EV-seller perspective based on an Indian sample. Degirmenci & Breitner (2017) included Environmental Performance with the constructs Price Value and Range Confidence towards Attitude for EVs and concluded that Environmental Performance is the strongest predictor of attitude, which in turn affects positively the AI. Nevertheless, it is important to point out that these studies included the construct EC (or environmental performance as Xu et al. (2019) did) on the same level as the other constructs, and not as a antecedent construct for other TPB elements, which differs from our present study.

Therefore, considering previous research, we investigate the direct impact of EC on the intention to adopt BEV in our study. In fact, referring to the results obtained in previous studies, our following hypothesis establishes a positive impact of environmental concern on the adoption intention of BEVs:

H5: Environmental Concern (EC) has a significant direct and positive impact on the adoption intention of BEVs.

2.2.7 Indirect Impact of Environmental Concern

Bamberg (2003) supposed that "*environmental concern influences specific behavior indirectly via its impact on the generation and evaluation of situation-specific beliefs in the context of the decision to acquire information about green electricity products and the local providers of these products.*" (p.23). Bamberg (2003) explained unequivocally that environmental concern as general attitude is not a direct but rather an important indirect determinant of a specific behaviour.

Wang et al. (2016), Mohamed et al. (2016, 2018), and Adnan et al. (2018) found an indirect effect of EC on the adoption intention, and a positive impact of EC on the TPB constructs ATT, SN, PBC, and personal MN which again influenced the adoption intention positively. Adnan et al. (2017) introduced EC as moderating variable of the relationship between consumers behavioural intention and consumers adoption to using PHEVs as a frontal factor, and concluded that the intention towards PHEVs adoption is positively and indirectly effected by EC.

Taking into consideration the previous explained importance of EC, especially as indirect impact on EVs adoption intention, the other TPB constructs can be considered as mediating variables

when investigating the impact of EC on the relationship towards AI. Therefore, we suggest that EC has an indirect positive effect on the intention to adopt BEVs through consumer´s attitude, subjective norm, moral norm and perceived behavioural control.

H6: Environmental Concern (EC) has an indirect positive effect on the adoption of BEVs through consumers' Attitude (ATT).

H7: Environmental Concern (EC) has an indirect positive effect on the adoption of BEVs through consumers' Subjective Norm (SN).

H8: Environmental Concern (EC) has an indirect positive effect on the adoption of BEVs through consumers' Perceived behavioural control (PBC).

H9: Environmental Concern (EC) has an indirect positive effect on the adoption of BEVs through consumers' Moral Norm (MN).

In summary, and regarding the construct of EC, our model investigates whether there is a direct impact of EC on the adoption intention; and secondly, it analyses the indirect impact of EC through the other constructs towards AI. Therefore, we are analysing the mediating effect of consumers' ATT, SN, PBC, and MN in the relationship between EC and BEVs adoption intention. Doing so, the study provides a complete investigation with focus on the direct and indirect impact of EC as important construct to include in pro-environmental research.

2.2.8 Moderating variables: Profile with Experience, Gender, and Education

Following our theoretical framework, a newly created variable "profile" which includes experience, gender, and education, is introduced. We selected these three variables based on their importance concluded in other research in literature. For additional information regarding these variables, please refer to Chapter 2 where an extensive literature has been conducted. In the following, some additional studies regarding the variable "experience" in relation to the TPB are listed. The purpose of including the variable "**experience**" is to explore the influence of an individual's previous experience on the adoption intention of BEVs. There are studies who used vehicle trials to investigate whether attitudes and preferences toward EVs change with having had previous experience. Jensen et al. (2013) analysed the impact of experience on the preference for EVs and concluded that the preferences change significantly after carrying out a real experience with an EV. Liu et al. (2020) investigated the impact on experience on the traditional TPB model and highlighted the importance of other studies analysing the impact on experience on BEV adoption. Other studies have also shown that the evaluation of BEV attributes varies with the level of experiences (Jensen et al., 2013; Schmalfuß et al., 2017). Haustein & Jensen (2018) highlighted the importance of experience to establish realistic attitudes for EV as new product.

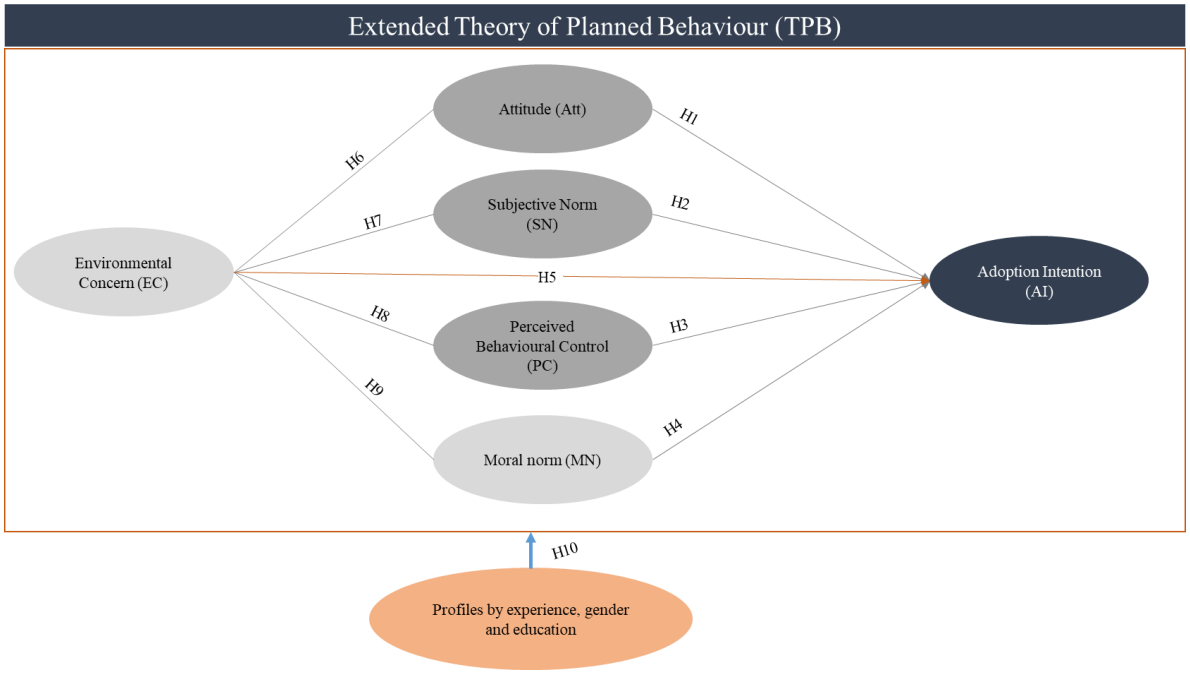
In line with Schmalfuß et al. (2017) we estimate that BEV-experienced users have a more positive subjective norm than BEV-unexperienced drivers. The term "experience" refers in this study to the direct experience of having driven a BEVs. Other studies showed that specific attitudes towards BEVs can change depending on the level of experience (Rezvani et al., 2015), and Liu et al. (2020) gave evidence that ATT, SN, PBC, and adoption willingness is higher for experienced consumers compared to inexperienced drivers. Peters & Dütschke (2014) showed that experienced BEV drivers have a higher increase in the purchase intention and willingness to pay for BEVs. Degirmenci & Breitner (2017) applied a structural equation model to analyse the impact of different constructs on ATT towards EVs, and included as control variables "experience", "age", "gender" and "profession". The authors confirmed the significant influence of "experience" on attitude, whereas demographic variables did not exert any significant influence on attitude. Schmalfuß et al. (2017) explained that "*experience should be seen as influencing background factor*" (p.63), and therefore our survey included a question regarding experience of a BEV once or on a regular basis.

In this research, the variable "profile" will be included as moderating variable by applying a multigroup structural equation model. The so-called moderator effect happens when the moderator (here "profile") changes the strength of the relationship between other constructs in the model (Hair et al., 2017). Therefore, we assume that the relationships previously established among environmental concern, attitude, subjective norm, personal norm, and perceived behavioural control on the BEVs adoption intention will be affected by the "profile" of the consumers. Hence, this study hypothesizes the following:

H10: The profile of the consumer considering experience, gender and education will moderate the relationships among EC and all constructs of the extended TPB and the intention to adopt.

Referring to the suggested hypotheses, Figure 21 summarizes the model of this research:

Figure 21: Overview Model with hypotheses (Chapter 3)



Note: Own work based on Literature Review

3 Research Methodology

A questionnaire survey is conducted based on the information of the extended Theory of Planned Behaviour. A two-part survey was used to collect first participants´ demographic information and then the answers for the items defined in the extended TPB model. For further information about the sample and data collection, please refer to Chapter 2 in this doctoral thesis. The survey questionnaire was distributed online via the university's data set and represents the population of interest (Barcelona, Spain) without being a convenience sample set. As Hair et al. (2017) explained for empirical data collected via questionnaires, data collection issues such as missing data, suspicious response patterns, outliers and data distribution must be addressed. For the present analysis, we counted with 1.816 valid answers after eliminating missing values.

3.1 Constructs and Description of Variables

In order to achieve the objectives of this chapter, the following variables are important to generate the variable "profile":

Table 15: Chapter 3 Variables used to generate consumer's profile

Variable	Question	Definition	Descriptive
Gender	What is your gender?	0=female, 1=male	0 = 54% 1= 46%
Edu	What is your highest level of education?	2= High school (Abitur), 3=Bachelor Degree, 4= Master Degree, 5=Doctor and above	2=18%/ 3=38%/ 4=27%/ 5=17%
PrevExp2	Have you had previous experience with electric vehicles (EVs)? Response	0= No. No experience at all./ 1= Yes	0=78%/ 1=22%

The constructs and measures for the extended TPB model were adapted from previous studies (Mohamed et al., 2016; Shalender & Sharma, 2020; Wang et al., 2016; Yan et al., 2019; Yeğin & Ikram, 2022; Zhang et al., 2018). The constructs "SN", "EC", and "AI" were measured by a 5-point Likert Scale from "strongly disagree" to "·strongly agree", and the other constructs were measured with 5-point semantic differential scale items, such as "For me, adopting a BEV is …": unfavorable - favorable, negative-positive, false – definitely true (see Table 16). EC were measured with five indicators. All constructs are reflective according to the previous research.

Table 16: SEM Variables Likert Scale (Chapter 3)

Construct	**Measurement variables**	**Scale** **5-point Likert Scale**
Attitude	I consider the adoption (purchase) of a Battery Electric Vehicle BEV as:	(unfavorable 1 – favorable 5)
	I consider the adoption (purchase) of a Battery Electric Vehicle BEV as:	(negative 1 – positive 5)
	I consider the adoption (purchase) of Battery Electric Vehicle BEV as:	(undesirable 1 – desirable 5)
	It is environmental-friendly to buy Battery Electric Vehicles (BEVs):	(strongly disagree 1 to strongly agree 5)
Perceived Behavioural Control	I can buy a BEV if I wanted to.	false (1) to definitely true (5).
	The price of a BEV is important to me when I decide to adopt.	
	I can find where to buy a BEV if I wanted to.	
	It is mostly up to me to buy or not to buy a BEV.	
Subjective norm	Most people who are important to me think I should adopt a BEV when adopting a vehicle in the near future.	(strongly disagree) to 5 (strongly agree)
	I think that many people who are important to me expect that I buy an environmentally friendly car such as a BEV.	
	People whose opinion I value would prefer that I adopt a BEV when adopting a vehicle in the near future.	
	While adopting a new vehicle, I consider the wishes of other people who are important to me.	
	If I buy a BEV, then most people who are important to me would also buy a BEV.	
Moral Norm	I believe it is my moral responsibility to reduce environmental pollution and greenhouse gases emissions.	false (1) to definitely true (5).
	If I buy a vehicle, I feel morally obliged to buy a BEV, regardless of what other people do.	
	I take environment consequences into account while I adopt a vehicle.	

	I feel obliged to take the environmental consequences of vehicle use into account when making adoption choices.	
Environmental Concerns	I think we as individuals have the responsibility to protect the environment.	1 (strongly disagree) to 5 (strongly agree)
	I am very concerned about the environment.	
	I think the environmental issues are becoming more serious in recent years.	
	I think we should live in harmony with the environment for achieving sustainable development.	
	I take environmental consequences into account while I adopt a vehicle.	
BEVs Intention to adopt Intention to adopt a BEV	I am willing to adopt a BEV when adopting a vehicle in the near future.	1 (strongly disagree) to 5 (strongly agree
	I intend to adopt a BEV when adopting a vehicle in the near future.	
	I plan to adopt a BEV when adopting a vehicle in the near future.	

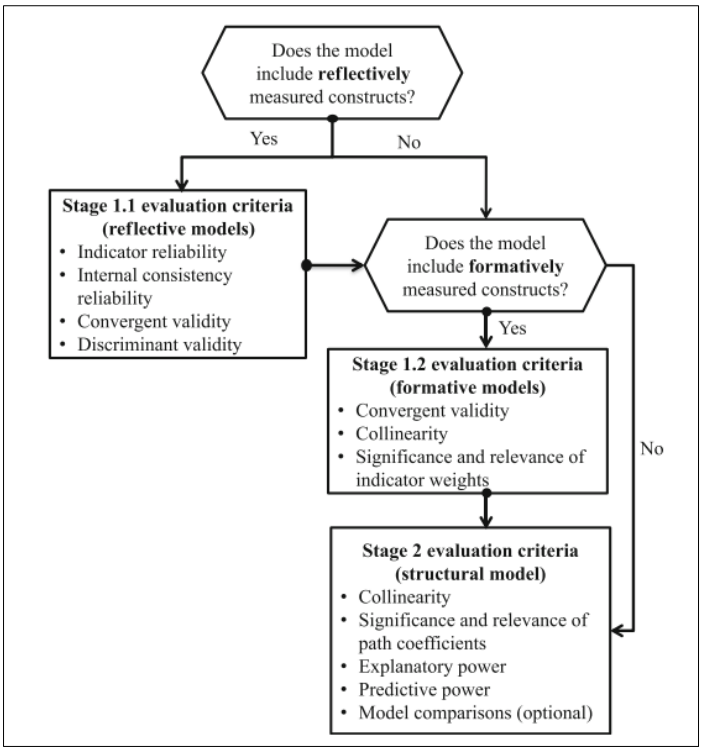
3.2 Analysis

3.2.1 Structural Equation Model (SEM)

For the purpose of this research and to measure the different constructs, partial least squares structural equation modelling (PLS-SEM) with the SmartPLS4-tool was implemented to test the hypotheses listed. The Smart PLS tool was used as it allows to estimate and test causal relationships. In line with Shalender & Sharma (2020) partial least square method is applied as SEM technique to validate hypotheses and to investigate the overall fit of the survey data. Sarstedt et al. (2021) explained that PLS-SEM is a common method to estimate path models and the relationship of the latent variables in social sciences. Sarstedt et al. (2021) explained that PLS-SEM is often used in studies to identify key success factors for constructs as customer satisfaction, loyalty, behavioural intentions, and consumer behaviour. Yeğin & Ikram (2022) summarized that the structural equation modelling (SEM) is a preferred method especially in green energy research as it allows to include complex model situations and including (latent) variables that cannot be measured in a direct way by observable ones. The Partial Least Squares Structural Equation Modelling is recommended to predict a set of dependent variables from a large set of independent variables, so to say, it allows to reduce a complex model with many constructs and variables. As Sarstedt et al. (2021) resumed, PLS-SEM allows a causal-predictive paradigm to validate the predictive power of a model developed with theory and logic. Furthermore, we used this technique due to the non-normal distribution of most indicators (80%) considering the results of the Shapiro–Francia normality test (Chin et al., 2003). The results of the Shapiro-Francia normality test can be found in the table in Appendix 15.

For the analysis conducted in SEM-PLS, the guideline by Hair et al. (2017) was used to test the constructs´ reliability and validity. Sarstedt et al. (2021) explained that PLS-SEM results can be evaluated in two stages to address first the reflective measurement model, and if applicable the formative measurement models. Figure 22 shows the different stages as defined by Sarstedt et al. (2021).

Figure 22: PLS-SEM Model evaluation (Chapter 3)

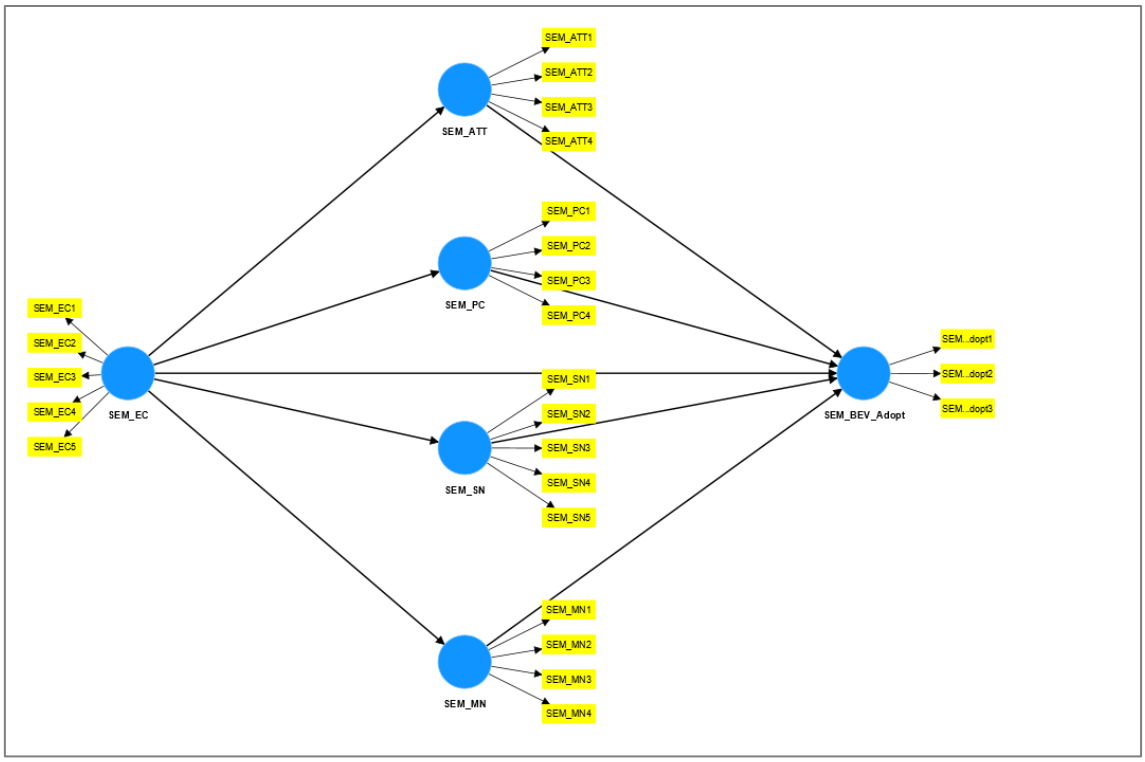


Note: Sarstedt et al. (2021)

3.2.2 Path Models with Latent Variables

In Figure 23 the path model for the present research study is shown. The latent variables (ATT, SN, PBC, MN, EC) are constructs that represent conceptual variables included in our theoretical model, as explained previously. These constructs are directly measured by items collected with the survey. The path model usually consists of two elements: the structural model that represents the causal-predictive relationship between the constructs themselves, and the measurement model that represents the relationship between each construct and its indicators (Sarstedt et al., 2021). The latent variables serve both as independent and dependent variables and are therefore called endogenous latent variables (Hair et al., 2017).

Figure 23: Final SEM Model with its relationships (Chapter 3)



Note: Screenshot Smart PLS4 SEM

3.2.3 Common Method Bias

In line with the study by Wang et al. (2016) the present study might be affected by Common Method Bias (CMB) or Common Method Variances (CMV) as all data were collected from a single source at a single point in time. Kock et al. (2021) explained that research can be affected by CMB when both dependent and independent variables are obtained within the same survey with the same response method, which is the case for the present study. CMB is considered as threat to the integrity of the study result (Kock et al., 2021). As prevention to reduce the likelihood CMB in a research study, we took it into consideration already when creating the survey by including a short reminder about the survey's anonymity for participation as part of the introduction, and by applying different scale types (Likert Scale).

As ex post control technique, we conducted the unmeasured latent method as another technique to control for CMB (Kock et al., 2021). This technique includes adding a new, theoretically unrelated construct (marker variable), which is not used in the original theoretical model, as dependent variable. This marker variable is to review the correlations among the models´ principal constructs. Any high correlation among this marker variable (SEM_Blue) and the other principal constructs would indicate CMB. As Kock (2015) explained, an occurrence of variance inflation factors (VIFs) greater than 3,3 indicates a pathological collinearity and thus, a possible

model´s contamination of CMB. When we estimated the relations among all the constructs and the new dependent latent variable, we detected a critical VIF value above the reference for item AI2 (see Table 17 1st estimation). Therefore, we deleted the item AI2 to avoid CMB problems in the model. We estimated the same model again without the item AI2 and found all VIFs lower than 3.3 (see Table 17 2nd estimation). Finally, our model can be considered free of CMB.

Table 17: CMB VIF Loadings - Original Model (Chapter 3)

Outer Model	1st Estimation VIF Original Model	2nd Estimation VIF w/o Att2
SEM_ATT1	1,672	1,672
SEM_ATT2	2,106	2,106
SEM_ATT3	2,035	2,035
SEM_ATT4	1,264	1,264
SEM_BEV_Adopt1	2,582	2,005
SEM_BEV_Adopt2	5,900	
SEM_BEV_Adopt3	**4,596**	2,005
SEM_EC1	1,722	1,722
SEM_EC2	2,082	2,082
SEM_EC3	1,645	1,645
SEM_EC4	1,991	1,991
SEM_EC5	1,439	1,439
SEM_LMblue1	1,368	1,368
SEM_LMblue2	2,007	2,007
SEM_LMblue3	1,749	1,749
SEM_MN1	1,486	1,486
SEM_MN2	1,390	1,390
SEM_MN3	1,913	1,913
SEM_MN4	2,110	2,110
SEM_PBC1	1,333	1,333
SEM_PBC2	1,036	1,036
SEM_PBC3	1,199	1,199
SEM_PBC4	1,292	1,292
SEM_SN1	2,454	2,454
SEM_SN2	2,715	2,715
SEM_SN3	2,712	2,712
SEM_SN4	1,223	1,223
SEM_SN5	1,575	1,575

As another control technique to reject possible CMB, we applied the Harman´s one-factor/ single factor test in STATA. In our study, we applied this test with an exploratory factor analysis. The results of Harman´s one-factor test suggested that the unrotated solution which includes all items of the measured variables are fulfilled with 32,7% of the variance (see Appendix 11). As Kock et al. (2021) clarified, CMB is present if this value is higher than 50%, and therefore we can confirm that our sample with 32,7% is not affected by CMB based on Harman´s test.

3.2.4 Reliability and Validity Analysis

Related to the Outer (measurement) model, it is necessary to evaluate the construct's reliability as well as its convergent and discriminant validity (Hair et al., 2017). This assessment allows to determine the reflective items' capability to predict the defined constructs and determines if the constructs are related but providing different information.

Referring to the model´s constructs reliability, the Cronbach´s Alpha is the traditional criterion of the internal consistency and "*provides an estimate of the reliability based on the intercorrelations of the observed indicator variables*" (Hair et al, 2017, p.136). It is recommended that Cronbach's alpha should be above 0,7 as a rule of thumb for the variable to explain a substantial part of each indicator's variance. Referring to the model's convergent validity, Hair et al. (2017) specified: "*Convergent Validity is the extent to which a measure correlates positively with alternative measures of the same construct*." (p.137). The outer loadings should share a high proportion of variance and the following results show the validity of the items of each construct.

Based on the reliability and validity check, Att4, PBC2 and SN4 items had to be deleted because they did not accomplish the mentioned requirements (see Appendix 12). Att4 showed a value of 0,616, PBC2 a value of 0,430 and SN4 a value of 0,472. EC3 with an initial value of 0,694 can be considered as 0,7 when rounded up. The PBC4 load with 0,637 and thus, below 0,7, was preserved because it allowed us to maintain 3 items to measure this construct. Doing so, the construct "PBC" shows a Cronbach´s Alpha yielded 0,633 (instead of 0,502 if PBC4 was deleted). PBC4 is included in the model due to its proximity to the theoretical threshold level and this is in line with what Hair et al. (2017) suggested that the composite reliability is considered acceptable in exploratory research from 0,6. In Table 18 we provide the loadings, the composite reliability (CR), and the average variance explained (AVE).

Table 18: Construct Reliability and Validity Analysis Results (Chapter 3)

	Loads	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
SEM_ATT		0,822	0,833	0,893	0,735
SEM_ATT1	0,859				
SEM_ATT2	0,860				
SEM_ATT3	0,854				
SEM_BEV_ AI		0,829	0,831	0,921	0,854
SEM_BEV_Adopt1	0,928				
SEM_BEV_Adopt3	0,920				
SEM_EC		0,830	0,861	0,877	0,589
SEM_EC1	0,761				
SEM_EC2	0,838				
SEM_EC3	0,690				
SEM_EC4	0,773				
SEM_EC5	0,766				
SEM_MN		0,799	0,804	0,869	0,626
SEM_MN1	0,760				
SEM_MN2	0,718				
SEM_MN3	0,830				

SEM_MN4	0,849				
SEM_PBC		0,633	0,661	0,792	0,562
SEM_PBC1	0,826				
SEM_PBC3	0,773				
SEM_PBC4	0,637				
SEM_SN		0,863	0,876	0,908	0,713
SEM_SN1	0,875				
SEM_SN2	0,889				
SEM_SN3	0,890				
SEM_SN5	0,711				

Regarding discriminant validity, we examined the Heterotrait-monotrait ratio (HTMT). As Hair et al. (2017) explained "*discriminant validity is the extent to which a construct is truly distinct from other constructs by empirical standards*" (p.139). A model suggests lack of discriminant validity if an HTMT value is above 0,90 or above 0,85 when the constructs in the path model are conceptually distinct. As Table 19 shows, all constructs in our model exhibit discriminant validity based on the HTMT method.

Table 19: Discriminant validity: Heterotrait-monotrait ratio (HTMT) Matrix (Chapter 3)

	SEM_ATT	SEM_BEV_Adopt	SEM_EC	SEM_MN	SEM_PBC	SEM_SN
SEM_ATT						
SEM_BEV_Adopt	0,718					
SEM_EC	0,381	0,400				
SEM_MN	0,516	0,613	0,842			
SEM_PBC	0,149	0,228	0,118	0,155		
SEM_SN	0,416	0,554	0,206	0,477	0,220	

Additionally, the Fornell-Larcker criterion can be applied to assess a model's discriminant validity (Hair et al., 2017). This approach checks if the square root of the AVE values is greater than its highest correlation with any other construct. This is based on the idea that the construct shares more variances with its associated items than with other constructs. In the present model, this additional test of discriminant validity is successfully fulfilled, as Table 20 confirms.

Table 20: Fornell-Larcker criterion (Chapter 3)

	SEM_ATT	SEM_BEV_Adopt	SEM_EC	SEM_MN	SEM_PBC	SEM_SN
SEM_ATT	0,857					
SEM_BEV_Adopt	0,602	0,924				
SEM_EC	0,327	0,360	0,767			
SEM_MN	0,417	0,495	0,729	0,791		
SEM_PBC	0,117	0,178	0,095	0,121	0,750	
SEM_SN	0,356	0,469	0,204	0,392	0,174	0,844

3.2.5 Structural Model (Path Coefficients)

As Hair et al. (2017) explained, it is essential to analyse the path coefficients (structural model relationships) to test the model's hypotheses among the constructs. First to mention is that the five constructs ATT, PBC, SN, MN, and EC explain 48% of the variance of the endogenous construct AI (R^2 = 0,481; R^2 adjusted = 0,479). As for the goodness-of-fit of the model, the Chi-square shows 4.547,253 in the saturated model, and 4.503,210 in the estimated model.

Regarding the estimated coefficients among the constructs, we used a bootstrapping estimation method. Bootstrapping replaces a large number of samples which are taken from the original sample (Hair et al., 2017). PLS-SEM requires bootstrap procedure to validate the coefficients significance level (Hair et al., 2017). The bootstrapping estimated path coefficients show standardized values between -/+ 1, and the closer to +1, the stronger the relationship. SmartPLS4 reports p-values (probability values) that equal the probability of achieving an empirical t-value under the condition that the null hypothesis is being supported (see Table 21). In addition to examining the sizes of the path coefficient, it is necessary to determine the statistical significance level (Hair et al., 2017). It is important to check the coefficient estimates´ standard error for final determination which is obtained by means of bootstrapping.

Table 21: Bootstrapping Path Coefficient Matrix (Chapter 3)

Mean, STDEV, T values, p values

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
SEM_ATT -> SEM_BEV_Adopt	0,422	0,423	0,021	20,360	0,000
SEM_EC -> SEM_ATT	0,327	0,327	0,024	13,548	0,000
SEM_EC -> SEM_BEV_Adopt	0,015	0,015	0,025	0,609	0,543
SEM_EC -> SEM_MN	0,729	0,729	0,011	65,172	0,000
SEM_EC -> SEM_PBC	0,095	0,097	0,027	3,476	0,001
SEM_EC -> SEM_SN	0,204	0,205	0,023	8,874	0,000
SEM_MN -> SEM_BEV_Adopt	0,214	0,214	0,029	7,479	0,000
SEM_PBC -> SEM_BEV_Adopt	0,063	0,064	0,020	3,121	0,002
SEM_SN -> SEM_BEV_Adopt	0,221	0,220	0,020	11,004	0,000

The bootstrapping results indicate that path coefficients for the following relations ATT→AI, PBC→AI, SN→AI and MN→AI are statistically significant; therefore, H1, H2, H3, and H4 are not rejected. However, the path relation of EC → AI is not significant. Therefore, H5 is rejected due to missing statistical significance level, so to say there is no proof of having a direct relationship of EC towards the BEV Adoption Intention.

3.2.6 Indirect effects SEM (Inner Model)

Referring to the results of the indirect effect of the SEM, the estimated coefficients for the following relationships (EC→ATT, EC→MN, EC→PBC and EC→SN) are significantly different than 0. Furthermore, when we analysed the specific indirect effects of EC on AI, the results indicate that all relationships are statistically significant (see Table 22).

Table 22: Indirect Effects SEM (Chapter 3)

Mean, STDEV, T values, p values

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
SEM_EC -> SEM_SN -> SEM_BEV_Adopt	0,045	0,045	0,007	6,843	0,000
SEM_EC -> SEM_ATT -> SEM_BEV_Adopt	0,138	0,138	0,012	11,418	0,000
SEM_EC -> SEM_PBC -> SEM_BEV_Adopt	0,006	0,006	0,003	2,305	0,021
SEM_EC -> SEM_MN -> SEM_BEV_Adopt	0,156	0,156	0,021	7,283	0,000

3.2.7 Multigroup

As previously hypothesized, experience, education and gender will moderate the relations established among the first order constructs in the model through the new variable "profile". In the following the multi correspondence analysis (MCA) approach is explained with the objective of generating the variable profile. Once created, this new variable will be considered a moderator variable and multigroup analysis will be implemented to test H10.

3.2.7.1 Profile

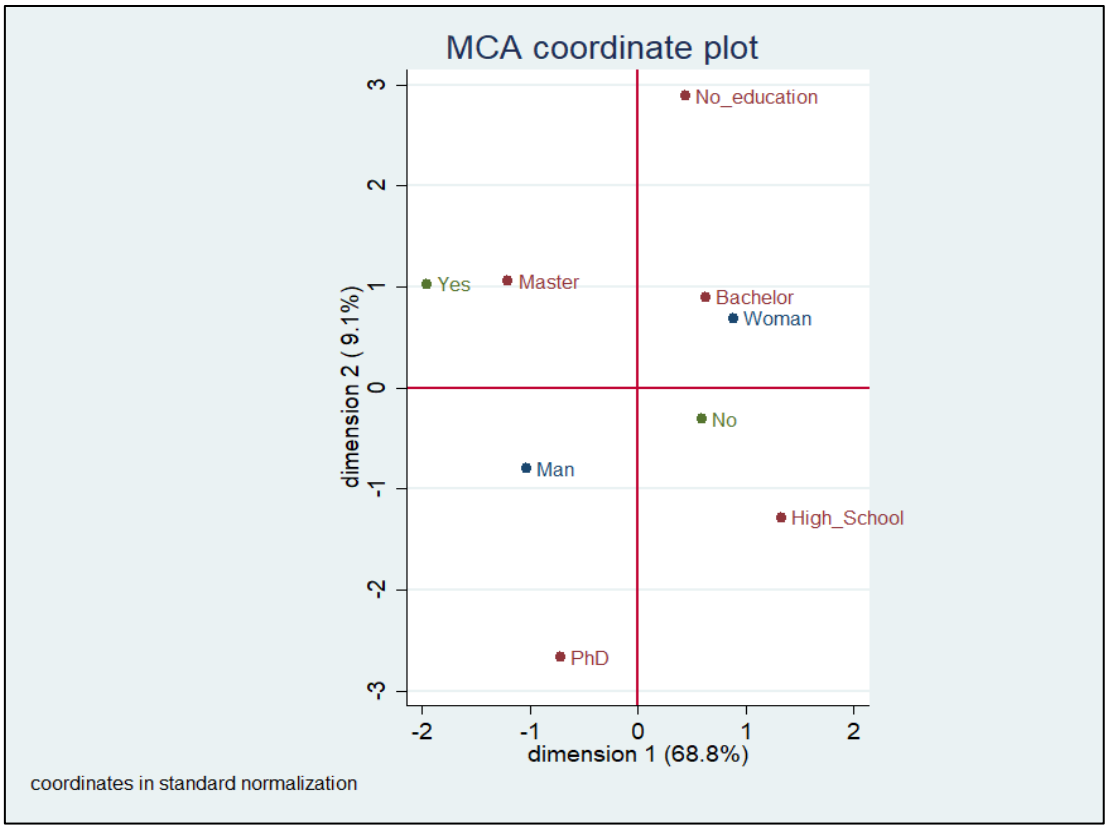
In Figure 24, the different dimensions created are visually shown. On the right hand-side d>0 there are rather consumers being female with no or less education (No, High-School, Bachelor) and without previous experience for BEVs, whereas on the left hand-side d<0 the group is formed by man with higher education level of Master and PhD and previous BEV experience. Table 23 informs about the relative frequencies of both profiles in the data.

Table 23: Variable "Profile" (Chapter 3)

tab_profile

profile	Freq.	Percent	Cum.
1: Profile_Man, with experience, higher education	1,124	61.83	61.83
2: Profile_Woman, no experience, less education	694	38.17	100.00
Total	**1,818**	**100.00**	

Figure 24: MCA Coordinate plot (Chapter 3)

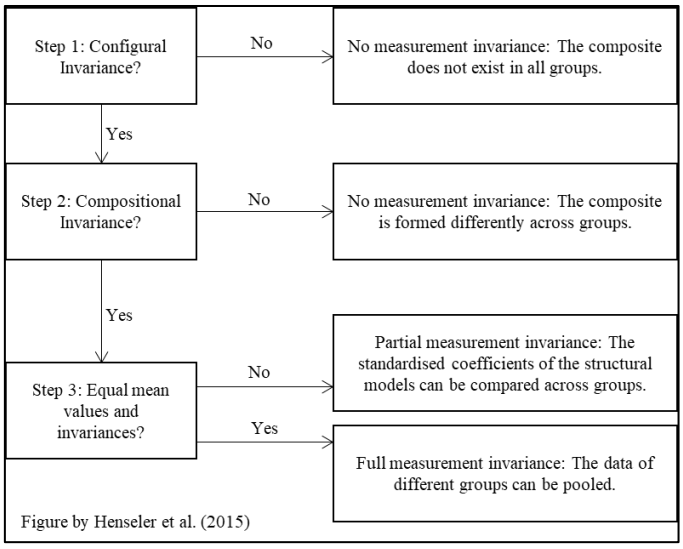


Note: Screenshot Stata MCA

3.2.7.2 Results MICOM

The measurement invariance of composite models (MICOM) procedure is a series of statistical tests that allows to validate that the composite scores do not significantly differ across groups. The MICOM procedure identifies no, partial, or full measurement invariance, and when analysing research data with a SEM model the group comparison can mislead if the variances of their measures are not established (Henseler et al., 2016). MICOM includes three steps: (1) configural invariance (i.e., equal parameterization and way of estimation), (2) compositional invariance (i.e., equal indicator weights), and (3) equality of composite mean values and variances (Hair et al., 2017). The three steps are hierarchically interrelated (see Figure 25), whereas step 3 does not necessarily to be confirmed and thus, defines if a model fulfils partial or full measurement invariances. Therefore, the validity of the MICOM analysis can conclude partial or full measurement invariances of the research model (Henseler et al., 2016).

Figure 25: MICOM Approach (Chapter 3)



Note: Henseler et al. (2016)

As explained in the following, the data set allowed partial measurement invariance of the MICOM procedure statistically fulfilled (see Table 24). The results satisfied the requirements of configural invariances (Step 1) and compositional invariances (Step 2). In step 3, our model showed that the composite's mean values are unequal across groups which lead to the partial measurement invariance. Based on this result, we can continue with the multigroup analysis by comparing the standardized coefficients of the model, however we cannot pool the data. Henseler et al. (2016) explained that permutation tests are non-parametric and allow to statistically test for compositional invariance.

Table 24: Results MICOM (Chapter 3)

	Original correlation	Correlation permutation mean	5.0%	Permutation p value
SEM_ATT	1,000	1,000	0,999	0,272
SEM_BEV_Adopt	1,000	1,000	1,000	0,584
SEM_EC	0,999	0,999	0,999	0,364
SEM_MN	1,000	1,000	0,999	0,983
SEM_PBC	0,992	0,982	0,941	0,601
SEM_SN	1,000	1,000	0,999	0,660

3.2.7.3 Permutation Multigroup Analysis

In the following Table 25, we can find the results of the permutation multigroup analysis and its path coefficients. Our data set showed that there are no significant differences in the estimated coefficient among the constructs of the model in the different groups created. Therefore, the effect of the constructs towards AI can be considered the same independently of being male with experience and higher education or being female, without experience with less education; in other words, profile does not moderate the established relationships.

Table 25: Permutation Multigroup Analysis (Chapter 3)

	Original (Profile_Man, with experience, higher education)	Original (Profile_Woman, no experience, less education)	Original difference	Permutation mean difference	2.5%	97.5%	Permutation p value
SEM_ATT -> SEM_BEV_Adopt	0,458	0,402	0,056	-0,001	-0,085	0,082	0,188
SEM_EC -> SEM_ATT	0,344	0,316	0,028	0,001	-0,098	0,106	0,575
SEM_EC -> SEM_BEV_Adopt	0,041	0,002	0,039	0,003	-0,100	0,110	0,458
SEM_EC -> SEM_MN	0,733	0,726	0,007	-0,001	-0,047	0,043	0,793
SEM_EC -> SEM_PBC	0,115	0,087	0,028	0,002	-0,114	0,117	0,662
SEM_EC -> SEM_SN	0,214	0,197	0,017	-0,002	-0,088	0,087	0,721
SEM_MN -> SEM_BEV_Adopt	0,184	0,232	-0,047	-0,004	-0,118	0,108	0,417
SEM_PBC -> SEM_BEV_Adopt	0,030	0,067	-0,037	0,000	-0,078	0,082	0,361
SEM_SN -> SEM_BEV_Adopt	0,217	0,217	0,000	0,002	-0,085	0,079	0,987

3.2.7.4 Bootstrapping Multigroup Analysis

When applying Bootstrapping Multigroup Analysis, the following results as in Table 26 are obtained. Again, there are no significant differences in the estimated coefficients among the constructs of the model in the different groups created. Therefore, the effect of the constructs towards AI can be considered the same independently of being male or female, having higher or less education and having had or not experience.

Table 26: Bootstrapping Multigroup Analysis – 1 (Chapter 3)

	Difference (Profile_Man, with experience, higher education - Profile_Woman, no experience, less education)	1-tailed (Profile_Man, with experience, higher education vs Profile_Woman, no experience, less education) p value	2-tailed (Profile_Man, with experience, higher education vs Profile_Woman, no experience, less education) p value
SEM_ATT -> SEM_BEV_Adopt	0,056	0,095	0,190
SEM_EC -> SEM_ATT	0,028	0,286	0,572
SEM_EC -> SEM_BEV_Adopt	0,039	0,221	0,443
SEM_EC -> SEM_MN	0,007	0,379	0,758
SEM_EC -> SEM_PBC	0,028	0,322	0,645
SEM_EC -> SEM_SN	0,017	0,357	0,715
SEM_MN -> SEM_BEV_Adopt	-0,047	0,790	0,420
SEM_PBC -> SEM_BEV_Adopt	-0,037	0,821	0,357
SEM_SN -> SEM_BEV_Adopt	0,000	0,504	0,992

When analysing the p-value of the path coefficients of the Bootstrapping Multigroup Analysis, the following table is yielded (Table 27). We want to point out that the effect of PBC → AI is not significant in the case of the group of experienced man (estimated coefficient is 0,030, p value = 0,306) while in the group of non-experienced women the effect of PBC on AI is significantly different than 0 (the coefficient is 0,067 with a p-value of 0,014).

Table 27: Bootstrapping Multigroup Results – 2 (Chapter 3)

	Original (Profile_Man, with experience, higher education)	Original (Profile_Woman, no experience, less education)	Mean (Profile_Man, with experience, higher education)	Mean (Profile_Woman, no experience, less education)	STDEV (Profile_Man, with experience, higher education)	STDEV (Profile_Woman, no experience, less education)	t value (Profile_Man, with experience, higher education)	t value (Profile_Woman, no experience, less education)	p value (Profile_Man, with experience, higher education)	p value (Profile_Woman, no experience, less education)
SEM_ATT -> SEM_BEV_Adopt	0,458	0,402	0,459	0,402	0,034	0,026	13,602	15,168	0,000	0,000
SEM_EC -> SEM_ATT	0,344	0,316	0,344	0,316	0,040	0,031	8,693	10,312	0,000	0,000
SEM_EC -> SEM_BEV_Adopt	0,041	0,002	0,039	0,002	0,038	0,034	1,088	0,065	0,277	0,948
SEM_EC -> SEM_MN	0,733	0,726	0,733	0,726	0,020	0,013	36,076	55,616	0,000	0,000
SEM_EC -> SEM_PBC	0,115	0,087	0,120	0,092	0,047	0,037	2,438	2,383	0,015	0,017
SEM_EC -> SEM_SN	0,214	0,197	0,214	0,198	0,036	0,030	5,969	6,603	0,000	0,000
SEM_MN -> SEM_BEV_Adopt	0,184	0,232	0,184	0,232	0,046	0,037	4,019	6,284	0,000	0,000
SEM_PBC -> SEM_BEV_Adopt	0,030	0,067	0,032	0,069	0,030	0,027	1,025	2,465	0,306	0,014
SEM_SN -> SEM_BEV_Adopt	0,217	0,217	0,217	0,217	0,033	0,027	6,657	8,051	0,000	0,000

In summary, all previous statistical results give insight into the data's reliability and the impacts the different constructs and variable have on the adoption intention.

4 Hypotheses: Results SEM Analysis

This section focuses on the path analysis results of the research model in reference to the established hypotheses. In order to test our hypotheses on the research model, the SEM was applied, which is often used for green energy research. The diagram for the SEM and its bootstrapping method showed the degrees of relationship between the EV adoption intention and each of the constructs included.

Table 28 summarizes the results of all hypotheses that were tested in this model. As conclusion, all hypotheses except H5 (EC has a direct and positive significant impact on the adoption intention of BEVs) and H10 (The profile of the consumer considering experience, gender and education will moderate the relationships among EC and all constructs of the extended TPB and the intention to adopt.) were accepted based on their significant p-values. The different constructs (ATT, SN, PBC, MN) had a positive direct impact on the adoption intention of BEVs, and consequently H1-H4 can be confirmed. Based on the results of the indirect relations of EC, we can confirm that the constructs served as mediating variables for EC with a positive impact of the indirect effect of EC on AI, and consequently H6-H9 can be accepted. The path coefficients from consumers' environmental concern to attitude, subjective norm, perceived behavioural control and personal moral norm were all statistically significant and in the expected (positive) directions. However, regarding H5 there was no direct impact of EC on AI found, nor is there statical difference between the different profile groups that we have created, so to say, the relationship of the different constructs towards adoption intention is not influenced by being male or female, having less or more education and having had or not previous BEV experience.

Table 28: Results Hypotheses (Chapter 3)

	Hypotheses	Roads	Original sample (O) ß (Path Coefficient)	Sample mean (M)	Standard Deviation	p values	Conclusion (the theoretical hypothesis is…)
H1	Consumers' attitude (ATT) toward BEVs has a significant direct and positive impact on the adoption intention of BEVs.	ATT --> AI	0,422	0,423	0,021	0,000	Accepted
H2	Consumers' subjective norm (SN) has a significant direct and positive impact on the adoption intention of BEVs.	SN --> AI	0,221	0,220	0,020	0,000	Accepted
H3	Consumer´s perceived behavioural control (PBC) has a significant direct and positive impact on the adoption intention of BEVs.	PBC --> AI	0,063	0,064	0,020	0,002	Accepted
H4	Consumer's moral norm (MN) has a significant direct and positive impact on the adoption intention of BEVs.	MN --> AI	0,214	0,214	0,029	0,000	Accepted
H5	Environmental Concern (EC) has a significant direct and positive impact on the adoption intention of BEVs.	EC --> AI	0,015	0,015	0,025	0,543	Rejected
H6	Environmental Concern (EC) has an indirect positive effect on the adoption of BEVs through consumers' Attitude (ATT).	EC --> ATT	0,327	0,327	0,024	0,000	Accepted
H7	Environmental Concern (EC) has an indirect positive effect on the adoption of BEVs through consumers' Subjective Norm (SN).	EC --> SN	0,204	0,205	0,023	0,000	Accepted
H8	Environmental Concern (EC) has an indirect positive effect on the adoption of BEVs through consumers' Perceived behavioural control (PBC).	EC --> PBC	0,095	0,097	0,027	0,001	Accepted
H9	Environmental Concern (EC) has an indirect positive effect on the adoption of BEVs through consumers' Moral Norm (MN).	EC --> MN	0,729	0,729	0,011	0,000	Accepted
H10	The profile of the consumer considering experience, gender and education will moderate the relationships among EC and all constructs of the extended TPB and the intention to adopt.	Profile --> All constructs				>0,05	Rejected

5 Discussion

The purpose of this paper was to investigate the factors influencing in the adoption of BEVs in the Spanish market based on behavioural constructs within the TPB. The traditional TPB suggested that consumers' behaviour (in our case, adoption intention of BEVs) is influenced by ATT, SN, and PBC. The TPB model was extended by the constructs of EC and MN, while including an additional dimension of consumer groups based on education, gender, and experience.

To the best of the author´s knowledge, there is no TPB model explicitly applied on a Spanish sample. Spain as Southern European Country still count for less BEVs adoption than other Northern European countries and it is therefore of interest to shed light on the possible BEVs consumers. Referring to the model´s validity and reliability analysis, the results of Cronbach´s alpha and CFA findings confirmed that the SEM model can be used to investigate on consumer's adoption intention for BEVs based on our Spanish sample.

H1 suggested that consumer's attitude towards BEVs is positively related to the AI of BEVs. This assumption can be accepted with a confidence level of 99% based on its p-value of 0,000 and with our second highest path coefficient of 0,422, meaning that consumers´ own attitude towards BEVs do play a significant role when purchasing BEVs. This is in line with the study by Thøgersen & Ebsen (2019) who highlighted the importance of creating more favourable value perceptions to improve the attitude towards the adoption of electric vehicles. This result should be taken into consideration for further promoting the positive benefits consumers receive by adopting a BEV. It is important that consumers create a positive attitude towards this new technology of vehicles. Mohamed et al. (2018) found attitude together with PBC as the strongest factor influencing consumers on the AI for EVs.

H2 stated that consumer's social norm is also positively related to the adoption intention of BEVs. This relationship can be accepted with a confidence level of 99% and a path-coefficient of 0,221. The social pressure plays an important role and reflects its impact on this result of H2. Moon (2020) showed subjective norm to have the strongest impact on the adoption intention of EVs and highlight the "*need to activate social networks for sharing information and knowledge of EVs among society, and it is necessary to have a strategy to reduce misunderstanding and dually increase knowledge of EVs by transmitting relevant information using interpersonal media*" (p. 98). The adoption of BEVs appears to depend significantly on social norm based on this Spanish sample. Du et al. (2018) found SN with the strongest influence on the intention to purchase New Energy Vehicles.

H3 suggested that the consumers' perceived behavioural control is positively related to the intention to adopt BEV, which can be confirmed on a 98% confidence level with a p-value of

0,002 and a path-coefficient of 0,063. Based on this result, in our study, it was found that PBC has the lowest direct impact on the AI of BEVs, which contrasts with Wang et al. (2016) who defined this construct with the second strongest impact on AI. Xu et al. (2019) found PBC to be the most important factor to influence the willingness to purchase a BEV, which is also in line with Zhang et al. (2018) who found PBC the primary factor on positive EV acceptance. Nevertheless, the positive coefficient sign of PBC in our study confirmed that consumers' intention to adopt BEVs increases if consumers perceive BEVs to be accessible. In order to increase the perception of BEVs, it is essential to analyse consumers' perceived ease and the obstacles they perceive to face when adopting BEVs. In addition, the context's infrastructure readiness is also an important factor to consider.

Ultimately, as for the direct impacts tested in this present research model, H4 can also be accepted. H4 claimed that consumer's moral norm is positively related to the adoption intention of BEVs. In our model, moral and social norm showed almost the same impact strength with a path coefficient of 0,214 and 0,221 respectively. When considering the purchase decision of a BEV, consumers seem to rely significantly on their own moral norm to adopt or not a BEV. The positive effect of moral norm is aligned with other previous studies (Adnan et al., 2017, 2018; Du et al., 2018; Mohamed et al., 2016, 2018; Shalender & Sharma, 2020; Wang et al., 2016).

H5 analysed the direct impact of EC towards the adoption intention of BEV. As previously explained, EC has an important impact for the adoption of green products. Therefore, we included the EC construct both with a direct and indirect relation towards AI. As for H5, we suggested that EC have a direct positive impact on the adoption intention of BEVs. However, this assumption cannot be validated based on an insignificant p-value of 0,545 and hence, need to be rejected. This result is in line with Mohamed et al. (2016) and Wang et al. (2016) who did not find a direct statistical significance level of EC towards AI. However, the authors confirmed an indirect impact of EC towards AI via the mediating constructs ATT, SN, PBC, MN. Mohamed et al. (2018) examined the direct effect of EC towards AI which resulted in a nonsignificant p-value. Sang & Bekhet (2015) found a direct positive relationship of EC towards Usage Intention, which is in line with Shankar & Kumari (2019) who found a positive direct relationship of EC towards AI, from an EV-seller perspective based on an Indian sample. Bamberg (2003) already explained that EC cannot have a direct impact on the adoption and therefore, our results support Bamberg's (2003) suggestion, and this finding should be taken into consideration for future research.

H5-H9 reflected the indirect effects of EC toward AI via the previously introduced constructs that served as mediating variables. For H5-H9 the following can be concluded: The constructs ATT, SN, PBC and MN all showed a positive p-value and hence, do play a positive mediating role of EC towards AI of BEV. The indirect, significant effect of EC towards AI via the mediating constructs confirmed previous studies who also analysed the indirect impact of EC (Adnan et al.,

2017, 2018; Mohamed et al., 2016, 2018; Wang et al., 2016). The path coefficient of SN and PBC in our model are 0,204 and 0,095 respectively (see Table 28). The relationships of EC → ATT → AI, EC → SN → AI, and EC → MN → AI can be accepted with a significant p-value of 0,000, and the relationship of EC → PBC → AI with a p-value of 0,001. Especially the strong impact of the path coefficients of EC towards MN (0,729) and of EC towards ATT (0, 327) must be taken into consideration. Mohamed et al. (2018) found EC with the highest impact on personal moral norm, compared to ATT, SN, PBC, which is in line with our results. The result of MN showed again the importance and the power of influence moral beliefs can exert towards BEV adoption intention.

Regarding H10, there is no statistical difference between the groups which was analysed with the multigroup analysis. Therefore, H10 is to be rejected. Considering the impact of the constructs per group, we see in Table 27 that PBC is not statistically significant for the groups of being male. All other constructs exert the same impact for both groups.

In summary, among all constructs with a direct impact toward AI, the impact of attitude (ATT) towards adoption intention (AI) is the strongest with a path coefficient of 0,422. This is in line with the study by Mohamed et al. (2018) who found attitude and perceived behavioural control to have the strongest effect on AI. Moreover, the five constructs in our model explained 48% of the variance of the endogenous constructs AI (R^2 = 0,480). Among the indirect impacts, the strongest one carries out MN as mediating variable of EC towards the Adoption Intention of BEVs. Therefore, it is important to highlight the impact consumer's moral norm and beliefs have on BEVs adoption intention. Referring to the created control variable "profile" that includes experience, gender, and education level, we could conclude that there is no significant difference between the two different groups created (Profile Man with experience and higher education; and Profile Women without experience and less education).

In conclusion, the validated factors of the constructs ATT, SN, PBC, MN, EC provide a good reliability for prediction EV adoption intention. The findings of the relationships between the constructs towards adoption intention helped to validate our hypotheses and were largely consistent with current literature.

Taking into consideration the importance of reducing GHG emission especially for the transport sector, BEVs are considered as promising solution. BEVs are recognized a novel technology with high potential to provide environmental benefits.

6 Conclusions

In this research, we applied the TPB which is a valid theory to explain consumer behavioural intentions to adopt EVs. The original TPB was extended by moral norm and environmental concerns to conduct a comprehensive analysis of consumer´s intention to adopt EV. Environmental concern was investigated both as a direct and indirect impact towards AI. Additionally, the variable experience was included in a newly created consumer dimensions formed by gender, education, and experience. PLS structural equation analysis was applied to analyse the data with 1.816 participants and to test the research model. The results of this research confirmed the appropriateness of the extended TPB.

Based on the validity check, some items were incompatible with the model´s requirement and were deleted (Att4, PBC2, SN4, AI2). The invalidity of item AI2 which belonged to the construct "adoption intention" was detected when doing the collinearity statistics (VIF) as part of CMB in the beginning. AI2 had to be deleted to fulfil CMBs requirements but did not impact on the rest of model´s analysis.

In this research, the focus was on consumers' intention to adopt BEVs, which are accepted as possible mean to reduce the CO2 carbon footprint and therefore regarded as promising solution in the transport sector. In summary, the present research creates valuable contribution to the literature which are listed as research highlights in the following:

1) Applying the extended TPB on a Spanish sample
2) Focus on BEVs which are considered as cleaner and technological more different than other EV such as PHEV or HEV
3) Focus on experience
4) Primary data set with 1.816 responses

In conclusion, the results of this research should help future studies to focus further on consumer behaviour on real BEV adoption.

6.1 Practical Implications

With this study, we gave evidence of the impact of consumer's attitude, social norm, perceived behavioural control, moral norm, and environmental concerns. According to the results, all constructs exerted a positive impact on the adoption intention of BEVs. The results help governments and industry to better define campaigns towards fully BEVs in order to increase their awareness and to promote environmental benefits. It is important that the perceived risk linked with BEVs will be reduced by focussing on the benefits these vehicles bring. In this context, consumers' environmental concerns with its positive impact towards the actual adoption need to be taken into consideration. If consumers have a higher level of environmental concerns,

it positively impacts on the defined constructs such as consumers' attitude, perceived behavioural control, social and moral norm. In the present model, especially attitude and moral norm exerted a stronger influence on consumers AI for BEVs. Governments should try to strengthen one's moral responsibility to protect the environment and the planet we all live in. Therefore, politicians and marketers should support the positive image and information availability of BEVs within society. This could be achieved for example with more vehicle shows, demonstration test drives, and marketing campaigns.

6.2 Limitations & Future Research

There are some limitations of this study and suggestions for future research that need to be pointed out. Above all, the present study takes into consideration the adoption intention and not real adoption. However, in line with the TPB by Ajzen (1991) the adoption intention can be considered as immediate determinant for actual behaviour and thus, the results of this study are valid. Nevertheless, future research could enrich this empirical evidence by focussing on real adoption of BEVs, which besides will be easier in the future once consumer adopt BEVs on a more scalable level. As previously explained, the construct "ATT" exerted the strongest direct impact (0,422 path coefficient) on the adoption intention of BEVs. Therefore, future research should focus on the importance and the power of influence of consumers' attitudes towards specific behaviours in pro-environmental research. Additionally, future research in behavioural attitudes of consumers could closer analyse the impacts of feelings and emotions. Dong et al. (2020) extended the TPB model with the norm activation model and included "feelings and emotions" as constructs that affect purchase intentions for EVs. Zhou & Thøgersen (2013) included values and the Schwartz values system in their TPB model to understand environmental behaviour. There is not much empirical research that include personal values on consumer-decision making, and therefore future research could enrich present literature with a focus on such values. When analysing consumer behaviour, it is important to consider that consumers are not homogenous. Additionally, it would be of interest to realise a cross-country study to highlight the differences between cultural perceptions. The present study focused on a Spanish sample to enhance literature with this cultural collective; however, future study should analyse deeper the cultural differences between different contexts. Current rising environmental concerns with intents to lower drastically CO2 emission highlight the importance of doing research in this area. Therefore, future study should also focus on BEVs as the most innovative technology of vehicles compared to PHEV o normal hybrid vehicles. Ultimately, future study should analyse the impact the influence of purchase price (see Bhutto et al., 2020) and (governmental) subsidies for BEVs (see Wang et al., 2017; Xu et al., 2019; Zhang et al., 2018).

IV) General Conclusions of Dissertation

Conclusions

In this chapter, the final conclusions of the complete dissertation (Chapter 1-3) are summarized.

7 Summary and Contributions

This dissertation contemplates three main chapters focussing on consumer behaviour for the adoption of EVs based on theoretical and empirical evidence. In Chapter 1 of the Doctoral thesis, different theoretical approaches and frameworks examining consumer behaviour, purchase intention or/and actual adoption for EVs are analysed within a systematic literature review. The paper reviewed in total 49 publications according to the explained process selection. The number of articles dealing with EVs consumers adoption in literature has considerably increased from 2018 on. Selected studies, mainly executed in China, America, or European Nordic countries, give a profound understanding and proposal for different theories that can be applied for consumer behaviour in pro-environmental research. Importantly and in line with several of the analysed studies, consumer perceptions significantly impact their behaviour and consequently their acceptance towards EVs. The objective of Chapter 1 was a systematic literature review of different theories applied for the purchase intention and adoption of EVs. Consumer behaviour has been analysed with different theoretical frameworks. There are various theories available for investigating consumers behaviour and their adoption of EVs, however the main approaches focus on the Theory of Planned Behaviour, established by Ajzen (1991). Several authors have extended this theory with new constructs to comply with their research scope, and the results verified the relevance of the (extended) TPB, demonstrating that it has a good explanatory power to predict consumers´ intention to adopt EVs. Although there are limitations of this theory, it is recommended for studies with a focus on pro-environmental (new) products. Based on the extensive systematic literature review, existing gaps in the literature were identified and the TPB was identified as the framework to apply for Chapter 3. The research conducted in Chapter 1 with its knowledge sharing should also help future researchers to focus directly on an adequate theory that meets their own research objectives. The conceptual frameworks and research methodologies of the reviewed studies should serve as a foundation. In general, all studies reviewed in Chapter 1 share the opinion that there is a strong concern for the environment and a strong believe that a different behaviour is required from consumers, politicians, and industries to solve the environmental problems we are facing. However, many studies prevail that consumers are rather looking for image and reputational reasons than truly caring for the environment when adopting EVs. It is also important to understand the different typologies of EVs, as a pure BEV will certainly elicit a different purchase behaviour than, for example, mild hybrid vehicles, which is technically less different from a consumer point of view.

Chapter 2 presents in a very complete and systematic way the impact of different research areas on consumer behaviour for EV adoption, that are often separately investigated in present literature. It includes 1) the sociodemographic variables of consumers and the impact of experience, 2) car attributes that might influence the probability of purchasing an EV and 3)

environmental settings such as governmental support schemes and infrastructure development on the preference for EV, additional to the findings of how consumer preferences would change if purchase prices were the same for both BEV and ICE vehicles. In order to meet the research objectives, the chapter analysed the hypotheses with two models and two different dependent variables. The second approach worked under the hypothetical case that all cars cost the same and gives valuable information of consumers opting for EVs if they had the same price as ICEVs. In doing so, the study is one of the first to investigate consumer´s behaviour and purchase adoption regarding EVs with three aspects (sociodemographic, car attributes, environmental settings) and two different dependent variables. The study addresses environmental and sustainability research with a focus on consumer perspective and helps to give a profound understanding to the reader and test the results´ validity. The results derived from logit regressions in Chapter 2 help to statistically validate the hypotheses which are based on previous studies. Analysing the heterogeneity of driver´s willingness to purchase an EV is important for public-decision-makers to understand market and consumer segmentation. Referring to socioeconomic factors, there are contradictory results in current literature, for example some studies found that educational level, age, or income are positively related to the perception of EVs, and other studies negating this. At the same time, there is a common understanding that sociodemographic variables do exert significant influence. In summary, in Chapter 2 we could show that a higher education and higher salary, as well as having children and living in urban areas instead of rural areas and owning a vehicle positively impacts on the adoption of an EV. Also, the fact of having had previous experience with an EV increases the probability of adopting an EV, which is in line with previous research (Liu et al., 2020; Xu et al., 2020; Rauh et al., 2020; Schmalfuß et al., 2017; Hahnel et al., 2014; Schmalfuß et al., 2014; Jensen et al., 2013; Peters and Dütschke, 2014). This is an interesting variable that has been analysed exclusively in some other studies. We found that experience was more common in a particular socio-demographic group: men with higher salaries who live in suburban areas tended to have EV experience. In addition, a higher range of EV as so-called “car attribute” seems to positively impact the adoption of EVs. The second model highlighted the importance for status and reputation for consumers when adopting an EV. The study suggests that the more consumers are driven by reputation, the less they opt for an EV in the situation that EVs cost the same, which is an interesting finding. Subsequently, being reputation-driven seem to positively influence the purchasing decision for EVs only if these cars are more expensive. In line with previous literature, it can be assumed that people tend to be more concerned about status value, whereas environmental issues are not priority. Based on this structural approach, the findings and recommendations help validate the present research literature to improve the utility of future studies. By highlighting the importance of reputation, the research gives valuable information about consumer’s behaviour.

The purpose of Chapter 3 was to investigate the factors influencing on the adoption of BEVs in the Spanish market based on behavioural constructs. As explained in Chapter 1, the TPB by Ajzen (1991) was the most adequate theory to do so. Contingent upon the original TPB, the factors of "attitude", "subjective norm" and "perceived behaviour control" are analysed, extended with "moral norm" and "environmental concern" to conduct relevant psychological factors with a comprehensive analysis of consumer´s intention to adopt EV. EC was included both as a direct and indirect impact towards adoption intention of BEVs. Additionally, the variable "experience" was included in a newly created consumer dimensions "profile" formed by gender, education, and experience to see their impact on the relationships of the different constructs towards adoption intention. A structural equation modelling with SmartPLS4 was applied to analyse the structural relationships with data of 1.816 participants and to test the research model. We found that ATT, PBC, SN and MN do exert a direct positive impact on the adoption intention whereas EC does not show a direct impact, but a strong indirect impact towards AI via the other constructs. Consequently, consumers' environmental concerns with its positive impact towards the actual adoption need to be taken into consideration. If consumers have a higher level of environmental concerns, it positively impacts on the defined constructs such as consumers' attitude, perceived behavioural control, social and moral norm. Referring to the constructs, attitude and environmental concern towards moral norm exerted the strongest influence on consumers AI for BEVs, which is in line with previous literature. In terms of the variable "profile" there is no statistical difference between the groups. Except for the construct PBC which is statistically not significant for the group of being male, all other constructs exerted the same impact for both consumer groups. The results are very helpful to understand consumer behaviour further. The results of this research confirmed the appropriateness of the extended TPB. Referring to the model´s validity and reliability analysis, the results of Cronbach´s alpha and CFA findings confirmed that the SEM model can be used to investigate on consumer's adoption intention for BEVs. By applying this framework, the study contributes to filling the literature gap for research studies in consumer behaviour for environmental-friendly products. The study focusses on BEVs, thus adding further value to the literature by focussing on a technology which is considered different and more complex compared to traditional or Plug-in vehicles. Furthermore, based on the empirical results, this study concludes practical contributions that provide valuable guidance for policymakers and industry to promote the adoption of EVs. With its structural approach, the thesis in its entirety provides valuable contributions for the academic, public, and industrial sectors. As explained in the individual chapters, the study fills an existing gap in the literature on consumer behaviour regarding the adoption of EVs based on a Spanish sample set.

7.1 Practical Implications and Policy Recommendations

First, the understanding of consumer behaviour helps both companies and governments. Institutions can only develop new products or adjust their marketing campaigns if they understand the forces that drive consumers' motivation to adopt or not adopt a certain product. As Sundareswaran et al. (2022) explained: "*Understanding consumer behaviour is important for companies to succeed with their current product and introduce new ones*." (p.83). Therefore, the conclusions of the doctoral thesis allow for a better understanding of consumer behaviour when adopting EVs.

Several studies have demonstrated that the adoption of EVs is likely to be limited without significant governmental incentives. Given the low market penetration of EVs, incentives are considered one of the prerequisites for changing the environmental behaviour of consumers. Current political promotions in several European countries, partially due to Covid-19 impact towards the automotive industry, could help to increase BEV market penetration and take away consumers' remaining hesitation. It is empirically shown in Chapter 2 that governmental incentives help to increase the probability of buying an EV, confirming earlier findings. For the Spanish market, the government has already put in place the new "MOVES III" support in 2021, which is an aid program to encourage the purchase of electric, plug-in hybrid and fuel cell vehicles. This grant aims to encourage electric mobility and, in particular, the purchase of EVs and the deployment of charging infrastructure for these vehicles.

In addition, the government and industry should encourage the availability of information. Since EVs are often associated with poorer performance, information diffusion and information availability are required both by government and industry. Ideally, more test drives are offered to show the real potential of these vehicles and make consumers acquiring driving experience of EVs, as one of the drivers to adopt EVs. The current-in-place greenhouse gas emissions limits will also help to promote EVs on a broad scale. It appears that many potential adopters of EVs are unaware of or are not convinced by the recent improvements in EV technology and charging infrastructure. Consumers are more likely to buy green cars when they perceive their true benefits and positive consequences of green cars (Ozaki & Sevastyanova, 2011). Consequently, consumers hold negative expectations about the hassle and inconvenience of owning an EV, which greatly reduces their purchase intention. Several studies have shown that consumer resistance to new technological methods hinders a faster market penetration of EVs.

In line with this information availability, a solid and reliable infrastructure should be introduced to promote a higher market share of sustainable technologies and to yield a sustainable environment and a different perception of EVs. It is critical to alleviate consumer's anxiety of not knowing where and how to recharge an EV. In order to overcome these challenges, policymakers

and industry are challenged to better disseminate information and create incentives to push new technologies.

Furthermore, in Chapter 3, evidence is given of the impact of consumer's attitude, social norm, perceived behavioural control, moral norm, and environmental concerns. The results help governments and industry to better define their campaigns towards fully battery electric vehicles to raise awareness and to promote environmental benefits. It is important to reduce the perceived risk linked with BEVs by focussing on the benefits of these vehicles. Consumers' environmental concerns with its positive impact towards the actual adoption need to be taken into consideration. In the model, especially attitude and moral norm exert a stronger influence on consumers AI for BEVs. Governments should try to strengthen consumers' moral responsibility to protect the environment and the planet. Therefore, politicians and marketers should promote the positive image of BEVs in society. This could be achieved, for example, through more vehicle shows, demonstration test drives, and marketing campaigns.

7.2 Limitations and Future Research

Although the chapters of this dissertation allow useful conclusions to be drawn, some limitations must be pointed out. At the same time, this subchapter highlights interesting directions for future research.

The literature review in Chapter 1 provides a global overview based on the keyword combination "electric vehicles", "theory" and "adoption". However, this may not include some other studies with the same or a similar objective that focus on "behaviour" or "purchase" rather than "adoption".. Future research could use a different keyword combination to overcome this limitation. At the same time, the research focuses only on the WoS platform and different results could be yielded on other academic platforms. Moreover, the focus on "EV" as keyword could exclude more specific studies that directly introduced a different type of electric vehicle. Nevertheless, it is recommended to clearly distinguish between the different vehicle types and ideally to focus on pure BEVs. It could be treacherous to generalize results from AFVs towards BEVs. This limitation was already addressed in Chapter 3 with the focus on BEV-only vehicles. Current rising environmental concerns and the intents to drastically reduce CO2 emissions highlight the importance of conducting research in this area.

Consistent with most studies in recent literature, the chapters focused on the intention rather than the actual adoption of EVs/ BEVs. This is acceptable given the literature and the current low market share for EVs. However, once EVs are better adopted by society, future research might focus on actual adoption rather than the intention itself. In line with the TPB by Ajzen (1991) the adoption intention can be considered as immediate determinant for actual behaviour and therefore, our results of this study are valid.

According to the previous conclusions and the positive impact of governmental incentives on EVs adoption, future research is recommended to investigate further on the impact of different incentives provided for environmental-friendly cars. Additionally, it would be interesting to realise a cross-country study to shed light on the differences between cultural perceptions. The present study focused on a Spanish sample to enrich existing literature with this cultural collective. However, future study should analyse deeper cultural differences between different contexts.

In addition, it is important to consider that consumer behaviour can change over time, and it would be interesting to see how status-, reputation- and image-focussed behaviour will change once EV are more accessible to all consumers. It is critical to deal with consumers´ attitudes and preferences to achieve greater success in adopting sustainable means such as green vehicles.

Moreover, future research should analyse the role of car brands in the adoption process of EVs. Do consumers prefer a particular brand? What is the influence of luxury brands (e.g., Mercedes, Porsche, Tesla, Audi), which may provide a higher status in society, compared to general brands such as VW, KIA, Renault, Nissan? There is very little to almost no comparative research on the influence of automotive car brands on the purchase decision for EVs, so this line of research is highly recommended.

Furthermore, it must be pointed out that the raise of EVs adoption is not free of criticism; there are some papers analysing the negative impact that the use and the production of EVs might have on the environment, and the harms of EV electricity consumption (see Henderson, 2020). Battery recycling policies could help to further promote the adoption of EVs (see Huang et al., 2022). Accordingly, future research should follow a holistic view when analysing EVs as a sustainable solution for the transport sector. And finally, in order to provide complete information, it is worth noticing that EVs are not an innovation of recent years but had their beginnings already more than a century ago. The new interest and demand for EVs can therefore be defined as a revival. In addition, it should be highlighted that while transportation has become more efficient with new vehicles emitting less CO2 than vehicles in the past, the growing volume in the transport sector (including cars, ships, planes) has increased and jeopardizes the EU´s target of reducing greenhouse gas emissions by 90% by 2050 compared to 1990 levels.

Consistent with everything else and related to the TPB, future research should focus on the importance and power of influence of consumer attitudes on specific behaviours in pro-environmental research. Future research in consumer behaviour could further analyse the effects of feelings and emotions. Dong et al. (2020) extended the TPB model with the norm activation model and included “feelings and emotions” as constructs that affect purchase intentions for EVs. Zhou & Thøgersen (2013) included values and the Schwartz-Values system in their TPB model

to understand environmental behaviour. When analysing consumer behaviour, it is important to consider that consumers are not homogenous, and their behaviour is not static.

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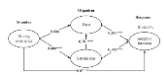
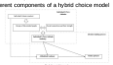
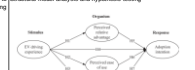
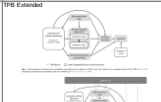
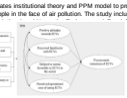
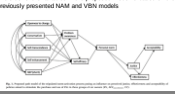
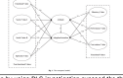
9 Appendices

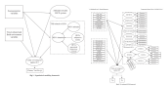
Appendix 1: Extended Literature Review Chapter 1

Authors	Titel	Year	Keywords	Research Question/ Aim	Type of Vehicle	Context	Sample	Hypothesis	Theoretical Framework	Method	Main Results	Limitations/ Future reccomendations
Xu, Guowei; Wang, Shanyong; Zhao, Dingtao	Transition to sustainable transport: understanding the antecedents of consumer's intention to adopt electric vehicles from the emotional research perspective	2020	Sustainable transport . Stimulus-organism-response framework . Driving experience . Trust . Satisfaction . Adoption intention Introdu	Does driving experience (S), one of the external stimuli, directly affects consumer'sadoption intention of EVs (R)? Will driving experience (S) triggere consumer's emotional state (O) (e.g., satisfaction and trust) towards EVs and indirectly affects the adoption intention (R)?	EVs	China (Beijing, Shanghai, Chongqing, Xi'an, and Hefei)	n=692	Consumer's EV driving experience positively affects trust in Eve Consumer's EV driving experience positively affects satisfaction with EVs. Consumer's satisfaction with EVs positively affects trust in Eve Consumer's trust in EVs positively affects adoption intention. Consumer's satisfaction with EVs positively affects adoption intention. EV driving experience positively affects consumer's adoption intention.	Stimulus-organism-response" (S-O-R) framework: one of the foundations of modern cognitive psychology. The core idea of S-O-R model is to assume that the effect of external stimulus on individual be- havior is mediated by individual cognitive and emotional states. stimulus (S) is referred to the external factors which can cause an individual's cognitive and emo- tional state 	Each variable is reflected by a certain number of measurement items, which were derived from previous research. Structural equation model with a partial least square (PLS-SEM) approach was used to estimate the research model and test the research hypotheses. SmartPLS 2.0 software was employed, and the bootstrapping method in PLS was used to obtain Tvalue for the significance test. The	The results show that driving experience can not only directly but also indirectly affects adoption intention via satisfaction. Specifically, driving experience has a signifi- icant positive impact on satisfaction but has no significant impact on trust. Driving experience, satisfaction, and trust all have a significant positive impact on adoption intention. Satisfaction not only plays a mediating role between driving experience and adoption intention but also plays a multiple mediating roles between driving experience and adoption in- tention together with trust. 	In order to build a concise research framework, this research only focused on driving experience. Other exter- nal stimulus such as brand, information, and policy are not considered. the research data was only collected in China, which may limit the universality of the research results. Future
Zolfagharian, Mohammadreza; Walrave, Bob; Romme A. Georges L.; Raven, Rob	Toward the Dynamic Modeling of Transition Problems: The Case of Electric Mobility	2021	electric mobility; transition studies; technological innovation system; unified theory of acceptance and use of technology; system dynamics; entity-based perspective	Study sheds light on the micro-macro links by modeling the entity types and clarifying the effects of various theories in the simulation results. Model of EV adoption to subsequently consider the influence of macro-variables in TIS and the micro-theory of UTAUT. This multi-level approach helps to better understand the dynamics arising from top-down versus bottom-up processes in any transition	AFVs/ Evs	Netherlands	data on number of EVs, (public) charging points, and potential EV purchasers + secondary data such as policy notes and weblogs, public databases	NA	Technological Innovation Systems (TIS) framework as well as the Unified Theory of Acceptance and Use of Tech- nology (UTAUT). These two theories are selected because they (a) adequately reflect the entities mentioned, utilizing key variables in each entity type [25,26] and (b) are sufficiently aligned with each other such that they can be combined in a single model. TIS informs the macro-level structure of EV diffusion, whereas UTAUT describes the micro- level structure of an e-mobility system, including the decision rules that guide the behavior of individual actors. The Unified Theory ofAcceptance and Use ofTechnology e-mobility transition in the Netherlands using an entity-based SD model. --> The simulation modeling approach adopted appears to enable a more in-depth study of transition problems related to e-mobility	System Dynamics Modeling In the context of transportation systems, System Dynamics (SD) modeling is especially appropriate because it serves to reveal underlying system structures and the transition dynamics arising from these structures. Furthermore, SD can assist in developing exper- imental transport tools to explore various transport policies and provide a platform for learning about transport problems [72]. 	The transition to e-mobility is highly complex [12,125–127], and, as a result, the uptake of EVs has been lower than expected in most countries [128]. we presented a rather comprehensive but parsimonious model of the e-mobility transition. In our case, the number of EV adopters can be explained from the dynamic interactions of e-mobility innovation functions at the macro level. our model also depicts the relations between EV markets and changes in e-mobility policies in terms of EV-related subsidies and resource mobilization, among others our study is among the first to present a model that considers the detailed macro-and micro-level interactions—and the complex dynamics arising from such interactions—associated with the EV transition process. market segmentation may serve to better understand how transition policies and strategies can target different classes of consumers.	For one, the entity of EV purchasers is mainly based on the UTAUT framework, but we did not include several variables in this framework—for example, "habit" as a behavioral characteristic and moderator variables such as "education." Second, we have acknowledged various characteristics of adopters in the model but have not allowed for any interactions between these individual consumers. Future work in this area may therefore seek to extend our multi-level model with an agent-based module, for example, [130]. hird, we assumed that consumers only have one characteristic (e.g., age, income) in conducting simulation runs. Here, future research can also examine e-mobility development by considering agents with compound characteristics
He, Zhengxia; Zhou, Yanping; Wang, Jianming; Li, Cunfang; Wang, Meiling; Li, Wenbo	The impact of motivation, intention, and contextual factors on green purchasing behavior: New energy vehicles as an example	2021	green purchasing behavior, intention–behavior gap, motivation, new energy vehicles, qualitative study, sustainable development 1	The main contribution of this study is to expand the MOA model, expanding the contextual conditions to include four components: reso- dents' characteristics behavioral ability, social norms, and institutional and technical contexts.	new energy vehicles NEV	China	36 interviewees + 16 individual in- depth interviews + 5 groups focus group	In this study, we employed a qualitative approach to examine the drivers for green pur- chasing behavior in China. NA	grounded theory for a quali- tative analysis, the results of which show that behavior motivation, behavior inten- tions, residential characteristics, social norms, behavior ability, and institutional and technological context are the main factors of green purchase, albeit in inconsistent ways Through the previous analysis, it is found that the integration model of "Motivation–Intention–Context–Behavior" can effectively explain the driving mechanism for NEVs purchase.	Grounded Theory + Motivation–Intention–Context–Behavior 	behavior motivation indirectly affects green purchase through behavior intention; residents' characteristics, behavioral ability, social norms, and the institutional and technological context have moderating effects on the relationship between behavior intention and green purchase, indicating the existence of an "intention–behavior" gap. Considering the above-mentioned mechanism, this study divides the external contextual factors affecting NEVs purchase into two cat- egories: social norms and the institutional and technological contexts. According to the results of this study, social norms and institutional and technological contexts have moderating effects between the pur- chase intention and the actual purchase behavior for NEVs. Specifically, residents' characteristics, green purchasing behavioral ability as HE ET AL. 17 internal contextual factors, social norms, and the institutional and technological contexts as external contextual factors can explain the formation of the "intention–behavior" gap to a certain extent.	Our findings highlight the need for a deeper understanding of contex- tual factors to moderate the "intention–behavior" gap in green pur- chasing behavior. In future research, we will collect survey data to test the unique mechanism model in this study and conduct quantitative research on the relative effectiveness of the different factors driving green pur- chasing behavior, to generate more quantitative and operational sug- gestions for the design of relevant policies. Additionally, we may conduct simulation research on relevant policies, to reflect the com- plex action path of policies on green purchasing behavior more comprehensively
Manca, Francesco; Sivakumar, Aruna; Daina, Nicola; Azevedo, Joao; Polak, John W.	Modelling the influence of peers' attitudes on choice behaviour: Theory and empirical application on electric vehicle preferences	2020	Social influence Correlated effects Social network Individual's peer attitudes Hybrid choice models Electric vehicle preference	In particular, we use three HCM specifications to test whether the IPA variable (a) directly affects the utility of an alternative as a source of systematic preference heterogeneity; (b) affects the unobserved component of the utility of an alternative by explaining (part of) the covariance of a latent attitude, or (c) represents a manifestation of such a latent attitude, i.e. it is an indicator of the latter, albeit 'indirect' as it is elicited indirectly from peers' attitudinal indicators instead of from a 'direct' response of the individual.	EV/ BEVs	UK	n= 105 employees	Individual's peer attitude (IPA) H1. The IPA variable has a direct effect of the peers' attitudes on the utility function. The individual's peer attitudes affect the utility (i.e. preferences) as a simple characteristic of the individual to capture unobserved heterogeneity explaining the decision making process. H2. The IPA variable characterizes the latent attitudinal characteristics of the individuals and, therefore, indirectly affects the utility by explaining (part of) the covariance of the attitudinal latent construct. H3. The IPA variable is an indirect manifestation of the underlying latent attitudinal characteristics of the individual.	We present a systematic analysis of how to best specify an HCM to capture the effects of the IPA variable.To understand its behavioural implications on the individual's choice, the in- dividual's peer attitude variable is tested in different components of a hybrid choice model HCM = hybrid choice models 	Exploratory factor analysis and cluster analysis to identify individuals' attitudes 	To understand its behavioural implications on the individual's choice, the in- dividual's peer attitude variable is tested in different components of a hybrid choice model. Our results show that the inclusion of this variable indirectly affects the decision making process of the individual as the peers' attitudes are significantly related to the latent attitude of the in- dividual. On the other hand, it does not seem to directly affect the utility of an alternative as a source of systematic heterogeneity nor does it work as a manifestation of the latent variable, i.e. as an indicator The results also show that the peers' attitude is a significant explanatory variable of an individual's attitude, as shown by the significance of the IPA variable in the structural model of the second HCM specification	In an ideal situation, all the employees of the workplace should have been interviewed to have a precise measure of the information needed. n the present study, the possible bias generated by interviewing only a proportion of employees is minimised by the name generator approach adopted to collect the data.
Sheldon, Tamara L.; Dua, Rubal	Effectiveness of China's plug-in electric vehicle subsidy	2020	Plug-in electric vehicle Subsidy Fixed fuel economy	we ex- plore the impact and cost-effectiveness ofthe Chinese PEV subsidy program. This paper seeks to shed light on the effectiveness of these subsidies with the intent of informing policy makers in the face of future program uncertainty.	plug-in electric vehicle (PEV) adoption	China	J.D. Power survey data - covers 67 cities n = 23,993	NA	A vehicle choice model is estimated using a large, random survey sample ofnew vehicle purchases in China. The estimation results are used to predict PEV sales if subsidies were eliminated	a vehicle choice model is estimated using a large random sample of individual level. The choice model is then used to predict PEV market share under alternative policies. Vehicle choice models and market share predictions are esti- mated separately for each subsample. Within this combined MCDM-RUM approach, the vehicle attri- butes enter the RUM function as cost per perceived value, denoted in the model by CPPVi. We	Simulation results suggest that the 2.5% PEV market share of Chinese new vehicle sales in 2017 resulted in China's new vehicle fleet fuel economy improving by roughly 2%, reducing total gasoline consumption by 6.66 billion liters. Eliminating the subsidy for high income consumers and increasing it for low income consumers could result in a substantially lower cost per additional PEV ($23,758 versus $24,506). This would allow for greater PEV adoption (3.11% versus 2.47% market share) for the same budget. In terms of the impact of the recently announced subsidy reduction, results suggest that the PEVmarket share in China would have de- clined by21% had the subsidy been halvedwithout any countervailingmeasures. Using the same reducedbudget, had zero PEV subsidies been given to high-income consumers and higher subsidies been given to low-income consumers, the PEV market share would have declined by only 8%.	
Dong, Xiaoyang; Zhang, Bin; Wang, Bo; Wang, Zhaohua	Urban households' purchase intentions for pure electric vehicles under subsidy contexts in China: Do cost factors matter?	2020	Pure electric vehicles Cost factors Purchase intentions Chinese urban households	To explore whether cost factors influence Chinese urban households' purchase intentions for electric vehicles under subsidy contexts	pure electric vehicles	China	n= 1021 samples	• H1: Personal norms positively influence purchase intentions for pure electric vehicles. • H2: Positive emotions and feelings positively influence purchase intentions for pure electric vehicles. • H3: Subjective norms positively influence purchase intentions for pure electric vehicles. • H4: Perceived behavioral control positively influences purchase intentions for pure electric vehicles. • H5: Residents' awareness of consequences of private cars positively affects their personal norms. • H6: Residents' ascription of responsibility of private cars positively affects their personal norms. • H7: The effects of cost factors on purchase intentions for pure electric vehicles are uncertain. Econ	We extended the theory of planned behaviour with the norm activation model as the theoretical framework and utilised a structural equation model 	We built the van Westendorp price sensitivity model to measure urban households' price preferences for pure electric vehicles. we established models to evaluate the influences of awareness of consequences, ascription of responsibility, personal norms, feelings and emotions, subjective norms, perceived behavioural control, and cost factors on household purchase intentions for pure electric vehicle.	The results indicate that under subsidy contexts cost factors do not significantly influence urban households' purchase intentions for pure electric vehicles in China, and people are more concerned about cruising power and charging-facility availability. Besides, subjective norms, feelings and emotions, personal norms, and perceived behavioural control affect urban households' purchase intentions. Influencing factors vary from household groups with or without cars. Urban families' acceptable price range for pure electric vehicles is CNY85,000 to CNY120,000.	There are some limitations to our study: it is based on a questionnaire survey, so the results are thus subjective. Besides, limited by time and research costs, we investigated the respondents' purchase intentions towards pure electric vehicles, but did not track their actual purchasing behaviours. Furthermore, we did not conduct qualitative research with respondents to dive deep into consumers' attitudes to, and cognition of, pure electric vehicles. n future research, we will aim to analyse purchase intentions using multi-source data including automobile sales website data, travel records, and geographic information, which can render our analysis more objective. In addition, a longitudinal cohort analysis will be conducted to track and analyse changes in residents' behaviours.
Shalender, Kumar; Sharma, Naman	Using extended theory of planned behaviour (TPB) to predict adoption intention of electric vehicles in India	2020	Automobile . Conventional vehicles (CVs) . Electric vehicles (EVs) . Environment . TPB . Sustainability	For measuring the adoption intention, the research utilizes a total of five determinants—three determinants from TPB theory [attitude (AT), subjective norm (SN), and perceived behaviour control (PBC)] and two determinants from extended TPB theory [moral norm (MN) and environmental concern (EC)].	Evs	India	n=326	The adoption attitude is positively related to intention to adopt EVs. 2. The subjective norm is positively related to intention to adopt EVs. 3. The perceived behaviour control is positively related to the intention to adopt EVs. 4. The moral norm is positively related to the intention to adopt EVs. 5. The environmental concern is positively related to the intention to adopt EVs		The study uses partial least square method. It is a structural equation modelling (SEM) technique and has been used in the test to test hypothesis and examine whether the survey data fit well into model proposed by the study. PLS involves a two-stage model testing process: stage one testing constructs for reliability and validity and stage two depicting the relationship between constructs and then examining the overall model fit. The concept of Construct validity is entirely different from the reliability. It reflects that an instrument actually measures the latent variable it intends to measure theoretically. This means construct validity deals with the accuracy of measurement (Hair et al. 1998). It is established by (a) convergent validity and (b) discriminant validity After obtaining the satisfactory measurement model, we conducted a structural model analysis, and results are given in Table 4.	The empirical analysis of the study shows that attitude, subjective norm, perceived behavioural control, moral norm, and environmental concern have a positive relation with adoption intention of buyers. The findings of study also suggest that extended TPB model is appropriate in pre- dicting the adoption intention of the customers towards the EVs.	the study focuses on adoption intention of the customers rather than their actual adoption behaviour. No doubt the behavioural intention is most important determinants of the actual behaviour, there exists a fine line of differ- ence between the intention to adopt and actual adoption (Ajzen and Fishbein 1980) and hence adoption intention does not necessarily mean the actual adoption. To further enrich the conclusions of research, scholars need to further research the actual adoption behav- iour of the respondents using various interview and survey techniques. Secondly,
Bhutto, Maqsood Hussain; Tariq, Beenish; Azhar, Sanwar; Ahmed, Khalid; Khawaja, Faiz Muhammad; Han, Heesup	Predicting consumer purchase intention toward hybrid vehicles: testing the moderating role of price sensitivity	2020	PLS-SEM, Theory of planned behaviour, Automobile industry, Greenhouse gases, Consumer purchase intention, Hybrid vehicles	Hence, underpinned into the theory of planned behaviour (TPB), this study aims to analyze consumers' response in terms of GPI for HVs, in addition to exploring the moderating-effect of price-sensitivity between independent-variables (attitude, subjective norms and perceived behavioural control) and consumers' GPI for HVs.	hybrid-vehicles (HVs)	Pakistan	n= 266 automobile-consumers with the help of questionnaires	H1. Consumer attitude positively influences consumer purchase intention for HVs. H2. Subjective norms positively influence consumer purchase intention for HVs. H3. Perceived behavioural control positively influences consumer purchase intention for HVs. Relationship H4. PS positively influences consumer purchase intentions for HVs. H5. PS plays the role of moderator between the relationship of attitude and purchase intention in a way when the PS is high, the relationship between attitude and purchase intention will be strengthened. H6. PS plays the role of moderator between the relationship of subjective norm and purchase intention in a way when the PS is high, the relationship between subjective norm and purchase intention will be strengthened. H7. PS plays the role of moderator between the relationship of perceived behavioural control and purchase intention in a way when the PS is high, the relationship between perceived behavioural control and purchase intention will be strengthened. Methodology 	In line with the nature and quintessence of this study, the underpinning theoretical framework adopted by this study is the "theory of planned behaviour" (TPB) introduced by Ajzen (1991, 2002) and Ajzen and Fishbein (1977), which entails the constructs such as "attitude, subjective norms and perceived behavioural control" as the basic determinants of consumer-purchase-intention. A	The present study used the partial least squares structural equation modelling (PLS-SEM) to test the conceptual model using Ajzens' TPB model. PLS-SEM Besides, the objective of this study was to predict the consumer purchase intention, which made PLS-SEM the most suitable choice for conducting the analysis (	First, significant empirical-evidence was secured regarding the impact of given independent- variables (i.e. attitude, subjective norms and perceived behaviour control) on consumer's GPI for HVs. Second, the empirical-evidence for the moderating effect of price-sensitivity onto the association between given independent-variables (except for the perceived-behavioural-control) and the consumers' GPI for HVs, also turned out to be quite substantial in this study In-line-with the TPB, this study extends the existing body of literature regarding consumers' GPI as it was significantly contingent to the given independent variables of the study, whereby, the price-sensitivity has been recognized as a key moderator particularly in the context of developing countries such as Pakistan. The present study thus provides in depth-insights to guide automobile manufacturers and marketers to redefine their pricing strategies to further strengthen the consumer's GPI for HVs within certain socio-contextual setup Results of this study show that attitude, subjective norms, perceived behavioural control and PS have a significant positive impact on consumers' purchase intention for HVs. Moreover,	This study has focused only on a specific product which is HVs and tried to assess the TPB-model-based determinants of purchase intention in the Pakistani market only. Similarly, to assess the moderating effect, the constructs other than PS could also be assessed that might discover different dynamics behind enhanced or hindered purchase intention for HVs. Besides, this study has used purposive sampling technique for data collection. So, future researchers should consider other sampling techniques to check the robustness of this study's findings and also to increase the findings' generalizability
Li, Linu; Wang, Zhiqiang; Wang, Qiang	Do policy mix characteristics matter for electric vehicle adoption? A survey-based exploration	2020	Electric vehicles; Policy mix characteristics; Theory of planned behavior; China	With an extended TPB model integrating psychological factors and policy mix characteristics, we explore the effects of TPB-related variables and policy mix characteristics on consumers' intention to purchase EVs, as well as the moderating effects of policy mix characteristics. In	EV	China	1,213 online questionnaires	Hypothesis 1 (H1): The consistency of policy mixes positively affects EV purchase intention. Hypothesis 2 (H2): The coherence of policy mixes positively affects EV purchase intention. Hypothesis 3 (H3): The credibility of policy mixes positively affects EV purchase intention. Hypothesis 4 (H4): The comprehensiveness of policy mixes positively affects EV purchase intention. Hypothesis 5 (H5): The consistency of policy mixes negatively moderates the relationship between consumer attitude and EV purchase intention. Hypothesis 6 (H6): The consistency of policy mixes negatively moderates the relationship between subjective norm and EV purchase intention. Hypothesis 7 (H7): The consistency of policy mixes negatively moderates the relationship between personal norm and EV purchase intention. Hypothesis 8 (H8): The consistency of policy mixes positively moderates the relationship between perceived behavioral control and EV purchase intention 	We use Cronbach's α, indicator reliability, construct reliability, convergent validity, and discriminant validity to assess the reliability and validity of the scales. To this end, we perform a confirmatory factor analysis (CFA) and Because self-reported data from a single participant might generate common method bias (CMB), we perform two-step statistical tests	n this study, we develop an extended TPB model by integrating psychological factors with policy factors to investigate 33 / 42 whether policy mix characteristics affect an individual's intention to purchase EVs and to examine how they might do so. With the proposed model, we examine both the direct and moderating effects of policy mix characteristics on EV purchase intention. In particular, the higher the consistency, coherence, and credibility of policy mixes, the higher is the level of EV purchase intention. Furthermore,Furthermore, the consistency of policy mixes negatively moderates the relationships between attitude and EV purchase intention, between subjective norm and EV purchase intention, and between personal norm and EV purchase intention, but positively moderates the relationship between perceived behavioral control and EV purchase intention	First, considering that only a small number of individuals currently own EVs, we mainly explore the drivers of purchase intention. Second, in this study, we assess four characteristics of policy mixes by asking participants subjective questions, instead of constructing objective indicators.
Liu, Rong; Ding, Zhihua; Jiang, Xin; Sun, Jing; Jiang, Yanling; Qiang, Wei	How does experience impact the adoption willingness of battery electric vehicles? The role of psychological factors	2020	Battery electric vehicles . Experience . Adoption willingness . Subjective norm . Attitudes . Perceived behavioral control	he current study intends to explore the following: (1) the differences between experienced and inexperienced partici- pants in the attitudes, perceived behavioral control, and adop- tion willingness ofBEV; (2) whether the consumer experience has an impact on adoption willingness of BEV; and (3) the influence mechanism of driving experience on adoption will- ingness (the role of psychological variables) The purpose of this paper is to explore the influence of driving experience on the adoption willingness of EV, and meanwhile compare the differences between experienced and inexperienced consumers. If	BEV	China	247 valid questionnaires	H1: Experience positively affects the adoption willing- ness ofBEV H2: Attitudes mediate the relationship between experi- ence and adoption willingness ofBEV. H3: Subjective norm mediates the relationship between experience and adoption willingness ofBEV. H4: perceived behavioral control mediates the relation- ship between experience and adoption willingness of BEV. H2a: The attitude towards the charging convenience me- diates the relationship between experience and adoption willingness ofBEV. H2b: The attitude towards cruising range mediates the relationship between experience and adoption willing- ness ofBEV. H2c: The attitude towards economic benefit mediates the relationship between experience and adoption willing- ness ofBEV. H2d: The attitude towards battery life mediates the rela- tionship between experience and adoption willingness of BEV. H2e: The attitude towards low-emission mediates the re- lationship between experience and adoption willingness ofBEV H2f: The attitude towards low noise mediates the rela- tionship between experience and adoption willingness ofBEV.	TPB model - extended 	Based on previous study results in the literature, we introduced the factor of driving experience to extend the TPB model.	significant differences were found in subjective norm, attitudes (bat- tery life, cruising range, economic benefit, low emission, and low noise), perceived behavioral control, and adop- tion willingness between experienced and inexperienced consumers.	However, we only divided con- sumers into the experienced and inexperienced groups. This approach may have certain limitations. In future study, con- sumers can be grouped further according to how much expe- rience they have or how positive their experience is, to explore richer information about the differences between consumers with more experience and less experience, as well as con- sumers with positive experience and negative experience. In addition, although the sample of luxury BEV is excluded in the research process, there are still differences between BEV of different brands and prices. In future research, different price segments and brands of EV should be further considered.

Authors	Titel	Year	Keywords	Research Question/ Aim	Type of Vehicle	Context	Sample	Hypothesis	Theoretical Framework	Method	Main Results	Limitations/ Future reccomendations
Xu, Guowei; Wang, Shanyong; Li, Jun; Zhao, Dingtao	Moving towards sustainable purchase behavior: examining the determinants of consumers' intentions to adopt electric vehicles	2020	Stimulus-organism-response framework . Driving experience . Perceived relative advantage . Perceived ease ofuse . Perceived risk . Adoption intention	Based on the stimulus- organism-response (SOR) framework, this research aims to explore how consumers' EV driving experience (S) affects their emotions and cognitions regarding EVs (O: perceived relative advantage, perceived ease ofuse, and perceived risk ofEVs) and then activates their intentions to adopt EVs (R). Based	EVs	China	n= 692	H1: Consumers' EV driving experience positively affects the perceived relative advantage ofEVs. H2: Consumers' EV driving experience positively affects the perceived ease of use ofEVs. H3: Consumers' EV driving experience negatively af- fects the perceived risk ofEVs. H4: Consumers' EV driving experience positively affects their EVadoption intentions. H5: Perceived relative advantage positively affects con- sumers' EVadoption intentions. H6: Perceived ease of use positively affects consumers' EVadoption intentions. H7: Perceived risk negatively affects consumers' EV adoption intentions.	Stimulus-organism-response framework This study adopts the "stimulus-organism-response" (SOR) model as the basic research framework to explore how con- sumers' EV driving experience (S) affects their cognitions and perceptions regarding EVs (O: perceived relative advan- tage, perceived ease of use, and perceived risk of EVs) and adoption intentions (R).	confirmatory factor analysis Structural model analysis and hypothesis testing 	the results suggested that con- sumers' EV driving experience has a significantly positive effect on perceived relative advantage and perceived ease ofuse, and then perceived relative advantage and perceived ease ofuse positively affect consumers' intentions to adopt EVs. The EV driving experience negatively affects perceived risk, and perceived risk is also negatively associated with EV adoption intentions. Furthermore, consumers' EV driving experience also has a significant direct affect on EV adoption intentions. According to the results of hypothesis testing, an external stimulus (S: EV driving experience) triggers the internal state of the individual organism (O: perceived relative advantage, perceived ease ofuse and perceived risk) and in turn activates response (R: adoption intention). Meanwhile, an external stimulus (EV driving experience) can also directly activate a response (adoption intention). That is, in this research, EV driving experience can directly and indirectly affect con- sumers' EVadoption intentions. Based on the SOR framework, this research explores how consumers' EV driving experience (S) affects their emotions and cognitions regarding EVs (O: per- ceived relative advantage, perceived ease of use, and per- ceived risk ofEVs) and then affects their EVadoption inten- tions (R). The results indicated that EV driving experience not only directly but also indirectly affects EVadoption intention.	It is known that the internal characteristics ofEVs, such as price, value, quality, and service, and external stimuli, such as Content courtesy of Springer Nature, terms of use apply. Rights reserved. 22564 incentive policy, brand, and information, will affect the adop- tion intention of EVs. Hence, these variables can be consid- ered in the following studies. Second, the current research data were collected from the pilot cities ofEVs in China.
Yang, Ye; Tan, Zhongfu	Investigating the Influence of Consumer Behavior and Governmental Policy on the Diffusion of Electric Vehicles in Beijing, China	2019*	electric vehicle; purchase behavior; Howard–Sheth theory; policy evaluation 1.	this paper investigates the uptake of EVs in Beijing, China, with a focus on the whole process of purchasing an EV, as well as the relevant policies.	EVs	China	n=360	NA - see Howard Sheth theory + What if	classical Howard–Sheth theory is used to the analyze the whole process of EV purchasing, which is divided into four stages here, namely, "Ignored and Neglected", "Proactive Attention", "Comparison and Selection of Vehicles" and "Usage Evaluation". Furthermore, several "what-if" scenarios are set up to quantify the influence of some typical EV-related policies, including the license plate lottery policy and no traffic constriction on battery electric vehicles (BEVs). The	classical Howard–Sheth theory + What - if 	This paper tried to provide insight into the behavioral transitions of potential purchasers in the whole process of EV purchasing, using the classical Howard–Sheth theory. Based on the results from the behavioral analysis together with the information from semi-structured interviews with transport planners, several "what-if" scenarios were set up to explore the roles of different EV-related policies, as well as the associated energy and environmental impacts.	The limitations of this study and the future work are discussed as follows. First, in the questionnaire survey, young people and people with higher education levels were disproportionately surveyed, according to the comparisons between the distributions from our survey and the statistical yearbook
Shankar, Amit; Kunnari, Pooja	Exploring the enablers and inhibitors of electric vehicle adoption intention from sellers' perspective in India: A view of the dual-factor model	2019	NA	this study explores the enablers and inhibitors of EV adoption intention from the sellers' perspective using a dual-factor model. The	EV	India	n = 278	H1 Sellers' intentions to adopt EVs is negatively related to resistance to adopt EVs. H2 Sellers' resistance to adopt EVs is negatively related to intention to adopt EVs. H3 Attitude is positively related to sellers' intentions to adopt EVs. H4 Subjective norms is positively related to sellers' intentions to adopt EVs. H5 Perceived behavioral control is positively related to sellers' inten- tions to adopt EVs. H6 Perceived CSR obligation is positively related to sellers' intentions to adopt EVs. H7 Environmental concern is positively related to sellers' intentions to adopt EVs H8 Sunk cost is positively related to sellers' resistance to adopt EVs. H9 Regret avoidance is positively related to sellers' resistance to adopt EVs. H10 Inertia is positively related to sellers' resistance to adopt EVs. H11 Perceived value is negatively related to sellers' resistance to adopt EVs. H12 Switching cost is positively related to sellers' resistance to adopt EVs. H13 Perceived threat is positively related to sellers' resistance to adopt EVs.		Theory of planned behavior (TPB) has been utilized to explore the motivating factors and the status quo bias (SQB) theory has been used to explore the resisting factors. With regard to resistance perception, adopting the SQB framework, sunk cost, regret avoidance (psychological commitment), inertia, perceived value (cognitive misperception), switching cost, and perceived threat (ratio- nal decision making) are used as six inhibitors of EV adoption from the sellers' perspective (see Figure 1). Intention to adopt is used as a posi- tive predictor of EV adoption intention, whereas resistance to adopt is considered to be a negative predictor. The dual-factor model is used in this study to explore sellers' EV adoption behavior.	The results indicate that atti- tude, subjective norm, perceived behavioral control, environmental concern, and per- ceived corporate social responsibility obligation have significant positive impacts on intention to adopt EVs. However, regret avoidance, inertia, perceived threat, and per- ceived value have significant impacts on the resistance to adopt EVs.	This study was confined to the EV market in India. Therefore, to better generalize the findings of this study, it needs to be replicated with EV markets in other countries, especially in other emerging and transitioning economies. This indicates that repli- cating this study with longitudinal data could reveal more interesting results.
Thogersen, John; Ebsen, Jonas V.	Perceptual and motivational reasons for the low adoption of electric cars in Denmark	2019	Reasoned action approach Personal norms Electric vehicles Buying intentions Denmark	It aimed to obtain a deeper insight into perceptual and motivational reasons for the slow adoption of ECs.	EV	The empirical study was carried out in Denmark in April 2017	In- depth interviews (n = 7) and a survey of a sample of Danish car owners (N = 238)	H1. The intention to buy an EC increases with the potential adopter's evaluation of an EC compared to a CEC, as reflected in his or her overall attitude towards buying an EC. H2. The intention to buy an EC increases with how common and accepted this behavior is in the person's social context (i.e., perceived injunctive and descriptive norms regarding the specific behavior, cf. Fishbein & Ajzen, 2009). H3. The intention to buy an EC increases with a person's perceived moral obligation or personal norm to choose an environmentally-friendly car. H4. The impact of perceived social (i.e., injunctive and descriptive) norms on the intention to buy an EC is mediated through a personal norm. H5. The intention to buy an EC increases with concerns about negative environmental impacts of road traffic H6. The effect of environmental concern about road traffic on intentions to buy an EC is mediated through personal norms regarding choosing an environmentally-friendly car. H7. The intention to buy an EC increases with the perceived ease of use. The H7. Experienced uncertainty about ECs negatively influences the intention to buy one H8. Due to reduced uncertainty and prejudices leading to more favorable beliefs, ownership experience with ECs positively affects the attitude towards buying and intentions to buy an EC	A theoretical framework was developed based on prior research and reasoned action theories (extended TPB and TAM). In the spirit of Fishbein and Ajzen (2009), the reasoned action framework developed for this study is based on both the TPB and the TAM (and thereby also on the TRA) and also informed by Schwartz and Howard's (1981) normative decision-making model (cf. Ajzen, 1991; Klöckner & Matthies, 2004). 	a mixed-method approach consisting of in- depth interviews (n = 7) and a survey of a sample of Danish car owners (N = 238) with an oversampling of EC owners was employed. Based on reasoned action theory and prior research, we propose a comprehensive yet parsimonious model for under- standing car owners' intentions to buy an EC. The model fits the empirical data from a survey of Danish car owners well, supporting the validity of the model's basic assumptions	We find that Danish car owners' intention to buy an EC increases with their attitude towards ECs and felt moral obligation to buy an eco-friendly car and decreases with increased perceived difficulty in use and feeling uncertain about ECs. Social influence on buying intentions is mediated through the attitude towards ECs and felt moral obligations. Personal experience as an EC owner leads to more favorable beliefs about ECs, which make all motivational factors more favorable In order to increase demand for ECs, the focus should mainly be on reducing uncertainty and negative expectations. The most effective tool for achieving this is extended trial experience The study identified psychological antecedents with both positive and negative, direct and indirect (i.e., mediated) effects on intentions to buy an EC This study confirms that the proposed reasoned action model is a useful framework for studying psychological antece- dents of intentions to buy an EC	it is based on a cross- sectional survey, which means that the relationships found do not necessarily reflect causalities. Many of the identified relationships, it would be difficult, if not impossible, to study in a realistic experimental setup. A couple of studies of experience effects have already been published and we encourage others to follow up on these studies Another important limitation is that the study is based on a convenience sample, which can hardly be assumed to be representative of Danish car owners. Especially,
Tu, Jui-Che; Yang, Chun	Key Factors Influencing Consumers' Purchase of Electric Vehicles	2019	electric vehicles; TPB; TAM; IDT; structural equation model	This paper studies consumers' opinions of electric vehicles in an uncertain environment, and analyzes the factors influencing consumers' acceptance of electric vehicles, in order to improve the penetration of electric vehicles into the market and to provide reference suggestions for future researchers. We review and discuss related literature, make necessary revisions according to the research results of previous scholars, establish the theoretical framework of factors influencing consumers' purchase of electric vehicles, and propose statistical hypotheses from different dimensions. 2. We design questionnaires, conduct surveys, analyze the questionnaires' reliability and conduct project analysis, according to the theoretical framework of factors influencing consumers' purchase of electric vehicles. 3. We establish a structural equation model based on the theoretical framework, conduct confirmatory factor analysis (CFA) on the data collected from the formal questionnaire, and analyze the convergence validity and discriminant validity to verify the applicability of the model. 4. We verify the statistical hypotheses across the dimensions using the structural equation model, and identify the key factors influencing consumers' purchase of electric vehicles.	China coastal areas as that is where the majority of electric vehicles in mainland China are.	300 valid questionnaires were collected	Hypothesis 1. Consumers' attitude toward electric vehicles has a significantly positive impact on their purchase intention. Hypothesis 2. Consumers' subjective norm regarding electric vehicles has a significantly positive impact on their purchase intention. Hypothesis 3. Consumers' self-control ability regarding electric vehicles has a significantly positive impact on their purchase intention. Hypothesis 4. Consumers' perceived usefulness of electric vehicles has a significantly positive impact on their attitude toward behavior. Hypothesis 5. Consumers' perceived ease of use of electric vehicles has a significantly positive impact on their attitude toward behavior. Hypothesis 6. Consumers' compatibility regarding electric vehicles has a significantly positive impact on their attitude toward behavior. Hypothesis 7. Consumers' personal innovativeness regarding electric vehicles has a significantly positive impact on their attitude toward behavior. Hypothesis 8 Subjective norm. Interpersonal influence has a significantly positive impact on consumers' Hypothesis 9. External influence has a significantly positive impact on consumers' subjective norm.	This technology acceptance model (TAM) and innovation diffusion theory (IDT), and explores the key factors influencing consumers' purchase of electric vehicles. The 	planned behavior (TPB), TPB; TRA; TAM Based on the literature review, this study integrates the three theories to construct the model. This study followed the two-step approach of Structural Equation Modeling (SEM) The first step examined the construct reliability and validity of the measurement model using Confirmatory Factor Analysis (CFA), and the second step checked the path effects and their significance in the structural model. The measurement model was assessed using the maximum likelihood estimation (MLE) in terms of factor loadings, reliability of measurement, convergent validity, and discriminant validity. Second-Order Confirmatory Factor Analysis Discriminant Validity Structural Model Analysis By	According to the structural equation modeling (SEM) analysis results, (1) In terms of behavioral intention: Consumers' control over the reasources required to purchase electric vehicles has the highest influence on their behavioral intention, while consumers' opinions from consumers' surroundings also significantly affect their behavioral intention to purchase electric vehicles. In addition, consumers' environmental awareness and acceptance of technology products will also influence their behavioral intention. (2) In terms of attitude toward behavior: When consumers believe that electric vehicles are more beneficial at the individual, environment or national level, or they believe that the usage of electric vehicles is simpler and more convenient, they will show a more positive attitude towards the purchase of electric vehicles. Consumers consider electric vehicles as forward-looking technology products with similar driving operation and usage cost compared to traditional vehicles. (3) In terms of regulations: The opinions of consumers' family members, friends, colleagues or supervisors do not significantly affect the attitude or behavior of consumers regarding electric vehicle purchase. According to the SEM analysis results, attitude toward behavior, subjective norm and self-control ability have significantly positive impacts on behavioral intentions. S	Due to time and resource limitations, this study only collected questionnaires from coastal areas in Mainland China. However, because of differences among different regions in Mainland China, people in other regions may hold different opinions about the topic of this study. Future researchers can also explore the situation in different regions to provide references for government and manufacturers to promote electric vehicles.
Simsekoglu, Ozlem; Nayum, Alm	Predictors of intention to buy a battery electric vehicle among conventional car drivers	2019	Battery electric vehicles Perceived accident risk Knowledge Perceived car attributes Theory of planned behavior Norway	The present study examines the role of perceived accident risk, knowledge, perceived car attributes, subjec- tive norm and perceived behavioral control, together with demographic variables, on intention to buy a BEV among conventional car drivers. The main aim of the present study is to examine the role of perceived accident risk, perceived car attributes, TPB con- structs (i.e., attitudes, subjective norm, and perceived behavioral control), knowledge about BEVs, and demographic variables in predicting intention to buy a BEV among conventional car drivers.	BEV	Norway	n= 205 conventional car drivers	Although the results of the hierarchical regression analysis indicates no direct effect of perceived accident risk and knowl- edge about BEVs on the intention to buy a BEV, they may have influence on the intention via the perceived car attributes reflecting benefits of BEVs.	TPB model 	First, a principal component analysis (PCA) was conducted to identify the dimensional structure of the items measuring per- ceived attributes of battery electric cars Second, a hierarchical multiple regression analysis was performed to investigate the predictors of intentions to buy a BEV among the conventional car drivers.	Although socio-demographic and attitudinal factors related to BEV adoption have been examined substantially in previ- ous research (Axsen & Kurani, 2013; Figenbaum & Kolbenstvedt, 2016; Graham-Rowe et al., 2012; Hjorthol, 2013; Rezvani et al., 2015; Skippon & Garwood, 2011; Schuitema et al., 2013), there is a lack of studies focusing on the role of perceived accident risk of BEVs as a predictor variable. The present study aimed to fill in this research gap by examining the role of perceived accident risk, together with well-investigated psychological constructs, in predicting the intention to buy a BEV among conventional car drivers. Therefore, emphasizing economic benefits of BEVs and making adoption of BEV easy by decreasing the purchase prices might be helpful	
Haustein, Sonja; Jensen, Anders Fjendbo	Factors of electric vehicle adoption: A comparison of conventional and electric car users based on an extended theory of planned behavior	2017	Attitude; electric vehicles; intention; personal norm; subjective norm	This paper examines these assumptions based on online sur- veys conducted in Denmark and Sweden among BEV users and conventional vehicle (CV) users. The	BEV	Denmark and Sweden	BEV users' (n D 670) and conventional vehicle (CV) users' (n D 1794)	The attitudinal factors included in this study were based on the TPB	In regression analyses, CV and BEV users' intention to use/purchase a BEV is modeled based on factors of the Theory of Planned Behavior extended by personal norm, perceived mobility necessities, and BEV experience. To ensure the inclu- sion of the most relevant psychological factors, we relied on the Theory of Planned Behavior (Ajzen, 1991)		For CV users, symbolic attitudes related to BEVs are the most important factor of intention, while perceived functional barriers in terms of driving range are most relevant for BEV users' intention. How BEV users cope with trips of longer distance seems of particular relevance. In multiple car households, we found the percentage of actual BEV usage related to the type of other cars in the household, perceived functional barriers of BEVs as well as (successful) behavioral adaption to longer trips by BEVs. This study shows that CV user and BEV users are distinct target groups that differ in demographics, mobility patterns, and attitudes on BEV. When aiming at increasing BEVs adoption, different strategies are indicated for both groups: For CV users, main efforts need to be put in measures to improve the image of BEVs as "green" status symbols and in filling knowledge gaps concerning driving range and related improvements. Additionally, gaining practical experi- ence with BEVs trough trials seems to be a promising strat- egy to increase affective attitudes in relation to BEVs
Wang, Shanyong; Li, Jun; Zhao, Dingtao	The impact of policy measures on consumer intention to adopt electric vehicles: Evidence from China	2017	Electric vehicles Policy measures Environmental concern Adoption intention	This study divides policy measures into three catalogs (i.e., financial incentive policy measures, information provision policy measures and convenience policy mea- sures) and investigates how these policy measures motivate consumers to adopt EVs and how such effects are moderated by consumers' environmental concern. The main research motivation of the current study is to examine the effects of these three catalogs of policy measures and explore The combined effects of policy measures and consumers' environmental concern on EVs adoption so as to enrich the research on EV- related policy measures and better understand the influential mechanism of policy measures. Meanwhile, this research aims to provide a reference for relevant government agencies to improve current policy measures and increase consumers' intention to adopt EVs. This	EV	China	324 useable responses	Hypothesis 1. There is a positive relationship between financial incentive policy measures and EVs adoption intention. Hypothesis 2. There is a positive relationship between information provision policy measures and EVs adoption intention. Hypothesis 3. There is a positive relationship between convenience policy measures and EVs adoption intention. Hypothesis 4. There is a positive relationship between consumers' environmental concern and EVs adoption intention. Hypothesis 5. Environmental concern positively and significantly moderates the relationships between (a) financial incentive policy measures, (b) information provision policy measures and (c) convenience policy measures and EVs adoption intention.	TPB extended with environmental concern 		The results of a survey of 324 respondents suggest that three catalogs of policy measures are positively and significantly related to EVs adoption intention, and convenience policy measures are the most important policy measures to promote EVs. In addition, the results indicate that consumers' environmental con- cern plays a moderating role in the relationships between two catalogs of policy measures (fi- nancial incentive policy measures and convenience policy measures) and EVs adoption intention. Implications Second, the present study explored the moderating effects of consumers' environmental concern on the relationships between policy measures and EVs adoption intention.	Firstly, this research focused on consumers' adoption intention rather than actual adoption behavior. Just Secondly, this research didn't distinguish the types and brands of EVs
Jansson, Johan; Pettersson, Thomas; Marmbeg, Andrea; Brannlund, Runar; Lindgren, Urban	Adoption of alternative fuel vehicles: Influence from neighbors, family and coworkers	2017	Adoption Alternative fuel vehicles (AFVs) Interpersonal influence Neighbor effect Diffusion of innovation theory	In this paper we analyze adopters and non-adopters of alternative fuel vehicles (AFVs). We use diffusion of innovation theory and the established notion that the social system and interpersonal influence play important roles in adoption. Based on a nationwide database of car owners we analyze interpersonal influence on adoption from three social domains: neighbors, fam- ily and coworkers. Thus, the main purpose of this paper is to explore how membership in social domains is related to AFV adoption. Although	AFV	Sweden	5,610 Golfs made up the sample – 1,690 were AFVs and 3,920 CVs (gasoline and diesel)	NA	We use diffusion of innovation theory and the established notion that the social system and interpersonal influence play important roles in adoption.	In order to analyze the influence of the three social domains (neighbors, family relations and coworkers) on AFV adoption several methodological choices were necessary Firstly, descriptive data were analyzed for the sample of Golfowners and thereafter two logistic regressions were run with type of car (CV or AFV Golf) purchased as the dependent (categorical) variable. In Model 2, the control variables were added to the three social domains. The	The results point primarily at a neighbor effect in that AFV adoption is more likely if neighbors also have adopted. The results also point at significant effects of interpersonal influence from coworkers and family members but these effects weaken or disappear when income, education level, marriage, age, gender and green party votes are controlled for. The A relevant question that the results raise is why the neighbor effect is the strongest of the interpersonal influences (with and without the controls) in our results.The influences from family and coworker domains are weaker, and for the co-worker the relation does not hold when controls are introduced. Primarily the influence comes from neighbors, but also from immediate family and coworkers (although the influence from the two latter domains, weaken or disappear, when controls are introduced). Based on our empirical analyses we conclude that interper- sonal influence and thus the neighbor effect is an important factor of innovation adoption in general, and for AFV adoption specifically. These findings have several implications.	The most obvious problem ofour study design concerns causality. The way the study is set up limits our ability to show that the interpersonal influence is the main influence on adoption of all possible factors; rather we show it is an important one. Although controlling for green party voting, we cannot either totally rule out the possibility of people having self-selected into the neighborhood domain, Another limitation of our study design is the relatively lee explanatory power of the models. Many other factors that are not included in our models, due to limitations in the data set, might be influential as well. For example, we did not have access to information on the friend domain Other limitations of our study concern the focus on one car make and model only; the VW Golf, and it's AFV type diffusion in one single market; Sweden. it is also important to point to the fact that our study shows that preferences for AFVs change over time, and that different types of AFVs might increase or decrease in popularity given policy and market factors. Thus,
Schmalfuss, Franziska; Muehl, Kristin; Krems, Josef F.	Direct experience with battery electric vehicles (BEVs) matters when evaluating whicle attributes, attitude and purchase intention	2017	Battery electric vehicle Experience Theory of planned behavior Acceptance Test trial Online survey	The present research contributes to the question of what role direct experience plays in acceptance of BEVs.	BEV	Germany	(1) an online survey (N = 286) and (2) a 24-h field test (N = 30).	Constructs created based on TPB with variable experience included	TPB Extended 	For analyzing our hypotheses, t-tests for independent variables and a path analysis via AMOS (Arbuckle, 2014) were cal- culated. With regards to the t-tests, data was not devised from the whole sample as the two groups, EXP and INEXP, differed extensively in group size as well as in various socio-demographic variables, and potential differences between groups could otherwise have been seen by several factors Path analysis1 was used to calculate direct, indirect and total effects of BEV experience Data was analyzed using t-tests for paired samples, linear mixed models (LMM) and multiple linear regression analyses. To account for the within-subject design, LMMs with a random effect for participant (intercept) and fixed effects for all other predictors were calculated using the package "lme40	Both studies showed several experience-based differences in evaluations of BEV attributes, attitude and purchase inten- tion, with most BEV attributes being evaluated more positively when people had BEV experience. Path analyses revealed a direct experience effect on purchase intention in the online study. Findings from the 24-h field test, showed effects ofBEV experience on BEV attributes and attitudes, but no BEV experience effect for purchase intention was found. Based on the results of both studies, we can conclude that practical (and also short-term) experience with BEVs has the potential to change the evaluation of BEVs and psychological factors rel- evant for determining behavioral intention. As many effects were positive, providing short- term BEV experience to enhance acceptance has the potential to change BEV evaluation as well as the satisfaction with such a vehicle and might be a promising strategy for promot- ing BEVs. Experience had significant positive direct effects on PBC and purchase intention as well as a negative direct effect on the perceived environmental friendliness of BEVs. "Enjoyable	but many had only driven a BEV on one occasion. For BEV non-owners, that were included in the path model test, the ques- tion arises as to whether they had sought the hands-on experience (i.e., asked to test drive) or if their one-off driving oppor- tunity had merely been coincidence. Furthermore, when people had experiences with BEVs, it is unclear if the experience was good or bad, or which facets of the tested BEV were positive or negative. It must also be acknowledged that, existing BEVs differ in their characteristics, with this potentially This is an interesting case to investigate given that the number of BEV owners is still limited in many countries, with the concept of BEVs still being considered 'new' to many people. It remains unclear however under which conditions a short test drive would not have the reported effects. It must also be acknowledged that participants applied to take part in the study, so they might present a population that is overly interested in BEVs in comparison with the general public Finally, the sample size of the current study was quite limited and models are quite complex what leads to a reduced power of LMM and regression analyses. Nevertheless, the reported results provide interesting insight into the value of pro- viding experience with BEVs.

Authors	Titel	Year	Keywords	Research Question/ Aim	Type of Vehicle	Context	Sample	Hypothesis	Theoretical Framework	Method	Main Results	Limitations/ Future reccomendations
Skippon, Stephen M.; Kinnear, Neale; Lloyd, Louise; Stannard, Jenny	How experience of use influences mass-market drivers' willingness to consider a battery electric vehicle: A randomised controlled trial	2016	Electric vehicle Consumer Adoption Randomised controlled trial Symbolic Performance	1. How far are MMCDs willing to consider having a BEV as a main or second household car, as a function of its available range on a fully charged battery? 2. How do MMCDs evaluate the dynamic and cruising performance of modern (2012 model) BEVs, compared to equivalent ICE cars? 3. What symbolic meanings do MMCDs attribute to BEVs? 4. How does the willingness of MMCDs to consider having a BEV relate to their evaluations of the performance of BEVs? 5. Does congruity between personal identity and the symbolic meaning attributed to BEVs impact on MMCDs' willingness to consider owning a BEV? 6. How far and in what direction are MMCD responses to 1, 2, and 3 affected by direct experience of the use of a modern BEV?	BEV for experiment EV in literature research		randomised controlled trial with 393 mass-market consumer drivers	H1. Participants' willingness to consider having a BEV as a main car in the household will increase after direct experience of BEV use. H2. Participants' willingness to consider having a BEV as a second car in the household will increase after direct experience of BEV use. H3. Evaluations of the performance of a modern BEV by participants who have had direct experience of using it will be more positive than evaluations of performance of an equivalent unfamiliar ICE car by participants who have had recent direct experience of using that. H4. Participants' attributions of symbolic meanings to BEVs will change after direct experience of BEV use.	Self-Congruity theory proposes that products are preferred whose symbolic mean- ings are congruent with personal identity. To explore their potential influences, we report a large-scale randomised controlled trial to measure UK MMCDs' willing- ness to consider having a battery electric vehicle (BEV), their evaluations of the performance of a modern (2012) BEV, and their attributions of symbolic meanings to BEVs. The research design addressed three methodological issues relevant to research on uptake of new product categories: psychological distance, sample bias, and Hawthorne effects	he study was conducted as a randomised controlled trial (RCT). The RCT used a 2 ? 2 mixed factorial design, with one between-participants independent variable (Group: Experimental; experienced BEV) or Control (experienced ICE)) and one within-participants variable (Time: before/after usage experience). Participants completed three online questionnaires, two before the usage experience, one after. In both the pre-experience and post-experience questionnaires, participants' attributions of symbolic meaning to BEVs were measured using the attribution-ignette method	Despite rating the performance of the BEV more highly than that of the conventional car, willingness to consider a BEV declined after expe- rience, particularly if the range of the BEV considered was short. The participants willing to consider a short-range BEV were those high in self-congruity, for whom the BEV could act as a strong symbol of personal identity. The results showed that people who had driven a modern BEV responded very positively to the driving experience	We note that this research does not enable us to draw valid inferences about uptake by fleets, rather than mass market consumer drivers, since the usage patterns, goals supported by vehicle use, and appraoches to total cost of ownership in dif- ferent types of fleets may be very different than those of mass-market consumer drivers. Ultimately, One limitation of this study was the relatively short duration of the usage experience.
Sajjad, Aqsa; Asmi, Fahad; Chu, Jianxun; Anwar, Muhammad Azfar	Environmental concerns and switching toward electric vehicles: geographic and institutional perspectives	2020	Green behavior . Electric vehicle . Switching intentions Push-pull-mooring . Institutional theory	The study exploires the switching intentions ofpeople from motorized vehicles to electric vehicles by integrating push-pull-mooring model and institutional theory. The study incor- porates environmental quality, regulative environment, alternative attractiveness, normative environment, self-(decision)efficacy, and willingness to pay into an integrated framework. The study further analyzes the green behavior ofconsumers by extending switching intentions for electric vehicles. this study aims to apprehend the switching inten- tions toward electric vehicles in the face of bad air quality. by proposing an integrated framework which combines the push-pull-mooring and institutional theory.	EVs	China	380 response	H1a: Environmental quality affects switching intention. H1b: Strict regulative environment affects switching intention H2a: Alternative attractiveness positively affects switching intention. H2b: Supportive normative environment affects switching intention. H3: Mooring factor affects switching intention. H4: Switching intentions significantly affect individuals' green behavior. H5: Mooring factor moderates the relationship between push, pull, and switching intentions.	The "push-pull-mooring" (PPM) model categorizes migration into push, pull, and mooring. The current study integrates institutional theory and PPM model to propose a framework to analyze the green behavior ofpeople in the face of air pollution. The study includes regulative environment (effects of n from institut The study in push effect.  Fig 1: Motivational model framework	ial settings) (North, 1990) ing intentions. e- environment (RE) into the	The integrated framework explains mooring as the most influential factor followed by normative environment from pull factors and environmental quality from push factors. The effect of regulative environment remains weak and significant, but the effect ofalternative attractiveness remains weak and insignificant. The switching intentions strongly and significantly explain green behavior. Furthermore, mooring moderates the relationship between push factors, some of the pull factors, and switching intentions. The study integrates the environmental quality, regulative en- vironment, alternative attractiveness, normative environment, self(decision)-efficacy, and willingness to pay and to capture the psychological, cognitive, and behavioral effects while switching to EVs.	
Yan, Qingyou; Qin, Guangyu; Zhang, Meijuan; Xiao, Bowen	Research on Real Purchasing Behavior Analysis of Electric Cars in Beijing Based on Structural Equation Modeling and Multinomial Logit Model	2019	electric cars; theory of planned behavior; structural equation modeling; multinomial logit model; purchase intention; real purchasing behavior	The main purpose of the current study is to explore the key factors influencing potential customers' actual purchase of electric cars	EV	China	537 valid questionnaires	H1: The more positive the consumers' attitude toward electric cars is, the stronger their purchase intention of electric cars and actual purchasing behavior; H1: The subjective norms of consumers are positively related to the purchase intention of electric cars, that is, the stronger their subjective norms are, the stronger their willingness to purchase electric cars and actual purchasing behavior; H3: The consumers' perceived behavioral control is positively related to the purchase intention ofelectric cars, that is, the stronger the perceived behavioral control is, the stronger their willingness to purchase electric cars and actual purchasing behavior.	TPB (Theory of Planned Behavior) THEORETICAL RESEARCH FRAMEWORK Finally, the TPB theoretical framework will be further developed to analyze the positive and negative attributes of attitude, subjective norm, and perceived behavior control and explore the main and key factors influencing purchase intention and real purchasing behavior  Figure 1 The framework of the actual purchasing behavior of electric cars	SEM (Structural Equation Modeling) and MNL (Multinomial Logit Model) models are used to analyze key factors affecting consumers' purchase intention and actual purchasing behavior. Based on the planning behavior theory, this paper constructs a framework that affects the actual purchasing behavior of electric cars The reliability and validity of the measurement model are tested using SPSS and Amos software. The multinomial logit model is built on the strength of random utility theory The maximum likelihood method is used to estimate the model coefficient matrix ß to study the influence degree of each characteristic factor on the purchasing behavior of electric cars	Under the TPB theory framework, we first studied the effects of attitude, subjective norm, and perceived behavior control on purchase intention, and the path coefficients of the three are significant. The results show that positive attributes have a significant positive effect on actual purchasing behavior, while, conversely, negative attributes have an adverse impact	due to the concentration of sample data in Beijing, there may be certain selection biases to some extent, which make its universal promotion limited in the process of analyzing the influencing factors of the actual purchasing behavior of electric cars, we fail to take into account specific family characteristics, such as the number of cars already owned and whether electric cars are used as the main means of transportation. Different brands of electric cars that have been neglected in research, such as Tesla, BMW, BYD and Toyota, which will also have diverse effects on the actual purchasing behavior of electric cars
Higueras-Castillo, Elena; Molinillo, Sebastian; Andres Coca-Stefaniak, J.; Liebana-Cabanillas, Francisco	Perceived Value and Customer Adoption of Electric and Hybrid Vehicles	2019	electric vehicles; hybrid vehicles; customer attitudes; perceived value; sustainable mobility; Spain; electromobility	This study aimed to improve the current understanding of factors influencing customers' intentions to adopt EM options. The aim of this research is to improve current knowledge related to the factors affecting customers' intention to purchase an EM vehicle in Spain. Building	adoption of electro mobility (EM) options	Spain	404 consumers in Spain	Hypothesis 1 (H1). Perceived quality value will have a significant positive impact on consumers' attitude towards EM. Hypothesis 2 (H2). Perceived emotional value will have a significant positive impact on consumers' attitude towards EM. Hypothesis 3 (H3). Perceived price value will have a significant positive impact on consumers' attitude towards EM. Hypothesis 4 (H4). Perceived social value will have a significant positive impact on consumers' attitude towards EM. Hypothesis 5 (H5). Strong acceleration will have a significant positive impact on consumers' attitude towards EM. Hypothesis 6 (H6). Low engine noise emission will have a significant positive impact on consumers' attitude towards EM. Hypothesis 7 (H7). The more favourable consumers' attitudes are towards EM, the greater their intention to adopt EM.	Building on the theories of perceived value and reasoned action, this study posits a behavioural model based on four dimensions of perceived value and two technical performance characteristics of EM vehicles with regards to their influence on customer attitudes towards EM options, as a precursor to purchase. 	structural equation modelling analysis The adequacy of the measures was evaluated by analysing their reliability and validity. The reliability analysis carried out involved two internal consistency indicators: Cronbach's alpha (CA) and composite reliability (CR). A behavioural model was proposed to evaluate the affect of the PERVAL scale's four dimensions on consumer attitudes, incorporating two functional EM vehicle performance dimensions.	The results of this study showed that emotional issues, product price, vehicle acceleration and low engine noise levels have a considerable impact on consumer attitudes, which, in turn, have a positive impact on purchase intentions of EM vehicles. However, quality and social value were not found to have a positive influence on consumer attitudes. The findings of this analysis indicate that potential buyers of EM vehicles are influenced primarily by emotions and the experience of driving an EM vehicle, followed by the product's value for money This research showed that rapid vehicle acceleration and low engine noise are two key characteristics this study makes a distinct contribution to the literature by stressing the importance of promoting the product's quality actively, this study showed that for the embryonic stages of the market development of innovative technologies such as EM vehicles, social factors are not crucial as regards the adoption of these technologies by customers. 5.2.	the fact that the research was carried out only in Spain
Wolff, Stellanie; Madlener, Reinhard	Driven by change: Commercial drivers' acceptance and efficiency perceptions of light-duty electric vehicle usage in Germany	2019	Electric vehicles (EVs) Driver acceptance Commercial EV fleet Drivers' efficiency perception Germany Technology Acceptance Model	By conducting a cross-sectional survey at Deutsche Post, a major German postal delivery service provider, we examine to what extent commercial drivers accept the substitution of conventional cars with light-duty e-vehicles (LDEVs). First, we investigate drivers' perceived satisfaction with LDEVs compared to con- ventional vehicles. Second, we question whether electric cars in general increase drivers' per- ceived efficiency of them. The research objective is to assess the benefits of the introduction of EVs into the delivery fleet from the drivers' perspectives, interpreted as efficiency gains. Thus, the overarching research question is: how does the drivers' satisfaction with EVs affect drivers' efficiency perception of EV usage? our two specific research questions are: (1) Are the drivers more satisfied with EVs than with ICEVs? (2) Do EVs increase drivers' efficiency perception? Next, we split the second research question into two: (2a) What are the drivers' efficiency perceptions when using an EV compared to using an ICEV? And (2b) What are the drivers' perceptions of their efficiency change due to a change in work equipment (i.e. vehicle tech- nology)?	light-duty e-vehicles (LDEVs)	Germany	n=66 responded	We hypothesize that the greater the drivers' overall satisfaction with LDEVs is, the higher their perceived efficiency of EV usage is.	Technology acceptance model & Diffusion of Innovations Theory (Dol) According to his theory, in an organizational context, technology acceptance by employees is a question of power, materiality, structure, and arrangement (employer-employee relationship).3 The literature has been applying the TAM and the Dol Theory se- parately to investigate the user acceptance of private as well as of commercial EVs. We made certain modifications to existing constructs of the TAM and the Dol Theory, resulting in our UTAM (Table 	We use a Principal Component Analysis (PCA) to confirm the constructs of the UTAM.	Combining these two perspectives, we show that the greater the drivers' overall perceived satisfaction with LDEVs is, the higher is the drivers' perceived efficiency of LDEVs. We prove this by means of perceived usefulness (perceived relative advantage) and perceived ease of use (the opposite of perceived complexity) of LDEVs, using adaptations of Davis' Technology Acceptance Model and Rogers' Diffusion of Innovations Theory to form our Unified Technology Acceptance Model (UTAM). Our findings suggest that, on average, drivers are slightly more sa- tisfied with the LDEVs than with the available conventional cars (n=66). If drivers were able to choose their preferred vehicles, the majority of them would favor LDEVs. We detect statistically significant patterns of latent measures affecting perceived usefulness and perceived ease of use of LDEVs. After the PCA, we find that only the first of five PU-components has a significant effect on intention to use (PU-automatic-gear, PU-technical, PU-engine-noise, PU- enwironment-recuperation, PU-acceleration). In comparison to ICEVs, the EVs' automatic gearbox seems to be relevant to the drivers. More importantly, we find that EV usage anxiety (one of the three affect variables) is entirely statistically insignificant to EV ac- ceptance. This	First, it faces retrospective limitations in cases where drivers have not used either EVs or ICEVs for a long time.25 Second, the stated nature of the data – a small sample and self- assessments – limits the explanatory power of this study.
Xu, Yueling; Zhang, Wenyu; Bao, Haijun; Zhang, Shuai; Xiang, Ying	A SEM-Neural Network Approach to Predict Customers' Intention to Purchase Battery Electric Vehicles in China's Zhejiang Province	2019	battery electric vehicles; purchase intention; structural equation model; neural network; theory of planned behavior	This study helps target and plan marketing and policy activities to promote the sale of BEVs, and this research will first identify and address the gap in existing literature concerning customers' purchase intention of BEVs by extending the theory of planned behavior (TPB) model.	BEVs	China, Zhejiang Province	382 surveys completed	H1: Consumers' attitude has a significant and positive effect on their intention to purchase BEV. H2: Perceived behavioral control has a significant and positive effect on their intention to purchase BEV. H3: Subject norm has a significant and positive effect on their intention to purchase BEV H4: Environmental performance has a significant and positive effect on the intention to purchase BEV H5: Price value has significant and positive effect on the intention to purchase BEV H6: Non-monetary incentive policy measures have a significant and positive effect on the intention to purchase BEV. H7: Monetary incentive policy measures have a significant and positive effect on the intention to purchase BEV	integrating a structural equation model (SEM) and a neural network (NN). TPB can be developed by discussing new variables such as environmental performance, price value, non-monetary incentive policy (NMIP) and monetary incentive policy (MIP) measures which influence consumers' purchase intention This study also combines the structural equation model (SEM) and neural network (NN) approach to perform hypothesis testing and a linear or non-linear regression model [21,22] to discover the factors affecting consumers' purchase intention.	a two-stage approach was be applied in this study. First, the SEM was first employed to test the variables that have significant relationships with BEV purchase intention. Next, the non-compensatory NN model was used to predict the BEV purchase intention considering the significant intention factors. A multi-analytical approach that combines partial least squares structural equation modeling (PLS-SEM) with NN was applied in this research.  Figure 1. Research model	The initial analysis results from the SEM revealed five factors that have impacted the customers' purchase intention of BEVs. In the second phase, the normalized importance among those five significant predictors was ranked using the NN. As the main result of this paper, the research model emphasizes the importance of perceived behavioral control, subject norm, environmental performance, attitude, and MIP measures (high to low) in consumer's purchase intention. Although environmental performance, attitude, and MIP measures had significantly positive effects on the intention to purchase BEVs, perceived behavioral control was the most important factor. In other words, the higher the consumer's perceived behavioral control concerning BEVs, the stronger their willingness to purchase BEVs. Furthermore, if customers have a positive attitude towards BEVs, and the MIP measures are superior, it can significantly enhance customers' willingness to purchase BEVs. The results also suggest that consumers with high education level (above undergraduate course) and high-income level (above 400k RMB annually) were more likely to accept the purchase and use of BEVs. Therefore, Moreover, it was found that price value and NMIP do not have significant impact on the customer's purchase intention, which rejects H5 and H6 The results showed that the subject norm (H3) and environmental performance (H4) have a significant influence on the intention to purchase BEVs.	attitude, perceived behavioral control, subject norm, environmental performance, price value, NMIP, and MIP have a positive influence on customer's purchase intention, but there are many other factors that may affect consumers' intention to purchase BEVs, which are not discussed in this research.Future studies should expand the independent variables to explore and establish a model that is more applicable for real-world decision-making Secondly, this study only considered consumers in Zhejiang Province.
Noel, Lance; Sovacool, Benjamin K.; Kester, Johannes; de Rubens, Gerardo Zarazua	Conspicuous diffusion: Theorizing how status drives innovation in electric mobility	2019	Electric vehicles Conspicuous consumption Diffusion of innovation Low carbon transition Tesla	This paper explores how conceptions of luxury and status affect the manner in which a relatively novel technology—an electric vehicle—diffuses across societies. Building on work across both diffusion of innovations and conspicuous consumption, this paper makes several contributions, first and foremost of which is the introduction of the theory of conspicuous diffusion. While many papers have peripherally investigated the link between technology and conspicuous consumption, our paper offers a testable, cogent theory that applies conspicuous consumption to the entire diffusion process as provided by Roger's diffusion theory. Particularly, we show how conspicuous con- sumption, which has lately been relegated to the fields of psychology and economics, could improve the understanding of diffusion and transition studies. At the same time we contribute to the diffusion and transition literature by adding a new layer to the understanding of the nexus between technology and status To make this case, the paper secondly explores how such conspicuous diffusion can improve the understanding of a specific technology, in this case Elec-	EVs	five Nordic countries of Denmark, Finland, Iceland, Norway and Sweden	227 semi-structured expert interviews with 257 participants + 8 focus groups with a total of 50 participants	Veblen's notion of conspicuous consumption and Roger's diffusion of innovation by proposing a new theoretical variation, which we term "conspicuous diffusion Diffusion of innovation Emerging 		We find that conspicuous diffusion can explain previous failures and current successes of electric vehicle diffusion patterns. First and foremost, conspicuous diffusion is particularly appropriate for the diffusion of vehicle-related technology in general, and specifically electric vehicles. In this paper we have introduce a new theory, conspicuous diffusion, which integrates conspicuous consumption with the dif- fusion of innovation. We show the relevance of conspicuous diffusion by applying it to the status of EVs in the Nordics, and sum- marize our findings in Fig. 5. We argue conspicuous diffusion fits the data well and provides three new concluding insights First, conspicuous diffusion radically challenges the design and application of existing policy mechanisms across the Nordic region, namely in Iceland, Sweden, Finland and Denmark where EV diffusion is still in the beginning processes.	t is proposed that conspicuous consumption characteristics should be included in future diffusion studies, to test whether this increases the explanatory power of diffusion models. Future research should investigate the ways that conspicuous diffusion could moderate successful diffusion, both in regards to the types of products, the perceived conspicuousness, and how it may vary from society to society (or even within subpopulations). Additionally, since our case study of EVs is still in the middle of the diffusion process, future research should focus on historical analyses of conspicuous diffusion of an innovation that has already completed the diffusion process
Noel, Lance; de Rubens, Gerardo Zarazua; Sovacool, Benjamin K.; Kester, Johannes	Fear and loathing of electric vehicles: The reactionary rhetoric of range anxiety	2019	Electric vehicles Range anxiety Reactionary rhetoric Diffusion of innovation	We examine range anxiety through Hirschman's Rhetoric of Reaction, which supposes that conservative forces may oppose change by propagating theses related to jeopardy, per- versity, and futility. Is range anxiety a true barrier to EV adoption? If so, is range anxiety technical or mental, or both? Does range anxiety decrease with experience or not? Therefore, this paper aims to explore the use of reactionary rhetoric in terms of individuals invoking range anxiety, utilizing a variety of qualitative and quantitative methods, including expert interviews, focus groups and surveys.	EV	17 cities in the five Nordic countries	227 semi-structured interviews with experts at 201 institutions, a survey with nearly 5000 respondents, and 8 focus groups	In this paper, we elaborate on this argument to demonstrate that range anxiety is, at least partially, rhetorical in nature. We argue that range anxiety is also a rhetorical argument that consumers use when discussing issues not covered by a technical or psychological con- struction of range anxiety.	The rhetoric of reaction: In order to illuminate the rhetorical aspects of range anxiety, we rely on Hirschman's Rhetoric of Reaction as our theoretical frame. 		We conclude with a reexamination of the policies geared to assuage range-based barriers, which a con- struction of range anxiety as a rhetorical excuse would render as ineffective or inefficient, as well as future implications for diffusion theory We have aimed to construct a better understanding of range anxiety by drawing from and extending the Rhetoric of Reaction; com-plementing the current technical and psychological frames existing in
Nordlund, A.; Jansson, J.; Westin, K.	Acceptability of electric vehicle aimed measures: Effects of norm activation, perceived justice and effectiveness	2018	Norm-activation Beliefs Transportation policy Acceptability Electric vehicle	In this study a model was applied on consumer acceptance of commonly implemented EV focused measures.		Sweden	EV owners=41%, n=494; AFVnon-electric owners=32%, n=388; CV owners=26%, n=312		The model is based on a norm-activation process as defined in the Value-Belief-Norm theory and the Norm-Activation Model. In this study the theoretical framework stems from the Norm-Activation Model (NAM, Schwartz, 1977) and the later developed but NAM-related Value-Belief-Norm theory (VBN, Stern, 2000). Attitudinal factors and the norm-activation process In this study a proposed path model (se Fig. 1) was tested on three groups of vehicle owners; EV, AFVnon-electric, and CV owners.	The order of the variables in the proposed model is based on the previously presented NAM and VBN models 	The results indicate that activating a personal normative reasoning in people can have a positive influence on the level of acceptance of EV aimed policy measures. The aim of this study was to investigate if the perceived justice and effectiveness of measures aimed to stimulate the purchase and use of electric vehicles, and subsequent the expressed acceptability of such policies, is related to a norm-activation process. The results of this study indicate that acceptance of different policy measures can be improved by making the normative aspect of the environmental consequence of fossil fuel salient. In this process, collective and environmental values, problem awareness, sense of self-efficacy and consumer effectiveness are important for the initiation of a norm-activation process	This study focused entirely on pull measures, and beginning with pull measures that are perceived as relatively high in perceived justice, effectiveness and acceptability could be a good idea, but require further investigation. In addition norm-activation models need to be tested empirically on push-oriented measures in order for policy research to have a real impact on moving out of the fossil fuel based vehicle era

Authors	Titel	Year	Keywords	Research Question/ Aim	Type of Vehicle	Context	Sample	Hypothesis	Theoretical Framework	Method	Main Results	Limitations/ Future reccomendations
Du, Huibin; Liu, Diyi; Sowcod, Benjamin K., Wang, Yunz; Ma, Shoufang; Li, Rita Yi Man	Who buys New Energy Vehicles in China? Assessing social-psychological predictors of purchasing awareness, intention, and policy	2018	New energy vehicles Social-psychological factors Theory of planned behavior Low-carbon awareness Transport policy China	This paper investigates the salience of social-psychological factors in explaining why dri- vers purchase (or fail to purchase) New Energy Vehicles (NEVs)—including hybrid electric vehicles, battery electric vehicles, and fuel cell electric vehicles—in China. First, we show how social- psychological factors can exert both direct and indirect influence on purchasing patterns. two central research questions: (1) what are the major factors affecting intentions to purchase NEVs, and (2) how does low-carbon awareness affect those factors?	NEV	Tianjin, China	n=811	we posit that subjective norms are strongly correlated with pro-environmental behavior. We propose and test an extended Theory of Planned Behav- ior (TPB) research model which includes personal norms and government policies to examine NEV purchasing intentions	Theory of Planned Behaviour - extended 	A questionnaire measuring six dimensions (including attitudes, subjective norms, perceived behavioral control, personal norms, low-carbon awareness and policy) was distributed. Correlation analysis and hierarchical multiple regression analyses are applied	We present three main findings. First, there is an "awareness-behavior gap" whereby low-carbon awareness has a slight moderating effect on purchasing behavior via psychological factors. Second, subjective norms has a stronger influence on intention to purchase New Energy Vehicles than other social-psychological factors. Third, acceptability of government policies has positive significant impact on adoption of New Energy Vehicles, which can provide reference potential tem- plate for other countries whose market for New Energy Vehicles is also in an early stage.	
Axsen, Jonn; Cairns, Josh; Dusyk, Nichole; Goldberg, Suzanne	What drives the Pioneers? Applying lifestyle theory to early electric vehicle buyers in Canada	2018	Plug-in electric vehicles Early adopter Lifestyle theory Consumer behaviour interviews	Our study uses semi-structured interviews with a sample of 17 PEV Pioneers to explore consumer behaviour and motivations for buying and using PEVs through the lens of lifestyle theory.	plug-in electric vehicle (PEV)	Vancouver, Canada	17 PEV Pioneer participants	In sum, it is better to interpret our qualitative results as hypothesis generating (or accessing different categories) rather than hypothesis testing (or making conclusive statements about those categories)	Concep Lifestyle we develop a conceptual framework based on lifestyle theory, which defines lifestyle as engage- ment in several related practices that inform and convey self-identity. We explain that lifestyle theory provides a comprehensive view of consumer percep- tions, can account for heterogeneity in consumer motivations, and de- scribes the potential for reflexive interaction between technology, so- cial practices and individual identity. 	We categorize participants based on their engagement in technology-oriented or pro-environmental lifestyles. We explore participants' functional, symbolic and societal motivations relating to PEV purchase, driving patterns, public charging usage, and interest in a controlled charging program In contrast, two segments (Low-Tech Green and High-Tech Green) had similar interest in environmental motivations, but differed in their technology-related motivations.	Some patterns are consistent across lifestyle segments, where most participants emphasized the practicality of PEVs, the improved driving experience and overall interest in environmental protection. However, motivations varied, some corresponding with participants' lifestyle engagement; for example, participants that engaged in pro-en- vironmental lifestyles were more likely to emphasize the environmental aspects of PEV usage. As noted above, some observations in this study were fairly con-sistent across all four lifestyle segments, including: enthusiasm for the positive aspects of PEVs (and BEVs in particular), increased frequency of trips, regular usage of public chargers, and interest in controlled charging.	the fact that these insights are drawn from a small sample size from one particular region our research design is not meant to produce generalizable results. Rather, we attempt to access a range of categories and perceptions that can help researchers and stakeholders to better understand Pioneers
Mohamed, Moataz; Higgins, Christopher D.; Ferguson, Mark; Requia, Weeberb J.	The influence of vehicle body type in shaping behavioural intention to acquire electric vehicles: A multi-group structural equation approach	2018	Electric vehicle adoption Vehicle body size Multi-group structural equation model Theory of planned behaviour Attitude	The study presents a multi-group structural equation modelling exercise to identify differences in the mindset of individuals towards electric vehicles (EVs) across seven vehicle body types in Canada. In this respect, the present study advances the work of Higgins et al. (2017) and offers an additional layer of behavioural-based analysis of EV mindset and mindshare that compliments their utilitarian-based approach. In addition, the present study offers means to identify the variations, or the lack thereof, in the outcomes of the two theoretical platforms. That said, both studies should be seen as two polar of the same sphere.	EV	Canada	15,392 households	The model is thought to test ten different hypotheses: • H1: Environmental concern positively influences attitudes towards adopting EVs • H4: Environmental concern positively influences perceived behavioural control • H3: Environmental concern positively influences personal mosal norm • H2: Environmental concern positively influences subjective norm • H7: Personal moral norm positively influences the intention to adopt EVs • H6: Subjective norm positively influences the intention to adopt EVs • H5: Attitude towards adopting EVs positively influences the intention to adopt EVs • H10: Behavioural factors influencing the intention to adopt EVs are significantly different across consumers of different vehicle • H9: Environmental concern influences the intention to adopt EVs • H8: Perceived behavioural control positively influences the intention to adopt EVs In addition, the model controls for several household socioeconomic and demographic (SED) variables that may influence the intention to adopt EVs.	potential EV adopters on an extended version of the Theory of Planned Behaviour. the study measures the impact of five latent constructs; environmental concerns, attitude, subjective norm, personal moral norm, and perceived behavioural control on the in- tantion to adopt EVs along with socio-economic-demographic (SED) variables. 	A structural equation model (SEM) is utilized to quantify the underlying relationships between the latent constructs. Multivariate analysis of variance/ Confirmatory factor analysis 	The results highlight that both attitude and perceived behaviour control are the strongest factors influencing individual intention to adopt EVs. However, the multi-group invariance analysis indicates that the psychographic orientation and the SED traits of potential adopters of different EV body types are significantly different, with particular standouts in the luxury and pickup truck classes. In this regard, the present study offers a better understanding of the factors that shape the mindset and mindshare of potential EV adopters in Canada.	it would be interesting to see further analysis of how individual mindsets and mindshare across each vehicle type are affected by geography-variant factors such as fuel cost, governmental incentives, urban form, and social networks First, different types of social pressure (e.g. conformity, socialization, peer pressure, obedience, and leadership) might play distinct role in shaping consumer behavior. Second, our scope is directed only towards consumers, therefore behavioural factors influencing fleet acquisition for different vehicle body types (especially SUV and Pickup Truck) might produce different findings. Third, our study models an individual's stated intention to adopt EVs, not their revealed behaviour. However, behavioural intention is employed in several studies as a robust proxy of actual behaviour. In addition, our target here is the more important behavioural intention of the larger untapped EV market in Canada as opposed to the small group of early adopters who have actually purchased EVs in Canada. Another issue is that we focus on the salient characteristics of those who intend to adopt a plug-in vehicle (EV) in general, without the distinction between plug-in hybrid (PHEV) and battery electric (BEV) consumers.
Fry, Amy; Ryley, Tim; Thring, Robert	The Influence of Knowledge and Persuasion on the Decision to Adopt or Reject Alternative Fuel Vehicles	2018	travel behavior analysis; cleaner cars; alternative fuel vehicles; diffusion of innovations; adoption; passive rejection	This paper examines the influence of knowledge and persuasion on the decision to adopt or reject alternative fuel vehicles, a novel and original application of Rogers' Theory of Diffusion of Innovations. the aim of this paper is to examine the influence of knowledge and persuasion on the decision to adopt or reject alternative fuel vehicles.	AFV Alternative fuel vehicles (electric vehicles and hydrogen fuel cell vehicles)	UK	413 households (suvey conducted in 2013)		Rogers' Theory of Diffusion of Innovations. Rogers' Theory of Diffusion of Innovations [5] that has been applied to this alternative fuel vehicles' case study, and principally the Innovation-Decision Process model within the theoretical framework. It is the Innovation-Decision Process model that focuses on how an innovation decision is influenced by the perceived newness of the innovation and the associated uncertainty that arises as a consequence 	The survey questionnaire was designed according to the Innovation-Decision Process framework, and a series of five-point Likert scale attitudinal statements were incorporated. Two deductive methods were utilised. Face-to-face was the preferred method due to the quality control that it allows, while the call-and-collect method was used if the respondent was willing to participate but could not spend the time at the point of contact	I is confirmed that respondents have limited knowledge of alternative fuel vehicles and perceptions have led to the development of negative attitudes towards them. The reasons largely relate to three problems: purchase price, limited range and poor infrastructure availability. Most respondents passively rejected alternative fuel vehicles, which confirms that a concerted effort is required to inform the general public about the benefits alternative fuel vehicles.	An understanding of the role of opinion leaders could be better developed Another research extension could be to focus on the potential adoption of alternative fuel vehicles amongst relevant younger population segments future studies must continue to monitor the diffusion of alternative fuel vehicles.
Ashmore, David P.; Pojani, Dorina; Thoreau, Roselle; Christie, Nicola; Tyler, Nicholas A.	The symbolism of 'eco cars' across national cultures: Potential implications for policy formulation and transfer	2018	Symbolism Hybrid cars Electric cars National culture Latent motivation Policy transfer	Through qualitative thematic analysis, this study utilises two of Hofstede's cross-cultural indices – power differential and individualism versus collectivism – to develop and strengthen theory on how the differing symbolism of eco cars currently varies between four cultural clusters – Anglo, Nordic, Confucian and South Asian. It also deliberates how observed symbolic qualitative differences may influence an individual or group choice to procure eco cars. The goal of the research is to assess the symbolism of eco cars in mega cities in India and China to see if there are cultural barriers in place which may hinder their adoption.	Toyota Prius	Anglo, Nordic, Confucian, South Asian	total of 48 interviewees	1. Eco cars possessing positive symbolism within a culture. 2. Eco cars possessing neutral or no symbolism within a culture 3. Eco cars possessing negative symbolism within a culture Broadly speaking, the authors hypothesised that for the high PDI/collectivist interviewees, there would only be positive symbolism attached to eco cars if the purchase price was widely known to be higher than equivalent petrol models. the authors expected that, for the interviewees from the low PDI/individualistic cultures, eco cars would possess positive symbolism by denoting environment awareness, and connoting education. The authors, however, expected that among the low PDI/individualistic interviewees, some negative connotations may apply to eco cars if it was felt those using them were acting in a 'pious' or sanctimonious manner	The study method, qualitative deductive thematic analysis, is then outlined, stressing its compatibility with the goal of the expansion of theory. 	Thematic analysis Thematic analysis works by allocating 'codes', blocks of interview texts, to a 'theme' The themes to be explored derive directly from the Hofstede (1984) power differential (PDI) and collectivism versus individualism (COLLIND) indices, described earlier. The	The findings demonstrate that for certain groups in low PDI/individualistic societies, products designed to promote greater sustainability will continue to possess strong symbolic value, provided they are demonstrably, visibly, 'different', as in the case of the Toyota Prius This paper also describes a paradox in offering incentives to encourage eco car uptake. It is clear that fiscal incentives for purchasing eco cars, such as tax breaks or exemptions from user charges, have proven successful among relatively affluent market segments in low PDI/individualistic nations. In high PDI/collectivist societies, however, such 'discounts' may connote to others constrained purchasing capacity. Perversely, making eco cars not only clearly discernible from others, but also considerably more expensive than their counterparts, on a par with 'prestige' brands, may encourage their uptake in places such as Delhi, where showing exclusivity, and equivalence, is important in social transactions such as arranging marriages. Having established eco cars as sym- bolically connoting being a member of the elite, more affordable models could then be promoted.	In terms of future research, the strength of the differences in coding density and quotes for the two interviewee cultural clusters is sufficient to justify the expansion of the theory for testing among the populations of interest. The next stage of the work would be to convert the findings into attitudinal surveys to measure how the symbolic imperatives and choice dynamics differ between the two high level cultural groups. There is also a reasonable basis for examining symbolic differences within each of the two high level cultural groupings as there are observable differences within each of the high level clusters that may warrant further examination within another study.
Adnan, Nadia; Nordin, Shahrina Md; Amini, M. Hadi; Langove, Naseebullah	What make consumer sign up to PHEVs? Predicting Malaysian consumer behavior in adoption of PHEVs	2018	Consumer behaviour Adoption Environmental concern Hypothetic discounting PHEV Empirical study	in order to forecast the customer's intention to adopt PHEVs by using the extended theory of planned behaviour. Thus, this study is carried out with the aim to use the Theory of Planned Behaviour (TPB) which explains the prediction, description, and explanation in affecting consumers' consumption beha- viour. Apart from that, attitudes have been included as a mediator in this study which will contribute as a new dimension for the theory of consumption value. The motivation of this empirical study is to determine the key predictors that influences the consumer adoption of PHEVs in the context of Malaysia. This study aims at scrutinising the substantial factors that influence a consumer's decision in the context of the PHEV adoption.	Plug- in Hybrid Electric Vehicles (PHEVs)	Malaysia	403 respondents	H1 Consumer's attitude will have a significant effect on consumer's intention to adopt PHEV. H2 Consumer's subjective norm will have a significant effect on consumer's intention to adopt PHEV. H3 Consumer's perceived behavioural control will have a significant effect on consumer's intention to adopt PHEV. H4 Consumer personal moral norm will have a significant effect on consumer's intention to adopt PHEV H5 Attitude have a significant effect to mediate the relationship between Consumer's environment concern and consumer's intention towards adopting PHEV; H6 Subjective Norm have a significant effect to mediate the relationship between Consumer's environment concern and con- sumer's intention towards adopting PHEV; H7 Perceived behavioural control have a significant effect to mediate the relationship between Consumer's environment concern and consumer's intention towards adopting PHEV. H8 Personal Norm have a significant effect to mediate the relationship between Consumer's environment concern and consumer's intention towards adopting PHEV.	in order to forecast the customer's intention to adopt PHEVs by using the extended theory of planned behaviour. 	The data was coded in SPSS 22.0 The statistical methodology practice for the purpose of the empirical investigation used was the second generation multivariate model which is known as (SEM) structural equation modelling (Fornell, 1982). Meanwhile, all the constructs of the projected model were considered as factor methods and so the consistent PLS method was used. The estimation procedure for PLS-SEM is the ordinary least square (OLS) method whereas the estimation procedure for CB-SEM is the maximum likelihood (ML) estimation procedure.	The empirical outcome using the PLS investigation exposed that all four constructs, subjective norm, personal moral norm, perceived behavioural control, and at- titude criminously shows an indirect effect which has inclined towards the Malaysian consumers' intention to adopt PHEVs. All these four major constructs were significantly predetermined by their respective environmental concern. Whereas, hypothetic discounting moderated the re- lationship between intention and adoption. The fostering result verifies that the relevance of the extended TPB had a good explanatory power in the line of predicting the Malaysian consumers' intention to adopt PHEVs. For	For future study, grounded by the observed outcome, authors explain the implication aimed at promoting the PHEV adoption. Whereas, this study contains a small sample size and the convenience sampling tech-nique did not allow for a generalisation. Additionally, the knowledge idea should be scrutinised in more detail in further research. The
Han, Liu; Wang, Shanyong; Zhao, Dingtao; Li, Jun	The intention to adopt electric vehicles: Driven by functional and non-functional values	2017	Electric vehicles Functional values Non-functional values Attitude Adoption intention	This study aims to investigate consumers' intention to adopt electric vehicles (EVs) from the consumption value perspective. We try to explore how consumers' intention to adopt EVs is affected by these two groups of values and how such effects are mediated by their attitude towards EVs. The main objective of this study is to examine how the EVs adoption intention is influenced by the perceived functional and non-functional values and how these effects are mediated by consumers' attitude towards EVs.	EVs	Helkі, China	607 responses	H1: Monetary value positively affects the consumer's attitude (H1a) and the adoption intention towards EVs (H1b). H2: Performance value positively affects the consumer's attitude (H2a) and the adoption intention towards EVs (H2b). H3: Convenience value positively affects the consumer's attitude (H3a) and the adoption intention towards EVs (H3b) H4: Emotional value positively affects the consumer's attitude (H4a) and the adoption intention towards EVs (H4b). H5: Social value i positively affects the consumer's attitude (H5a) and the adoption intention towards EVs (H5b). H6: Social value R positively affects the consumer's attitude (H6a) and the adoption intention towards EVs (H6b). H7: Epis temic value positively affects the consumer's attitude (H7a) and the adoption intention towards EVs (H7b) H8: Consumer's attitude towards EVs positively affects the EVs adoption intention.	Drawing from consumption value theory, consumers' value perceptions of EVs are classified into functional values (monetary, performance and convenience values) and non-functional values (emotional, social and epistemic values). Functional values and EVs adoption intention 	Confirmatory factor analysis (CFA) was conducted to evaluate the construct reliability, unidimensionality, convergent validity and discriminant validity of the multi-item measurement scales. All model analyses were conducted in SPSS 20 and Amos 21 software The proposed model in Fig. 1 was evaluated through structural equation modeling, which may be one of the most popular multivariate analysis tools and is often used to test the plausibility of the postulated model	The results indicate that the perceived functional value have both direct and indirect effects on consumers' intention to adopt EVs. While the perceived non-functional value have only indirect effects on the adoption intention, which is mediated by attitude. This research deepens the existing understanding of consumers' multi-dimensional value per- ceptions towards EVs. The results reveal that functional values not only have direct effects but also have indirect effects on EVs adoption inten- tion. Attitude does not mediate the effects of functional values on the adoption intention. Specifically, monetary and perfor- mance values significantly and positively affect consumers' attitude and the EVs adoption intention. The convenience value significantly and positively affects consumers' attitude but negatively affects the EVs adoption intention. This phenomenon can be explained by the expectancy violations theory. In addition, the results suggest that performance value is the most important value for the adoption of EVs by consumers.	First, although we divide consumers' values into two categories based on the pre-existing research, the unique contribution of each value could not be estimated. Hence, the result remains tentative. Second, the empirical model needs to be further extended. In addition, the relationships among critical constructs should be further inves- tigated. Third, the results are based on cross-sectional data Finally, the results of this research are mainly based on data collected from Chinese consumers, which may restrict the generalizability of findings
Adnan, Nadia; Nordin, Shahrina Md; Rahman, Imran; Rasli, Amran Md	A new era of sustainable transport: An experimental examination on forecasting adoption behavior of EVs among Malaysian consumer	2017	Adoption Intention Personal norm PHEV EV Interaction Knowledge sharing Response of vehicles owner	the idea of this paper is to scrutinize whether attitudes (ATT) towards EV adoption by integrating three dimensions of attitude along with the theory of planned behavior the study suggests an assimilated model. to forecast the customer's purchase intention to adopt EV by using the extended theory of planned behavior. This review study aims at scrutinizing the substantial factors that influence a consumer's decision in the context of the EV adoption. There	EV	Malaysia	391 respondent	H1. Consumer's attitude will have a significant effect on consumer's intention to adopt PHEV. H2. Consumer's subjective norm will have a significant effect on consumer's intention to adopt PHEV H3. Consumer's perceived behavioral control will have a significant effect on consumer's intention to adopt PHEV. H4. Consumer personal moral norm will have a significant effect on consumer's intention to adopt PHEV. H5. Consumer behavioral intention will have a significant effect on adopting PHEV H6. Consumer environmental concern moderate the relationship between consumer's behavioral intention and consumer's adoption to using PHEV	The empirical outcome by using PLS investigation exposed the three dimension of attitude have a significant effect to build attitude. ti. The questionnaire was developed grounded by the Theory of planned behavior (TB) Functional Theory (FT) and constructive Theory (CT) to understand the Malaysian con- sumer intention of EV 	the finding of this survey ques- tionnaire is analyzed by using Smart PLS to perform CFA and SEM. Assessment of PLS-SEM Moderation effect test with adoption EV as DV	The research model included social psychology (models for attitude formation and behavioral intention), Knowledge sharing, Response and Interaction, and the personal norms ofconsumers towards the EVs adoption. Gen- der, age, income or education groups, and willingness to pay, where studied; the result was positive but not generally influ- enced by the level of environmental awareness of the respondents. The qualitative research provided insights about how the attitudes towards the technologies evolve with the provision of additional information. The main outcomes are in agreement with the conclusions from previous quantitative surveys: there seems to be not any significant conflict to the technologies; as well, safety concerns were at best moderate	
Cherchi, Elisabetta	A stated choice experiment to measure the effect of informational and normative conformity in the preference for electric vehicles	2017	NA	This work aims to measure the effect of both informational and normative conformity in the preference for electric vehicles (EV) versus internal combustion vehicles (ICV). The study is applied to the choice between electric vehicles (EV) and internal combustion vehicles (ICV). The stated choice experiment was also aimed at testing the effect of parking policy on the choice of electric vehicles, which is an important topic that has received much less attention in the literature compared to the car characteristics and recharging infrastruc- tures. The only literature, we are aware of that tested the effect of parking policies on the adoption of EV, included the option "free parking" as one of the three levels (along with "access to bus lanes" and "no road/purchase taxes") of an attributa "in- centive"	EV vs ICV	Denmark	Completed the full survey:2403 Completed the SC experiment: 2656	NA	Informational conformity Normative conformity	Differently from most of the literature in the field, measures of conformity are included as attributes inside a stated choice (SC) experiment, allowing Stated choice experiment The model structure used in this paper is a typical hybrid choice model where a mixed logit model is used to model the discrete choice, while the latent variable model allows accounting for the effect of the injunctive norm.	(1) it measured informational conformity based on the experience of other users regarding specific features of the alternative; (2) it used a more realistic design where individuals are asked to answer the same stated choice experiment before and after they received the information; (3) it tested the effect of social-signalling other than social adoption and (4) it accounted also for the effect of injunctive norms. The study is applied to the choice between EV and ICV and (5) it also tested the effect of parking price and parking spaces reserved for EV, shedding some light on the effect of parking policies in boosting the EV market. Our results also show that injunctive norms can play an important role in boosting the demand for EV. In	As we discussed in the paper, a better measure would have been to manipulate the descriptive norm specifying the reference group who perform a given action or the person who gives you the informa- tion. Finally, our experiment also shows that parking policies (both parking price and slots reserved for EV) can be effective in boosting the demand for EV, but a combination of parking policies is needed because
Sovacod, Benjamin K.	Experts, theories, and electric mobility transitions: Toward an integrated conceptual framework for the adoption of electric vehicles	2017	Unified Theory of Acceptance and Use of Technology (UTAUT) Automobility Actor Network Theory Electric vehicles	What do theories of mobility, science and technology, and user adoption tell us about the acceptance of EVs? More impor- tantly, what are the benefits of theoretical unification should it be achieved? I	electric vehicles and mobility preferences	seven countries: Canada (n = 1), Denmark (n = 1), Finland (n = 1), the Netherlands (n = 5), Norway (n = 1), United Kingdom (n = 13), and the United States (n = 13). This	35 expert social scientists	two open-ended questions: What theories or concepts are most useful at explain- ing the adoption of electric vehicles or mobility preferences? And, how can these be integrated, if at all? I	I pro- pose a conceptual framework of user acceptance consisting of motile pleasure, sociality, sociotechnical commensurability, and habitual momentum. aspects of three theoretical approaches—also phrased at times as "conceptual frameworks," "models," "theoretical constructs," "analytical frameworks," or "concepts"—seldom used together: Automobility, ANT, and the UTAUT. (Actor Network Theory) (Unified Theory of Acceptance and Use of Technology) 		The integrative framework of electric mobility I present—consisting of motile pleasure, sociality, sociomaterial commensurability, and habitual momentum—attempts to draw from three previously isolated schools of thought concerning mass mobility (Automobility), science and technology (Actor Network Theory), and management science and the acceptance of information systems (the UTAUT). As the integrated framework proposes, motile pleasure suggests that drivers will value not only the purchase price, performance, or ease of use of an EV when deciding their intentions but also other nontechnical factors underlying or contributing to a sense of individual satisfaction or rectifying a social need. Sociality affirms the strong influence that norms and interpersonal networks (or lack thereof) can play in motivating and then enrolling and socializing adopters and non-adopters. Sociotechnical commensurability implies that compatible charging, fueling, and maintenance infrastructure must exist so that EVs are seen to be as reliable as the network assemblage undergirding their conventional counterparts. Habitual momentum implies that a process of "learning by driving" can acclimate and even socialize adopters into a new affinity group of EV drivers that can "freeze" into new behavioral patterns The integrative frame- work provides a more holistic conception of the user, moving beyond merely a driver	The validity of the proposed framework needs examined, and future research could assess the proposed structure using fac- tor analysis and then utilize regression to validate the predictive power of the framework, as many studies utilizing the UTAUT have done, or rely on agent based modeling to try and capture the influ- ence of actants, even human ones. Moreover, the predictive "fit" or usefulness of the concepts of motile pleasure, sociality, sociomaterial commensurability, and habitual momentum could be qualitatively evaluated based on field work and actual user feedback. Do

Authors	Titel	Year	Keywords	Research Question/ Aim	Type of Vehicle	Context	Sample	Hypothesis	Theoretical Framework	Methods	Main Results	Limitations/ Future reccomendations
Mohamed, Moataz; Higgins, Chris; Ferguson, Mark; Kanaroglou, Pavlos	Identifying and characterizing potential electric vehicle adopters in Canada: A two-stage modelling approach	2016	Electric vehicle Theory of planned behaviour Segmentation Structural equation model	the paper operationalizes an extended version of the Theory of Planned Behaviour in a structural equation model to quantify the impacts of personal beliefs on individual adoption intention towards electric vehicles. Model	plug-in hybrid (PHEV) and battery electric (BEV)	Canada	3505 households	H1: Environmental concern positively influences attitude to- wards adopting EVs, H2: Environmental concern positively influences subjective norm, H3: Environmental concern positively influences perceived be- haviour control, H4: Environmental concern positively influences personal moral norm, H5: Attitude towards adopting EVs positively influences the intention to adopt EV, H6: Subjective norm positively influences the intention to adopt EV, H7: Perceived behavioural control positively influences the in- tention to adopt EV, H8: Personal moral norm positively influences the intention to adopt EV, H9: Environmental concern indirectly influences the intention to adopt EV.		two-stage structural equation modelling and segmentation process The present study employs a sequential two-step analysis that utilizes a structural equation model (SEM) and cluster analysis he paper develops a model explaining in- dividual intentions to adopt economy-class EVs in the Canadian market and uses this information to profile dominant potential BEV and PHEV adopters. Working	Model results show that attitude, perceived behavioural control, and norms (moral and subjective) have significant direct impacts on behavioural intention, while a household's concern for the environment has an indirect impact. Age, level of em- ployment, and employment status are identified, among other variables, to significantly influence the adoption intention. Collectively, findings indicate that beliefs vary across socioeconomic and demo- graphic characteristics. To best characterize the most likely group of early adopters, we then conduct a Two-Step cluster analysis on households with a high demonstrated intention to adopt EVs. This results in three distinct socio-economic and demographic segments: Typical Early Adopters, Emerging Early Adopters, and Interested Retirees. Each	
Bigerna, Simona; Bollino, Carlo Andrea; Micheli, Silvia	Italian youngsters' perceptions of alternative fuel vehicles: A fuzzy-set approach	2016	Alternative fuel vehicles fsQCA Theory of planned behavior Consumer attitude	This study analyzes the attitude of Italian youngsters toward the adoption of alternative fuel vehicles (AFVs), using the fuzzy-set qualitative comparative analysis. This study intends to fill this gap by exploring the attitude of Italian youngsters toward the adoption oAFVs, using the fuzzy-set qualitative comparative analysis (fsQCA). In particular, the objective of this study is twofold: To analyze the decisively positive attitude toward AFV and decisively refusal attitude toward AFVs	AFVs	Italy (Italian university students)	n=330	na	This study analyzes youngsters' attitude toward AFVs using fsQCA	using the fuzzy-set qualitative comparative analysis (fsQCA). In	The findings from the survey (n=330) indicate the relevant determinants that spur the purchase of alternative fuel vehicles, the type of technology preferred among such vehicles, the specific related environmental benefits and the related barriers that youngsters perceive. Consumers' acceptance is crucial in the development oAFVs. This study applies fsQCA to explore two models. The first shows which conditions lead youngsters to show a definite interest in AFV. The second shows the conditions that render youngsters attitude toward AFV definitely negative.	The limitation of this research lies in a small sample of the population of youngsters which is not fully representative of the whole country
Stillwater, Tai; Kurani, Kenneth S.	Drivers discuss ecodriving feedback: Goal setting, framing, and anchoring motivate new behaviors	2013	Feedback Theory of Planned Behavior Ecodriving Goals Driving behavior Driver psychology Behavioral economics	To explore the effects on ecodriving of interaction between drivers and in-vehicle energy feedback, a customized, interactive energy feedback interface was deployed in a field test with real-world drivers This paper relies specifically on self-reports of driver motivations and behaviors to better understand what types of information motivated new ecodriving behavior;	Plug-in Hybrid Electric Vehicle (PHEV) drivers	California, USA	n=46	The mixed-method experimental design made it pos- sible to record and analyze the verbal responses of drivers to the introduction of feedback using interviews, as well as to experimentally determine both if and how hypothesized psychological factors such as perceived behavioral control and goal setting influence driver behavior and energy outcomes. A	The- ory of Planned Behavior (TPB) (Ajzen, 1980) and the Extended Model of Goal Directed Behavior (EMGDB). The TPB's main contribution is to incorporate social norms and perceived behavioral control (perception of one's own ability to effect change) into the same framework as attitudes and valuations on intentions to perform behaviors of interest. The EMGDB re-orients the TPB framework to focus on achievement of behavioral goals (e.g., getting 50MPG for a certain trip or tank of gas), rather than intentions to perform specific actions (e.g., moderating one's acceleration). 	The subjects participated in semi-structured interviews in which they discussed the PHEV experience in general and the experience of using the interface in particular	Driver interviews at the con- clusion of the study revealed that the introduction of feedback led three fourths of drivers to change driving styles to maximize on-road efficiency, at least in the short term. In addi- tion, this study finds that the context of the feedback information, provided by a built-in goal or other contextualizing information such as a comparison value, is important for both comprehension and motivation. Personalization of the information allowed different dri- ers to access pertinent information, increasing the motivational value of the information. Instantaneous performance feedback such as real-time energy economy or power is used primarily for experimentation and learning of new ecodriving behaviors, whereas average performance feedback is used primarily for goal-setting and goal achievement. In addition, the direct comparison of personalized driver goals and average performance created a game-like experience that encouraged high achievement. Finally, the driver interviews revealed that feedback frames driving as a time to act in an efficient manner The behavioral theories TPB and EMGDB posit that setting goals, increasing perceived behavioral control, information rel- evant to attitudes about driving, and the presentation of such information in social contexts will facilitate increases in MPG+.	
Jason Henderson	EVs Are Not the Answer: A Mobility Justice Critique of Electric Vehicle Transitions	2020	decarbonization, electric vehicles, mobility justice, transport geography, urban geography.	This article urges caution and pause before an EV lock-in and calls on geographers and other scholars, professionals, and sustainability advocates to consider the multiscale environmental and social problems associated with EVs. Using a mobility justice framework, I ask who is making these assumptions and why and discuss the influence of liberal economic theory on future projections of EVs. I next consider assumptions about the environmental efficacy and decarbonization potential of mass EV uptake and review how EV production and consumption might escalate rather than reduce global resource and energy demand. I also scale down to cities and describe how EVs will lay claim to many of the same spaces designated for green mobility, such as cycle tracks, bus lanes, and compact, walkable spaces.	EVs	no empirical research	no empirical research	no empirical research	Review and critical assessment of Evs	Review	Three areas are ripe for deeper inquiry into EVs and the broader future of mobility: (1) Critical analysis of the assumptions of more cars in the future and inclusion of green mobility in future projections; (2) closer interrogation of the resource, emissions, and energy claims of EVs; and (3) examination of the politics of mobility of EVs.	
Volkan Dogan & Mujdat Cirmen	Belief in Environmentalism and Independent/Interdependent Self-Construal as Factors Predicting Interest in and Intention to Purchase Hybrid Electric Vehicles	2017	Hybrid electric vehicles . Level of environmentalism . Self-construal . Optimal distinctiveness theory . Self-construal theory	The present study investigated whether relative level of environmentalism and self-construal jointly predicted de- gree of interest in and intention to purchase HEVs	Hybrid electric vehicles (HEVs)	(mainly from the U.S. and India	289 participants	We claim that consumer's relative level of environmental- ism interacts with self-construal to predict interest and pur- chase intention. Specifically, we hypothesize that among con- sumers who have a relatively low level ofenvironmentalism, consumers with interdependent self-construal will have great- er interest in HEVs and greater intention to purchase HEVs than will consumers with independent self-construal. In con- trast, we also hypothesized that among consumers who have a relatively high level of environmentalism, participants with independent self-construal will have greater interest in and greater intention to purchase HEVs than will participants with interdependent self-construal	optimal distinctiveness theory + self-construal theory Two theories as our framework, namely, optimal distinctiveness theory (Brewer 1991) and self-construal theory (Markus and Kitayama 1991). SCT proposes that people construe their selves in two different ways: independent con- strual or interdependent construal.		The results showed that level ofenviron- mentalism interacted with self-construal to predict the degree ofinterest in HEVs and intention to purchase HEVs. Post hoc tests revealed that among participants who had relatively low level of environmentalism, participants with interdependent self-construal had a greater degree of interest in HEVs and greater intention to purchase HEVs than did participants with independent self-construal. In contrast, among participants who had relatively high levels of environmentalism, partici- pants with independent self-construal had a greater degree of interest in HEVs and greater intention to purchase HEVs than did participants with interdependent self-construal. However, the effect of the interaction between relative level of environmentalism and self-construal on intention to purchase HEVs was not significant when the degree ofinterest in HEVs was controlled.	
Costanza Nosi Tommaso Pucci Cinzilia Sihezioi and Barbara Aquilani	Does Value Co-Creation Really Matter? An Investigation of Italian Millennials Intention to Buy Electric Cars	2017	value co-creation; electric vehicles (EVs); car attributes; Theory of Reasoned Action	The present research aims to explore the determinants of (full) electric vehicle (EV) buying intention of Italian millennials focusing on the role that value co-creation initiatives might play in the buying decision-making process. Value co-creation initiatives in the EV domain are studied employing an enhanced version of the Theory of Reasoned Action which, in addition to the traditional variables of the model, also includes perceived importance of cars' attributes.	EVs	Italy	523 Italians	Hypothesis (Hp.) 1a. Perceived importance ofbenefits is negatively related to EV buying intention. Hp. 1b. Perceived importance ofbenefits is positively related to EV buying intention. Hp. 1c. Perceived importance ofinnovative technological services is positively related to EV buying intention. Hp. 1d. Perceived importance ofpre- and post-sale services is positively related to EV buying intention. Hp. 2a. Attitude is positively related to EV buying intention. Hp. 2b. Subjective norm is positively related to EV buying intention. Hp. 3. Co-creation involvement positively influences EV buying intention. Hp. 4a. The higher is the perceived importance ofbenefits, the higher is the co-creation involvement. Hp. 4b. The higher is the perceived importance ofbenefits, the higher is the co-creation involvement. The Hp. 4c. The higher is the perceived importance of innovative technological services, the higher is the co-creation involvement. Hp. 4d. The higher is the perceived importance ofpre- and post-sale services, the higher is the co-creation involvement. Hp. 5a. Attitude positively influences value co-creation involvement. Hp. 5b. Subjective norm positively influences value co-creation involvement. Hp. 6a. Perceived importance ofbenefits is positively mediated by value co-creation involvement. Hp. 6b. Perceived importance ofbenefits is positively mediated by value co-creation involvement. Hp. 6c. Perceived importance ofinnovative technological services is positively mediated by value co-creation involvement. Hp. 6d. Perceived importance ofpre- and post-sales services is positively mediated by value co-creation involvement. Hp. 7a Attitude is positively mediated by value co-creation involvement. Hp. 7b. Subjective norm is positively mediated by value co-creation involvement.	Theory of Reasoned Action	Structural Equation Modeling (SEM) is used to analyze the data collected though an online survey	our results confirm that both attitude [9.47] and subjective norm [49–51] have an impact on EV buying intention. Specifically, the more positive is the attitude, the higher is the behavioral intention, and the greater is the perceived social pressure, the higher is the intention to purchase the car. Furthermore, the influence of salient referents—in our case parents and friends—in the millennials' purchasing decision suggests that communication targets should not only be single individuals, but also families and group of peers, such as university mates, that could represent more profitable target audiences given the reciprocal influence that they might exert on each other. With relation to electric cars' attributes, our findings are instead contradicting. The investigated barriers and benefits, including the explored novel technological services, do not seem to play a role in the millennials' decision-making. The only attribute that has been found to influence them, and negatively, is constituted by pre- and post-sale services	First, our study focuses on Italian millennials living in the center of Italy due to the purposive sampling methodology adopted. The socio-demographic characteristics of our sample surely influenced the provided answers. Further research should investigate wider populations living in different countries and having different socio-demographic characteristics Finally, the co-creation initiatives investigated in this work involved a high degree of cognitive effort on the part of consumers, being the activities related to co-design or co-development.
Milad Mehdizadeh , Afshin Shariat-Mohaymany	Who are less likely to vote for a low emission charging zone? Attitudes and adoption of hybrid and electric vehicles	2021	Low Emission Charging Zone Hybrid and electric vehicles Attitudes Referendum voting Road pricing	the current study was carried out to (a) determine the extent to which residents support a Low Emission Charging Zone (LECZ) via a hypothetical referendum voting, (b) examine the relationship between intention to adopt Hybrid and Electric Vehicles (HEVs) by voting for/against LECZ through employing the Theory of Planned Behaviour (TPB), and (c) investigate public attitudes towards the proposed system. We empirically investigated the acceptability of a stricter pollution charging zone	HEV	Tehran, Iran	n = 595)	it is hypothesised that attitudes towards the LECZ system, such as system complexity, LECZ effectiveness and fairness can be negatively or positively related to voting for/against LECZ in a hypothetical ref- erendum (as the outcome behaviour). it is hypothesised that HEVs adoption including structural associations between attitudes towards behaviour, subjective norms, perceived behaviour control, and intention to adopt can be positively linked to voting for the LECZ policy through the theory of planned behaviour. it is hypothesised that socioeconomic variables can exert direct/indirect impact on voting against/for the policy through latent psychological factors, known as mediator variables. Finally, it is assumed that the travel-related and built environment features can also be either positively or negatively associated with voting for/against the LECZ system.	Theory of Planned Behaviour (TPB) 	Factor analysis The hybrid choice modelling (HCM)	The results indicated that around two-thirds of the participants voted against the LECZ scheme, and that latent psychological factors had a stronger impact on voting against the LECZ than observed variables. The results also revealed that people would be more likely to adopt and less likely to oppose the LECZ if the price, maintenance, and repair of HEVs were affordable. Regarding public attitudes towards the proposed system, distrust in government concerning the use of LECZ-derived revenues was noticeably related to the LECZ rejection. In	The data used in the study was collected using a cross-sectional and self-reported design. This design may be biased towards socially desirable responses and cast doubts on causal expla- nations between the attributes. Besides, since the empirical results of the current study are restricted to the data collected from the Middle East, caution should be exercised in generalising the results to other contexts. We also used the socioeconomic variables as linear in the utility function. As Another limitation is that all respondents in our sample were car users, and in an actual ref- erendum, non-car users may be more willing to accept the LECZ scheme. Moreover, participants with older cars would be more opposed to the LECZ system as they have to pay a higher fee. However,
Gruber, Mario	An evolutionary perspec	2020	Adoption Diffusion Radical Multi-level perspective	Drawing on the multi-level perspective, an evolutionary system-approach theory, this article first identifies the limitations of extant adoption-diffusion theories. It then uses this perspective to propose an understanding of innovation adoption and diffusion that accounts for factors and developments beyond extant theories' typical focus. In particular, it highlights the evolutionary elements, such as co-evolution and whole system behavior, that should be considered for radical innovations, whose adoption and diffusion depend on co-evolving user preferences, technology, and polic	electric mobility			This article presents an evolutionary perspective on AD theory and suggests how the MLP – an evolutionary system perspective – can provide a deeper understanding of adoption and diffusion, as well as facilitate the adaptation of AD theory for radical innovations (e.g., electric mobility). Typical	Adoption-diffusion (AD) theories	This article draws on the multi-level perspective (MLP) (Geels, 2005) – a system approach allowing researchers to build theory on micro, meso, and macro levels of analysis – as a fitting system per- spective to analyze how AD theory is limited	MLP provides a useful lens to con- textualize the phenomena of radical innovations' adoption and diffu- sion by transcending taken-for-granted assumptions, static factors, and linear processes, and incorporating multi-dimensional interactions. First, it answers recent calls by AD theorists to use a system approach by showing how the MLP can be used as a lens to study adoption and diffusion Finally, this article offers suggestions for combining theoretical approaches of extant AD and ST theory, and recommends suitable research methods, such as exploratory case studies to construct new theory.	Hence, a key future research question is: How do system-level phenomena affect micro-level phenomena regarding the adop- tion or diffusion of radical innovations? This raises another question for future research: How do system-level influences affect micro- level adoption or diffusion factors?
Rahman, Imran	The Interplay of Product Involvement and Sustainable Consumption: An Empirical Analysis of Behavioral Intentions Related to Green Hotels, Organic Wines and Green Cars	2017	sustainable consumption; green hotel; organic wine; green car; consumer behavior; environmental products; purchase inten- tion; involvement Introduction	The purpose of this study is to examine how consumer involvement affects purchase intentions, willingness to pay more and willingness to sacrifice for three green products – green hotels, organic wines and green cars. By	green cars = Electric vehicles (and green hotels, organic wines)		n=375	Hypothesis 1. Willingness to purchase a green car is significantly less for high-involvement consumers than for low- involvement consumers. Hypothesis 2. Willingness to pay more for a green car is significantly less for high-involvement consumers than for low- involvement consumers. Hypothesis 3. Willingness to sacrifice for a green car is significantly less for high-involvement consumers than for low- involvement consumers. Organic	By applying consumer involvement and elaboration likelihood theory, this study investigates whether significant differences exist between high- and low-involvement consumers' behavioral intentions for these three environmental products. This study is based on quantitative methodology employing a survey design.	The elaboration likelihood model (Petty et al., 2005; Cacioppo and Petty, 1984; Petty et al., 1983) provides a general framework for organizing and understanding the effectiveness ofpersuasive communications and can be applied to product purchase situations.	Results reveal that consumers' behavioral intentions depend strongly on the type of environmental product considered and the underlying type and extent of involvement associated with the product category.	The same product involvement scale was used to measure consumer involvement for all three products. It would have been a better approach to use different scales, especially for products that can have different type of product involvement associated with them. This study utilized a self-report survey about consumers' product involvement and environment-friendly behavioral intentions. Social desirability bias might therefore be an issue. Theoretical
Bockarjova, M.; Steg, L.	Can Protection Motivation Theory predict pro-environmental behavior? Explaining the adoption of electric vehicles in the Netherlands	2014	Slow-onset risk Environmental risk Energy security risk Adoption of innovation Conventional fuel vehicle Efficac	In this paper we aim to test whether Protection Motivation Theory is successful in explaining pro-environmental actions (adaptive behavior) that are believed to reduce slow onset environmental risks such as climate change, environmental pollution, or security of energy supply. The following research questions will be answered: which barriers impede the adoption of pro-environmental actions and how to overcome them? And: which factors promote the adoption of pro-environmental actions?		Netherlands	N = 2974	Items of theory tested	Protection Motivation Theory provides a valuable framework to explain pro-environmental choices, by employing a wide set of predictors, such as the costs and benefits of current (maladaptive) behavior as well as prospective adaptive behavior. 	The Protection Motivation Theory, originally proposed to predict behavior in the context of personal health threats, Protection Motivation Theory not only focuses on cost and benefits of adaptive behavior that reduce environmental risks, but also considers benefits of current products or practices that increase the likelihood of maladaptive behavior that in turn increase environmental risks. Protection Motivation Theory accommodates aspects of collective action as well Items used for measuring perceived severity, perceived vulnerability and perceived response efficacy We ran a series of regression analyses to test to what extent the Protection Motivation Theory is successful in predicting the 4 different indicators of adoption of electric vehicles. We tested the models via multiple regression analyses, and report standardized regression coefficients to examine the relative importance of the different Protection Motivation Theory variables in explaining the adoption indicators	Respondents were particularly more likely to adopt an electric vehicle when they perceived the negative consequences caused by conventional vehicles as more severe, and when they expected electric vehicles to decrease these consequences. The most important barriers for electric vehicle adoption were perceived high monetary and non-monetary costs of electric vehicles, and benefits associated with the use of a conventional vehicle. our findings suggest that both collective concerns and individual concerns predict different indicators of adoption. Individual	uture studies need to test whether Protection Motivation Theory can be used to predict other types of pro-environmental actions related to such slow onset risks as energy savings, recycling, or eco-driving. Another important direction for future research is to explore the relative merits and effectiveness of various theoretical frameworks used in modeling pro-environ- mental behavior (for example, comparing Protection Motivation Theory to the widely used Norm Activation Model or Theory of Planned Behavior). As

Appendix 2: Results most important Factors Likert Scale (Chapter 2)

	1	2	3	4	5	6	7	8	9	10	na	Total general
Brand	192	93	165	141	277	204	368	446	154	129	35	2204
	9%	4%	7%	6%	13%	9%	17%	20%	7%	6%	2%	
Price	10	1	7	6	55	56	189	502	569	784	25	
	0%	0%	0%	0%	2%	3%	9%	23%	26%	36%	1%	
Drive	43	8	30	51	122	155	263	491	455	562	24	
	2%	0%	1%	2%	6%	7%	12%	22%	21%	25%	1%	
Design	58	39	81	83	223	256	416	497	295	230	26	
	3%	2%	4%	4%	10%	12%	19%	23%	13%	10%	1%	
Consum	10	5	15	23	84	115	252	522	559	590	29	
	0%	0%	1%	1%	4%	5%	11%	24%	25%	27%	1%	
Perf	27	20	52	70	222	272	402	460	335	318	26	
	1%	1%	2%	3%	10%	12%	18%	21%	15%	14%	1%	
Emissions	66	33	82	85	192	209	350	407	363	388	29	
	3%	1%	4%	4%	9%	9%	16%	18%	16%	18%	1%	
SocAccept	702	236	260	172	335	157	146	114	33	25	24	
	32%	11%	12%	8%	15%	7%	7%	5%	1%	1%	1%	
Reputation	432	126	192	157	331	226	297	228	105	83	27	
	20%	6%	9%	7%	15%	10%	13%	10%	5%	4%	1%	

Appendix 3: Factors Definition, Meand and Std. Dev.(Chapter 2)

What are the most important factors when buying a new car? Please indicate on a scale from "1 = not important at all" to "10 = most important".			
Variable name	**Description**	**Mean**	**Std Dev**
Factor_Brand	Brand	5,919529	2,560864
Factor_Price	Price, cost of car	8,703981	1,402387
Factor_Drive	Driving Range (distance your car can drive before recharging/refueling)	7,96676	1,989038
Factor_Design	Design	6,997657	2,126010
Factor_Consum	Consumption	8,332865	1,597029
Factor_Perf	Performance (HP, kwH)	7,310684	1,988836
Factor_Emiss	Emissions	7,265134	2,289515
Factor_SocAccept	Social Acceptance	3,548689	2,426912
Factor_Reput	Reputation	4,861697	2,714374

Appendix 4: Definition Variables for Factor Analysis

Please indicate on a scale from 1 (completely disagree) to 5 (completely agree) with the following. (EV = electric vehicle. ICE = internal combustion engine; traditional vehicle)			
Variable name	**Description**	**Mean**	**Std Dev**
Scale_personalnecess	An electric vehicle fits my personal necessities.	3,444548	1,059043
Scale_professionalnecess	An electric vehicle fits my professional necessities.	3,529135	1,082883
Scale_image_socialstatus	Driving an electric vehicle would improve my image and social status.	2,758072	1,10029
Scale_lifestyle	Driving an electric vehicle would improve my lifestyle.	3,119025	1,099326
Scale_environ	It is important to take care of the environment.	4,798689	0,5100564
Scale_lessemiss	For the purchase of an EV, I am motivated by a lower contamination of an EV (compared to an ICE).	4,074403	1,059815
Scale_ecofriendlyimage	For the purchase of an EV, I am motivated by an eco-friendly image towards others (others will think that I care about the environment).	2,354899	1,172772
Scale_statussociety	Individuals who purchase an EV have a better status in society.	2,700234	1,065377
Scale_penalty	A (penalty) tax for ICE would be fair and just.	2,613296	1,285586
Scale_subventions	The purchase of an electric vehicle should be incentivised by financial advantages.	4,127341	0,9787827
Scale_willingnesspaymore	I am willing to pay more for a technology with a lower contamination.	3,472625	1,091045
Scale_lowerconsumhigherprice	The lower consumption (cost) of an electric vehicle can compensate for a higher initial price of EVs vs. traditional cars.	3,404594	1,02635
Scale_lowrunningcosts	The lower running costs for workshop, parts, maintenance etc. can compensate for the higher initial price of electric vehicles vs. traditional cars.	3,380573	1,036053

Electric vehicles are not sold more often due to….			
Evless_price	Electric vehicles are not sold more often due to……the high purchase price.	4,339783	0,7385757
Evless_wallbox	… the fact of not having a private parking space to install chargers (Wallbox).	4,284507	0,7830966
Evless_lessinfo	… the little information provided about electric vehicles.	3,673412	1,066381
Evless_knowledgeDealer	…the lack of knowledge about electric vehicles of sales advisors in dealerships	3,284102	0,9784508
Evless_infrastr	…the lack of public chargers.	4,323156	0,7790937
Evless_costelectricity	…the cost of electricity to charge the car.	3,306459	1,149405
Evless_perfor	…the performance of the electric vehicle.	3,025071	1,107064
Evless_range	…the limited range of electric vehicles.	4,017908	0,9236072
Evless_installprivatecharger	…the effort (approval by community) to install a private charger in a shared parking space.	3,74189	0,9491536

Appendix 5: Factor Analysis/ Correlation (Chapter 2)

Factor analysis/correlation — Number of obs = 1985
Method: principal-component factors — Retained factors = 10
Rotation: (unrotated) — Number of params = 285

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	4.25686	1.50492	0.1290	0.1290
Factor2	2.75194	0.11469	0.0834	0.2124
Factor3	2.63725	0.55196	0.0799	0.2923
Factor4	2.08530	0.31491	0.0632	0.3555
Factor5	1.77038	0.20660	0.0536	0.4091
Factor6	1.56378	0.17755	0.0474	0.4565
Factor7	1.38623	0.03809	0.0420	0.4985
Factor8	1.34814	0.28558	0.0409	0.5394
Factor9	1.06256	0.02206	0.0322	0.5716
Factor10	1.04050	0.04633	0.0315	0.6031
Factor11	0.99417	0.11924	0.0301	0.6332
Factor12	0.87493	0.06011	0.0265	0.6598
Factor13	0.81482	0.03395	0.0247	0.6844
Factor14	0.78087	0.03922	0.0237	0.7081
Factor15	0.74165	0.02902	0.0225	0.7306
Factor16	0.71263	0.03307	0.0216	0.7522
Factor17	0.67955	0.00784	0.0206	0.7728
Factor18	0.67171	0.04878	0.0204	0.7931
Factor19	0.62293	0.02092	0.0189	0.8120
Factor20	0.60202	0.03397	0.0182	0.8302
Factor21	0.56805	0.03252	0.0172	0.8475
Factor22	0.53553	0.00237	0.0162	0.8637
Factor23	0.53316	0.03135	0.0162	0.8798
Factor24	0.50182	0.01255	0.0152	0.8951
Factor25	0.48927	0.02547	0.0148	0.9099
Factor26	0.46380	0.02935	0.0141	0.9239
Factor27	0.43445	0.01440	0.0132	0.9371
Factor28	0.42005	0.02533	0.0127	0.9498
Factor29	0.39472	0.04268	0.0120	0.9618
Factor30	0.35204	0.01179	0.0107	0.9725
Factor31	0.34025	0.03236	0.0103	0.9828
Factor32	0.30788	0.04710	0.0093	0.9921
Factor33	0.26078	.	0.0079	1.0000

LR test: independent vs. saturated: chi2(528) = 1.6e+04 Prob>chi2 = 0.0000

Appendix 6: Factor Loadings and Unique Variances (Chapter 2)

Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8	Factor9	Factor10	Uniqueness
Age	-0.0101	0.3052	-0.1594	0.7074	0.2563	0.2913	0.0974	-0.1068	0.1029	-0.1541	0.1751
Children	0.0184	0.2712	-0.2038	0.6498	0.2675	0.2892	0.0907	-0.1259	0.1508	-0.2265	0.2091
Factor_Brand	0.1127	0.6421	-0.0186	-0.0333	-0.1907	-0.0576	0.3377	0.0260	0.0859	0.0498	0.4093
Factor_Price	0.1087	-0.2036	0.3300	-0.2631	-0.3639	0.0689	-0.0242	0.2000	0.2626	-0.2161	0.4752
Factor_Drive	0.2374	0.1206	0.2612	0.3878	-0.3216	-0.0001	-0.1585	0.2412	-0.0876	-0.0129	0.5159
Factor_Des~n	0.1589	0.5972	0.0578	-0.1090	-0.3059	-0.1236	0.2416	0.0565	-0.0042	0.1662	0.4048
Factor_Con~m	0.2825	-0.1173	0.4671	0.2181	-0.3958	-0.0432	-0.1787	0.1502	0.0214	-0.2993	0.3376
Factor_Perf	0.1189	0.3011	0.3885	0.1952	-0.3936	-0.1735	0.0159	0.0388	-0.0384	-0.0760	0.5121
Factor_Emiss	0.4680	-0.1036	0.1736	0.5052	-0.2543	-0.0784	-0.1732	-0.0140	-0.1733	-0.0671	0.3493
Factor_Soc~t	0.2599	0.7069	-0.1924	-0.1578	-0.0741	-0.0375	0.0082	-0.0652	-0.0384	-0.0555	0.3551
Factor_Reput	0.1946	0.6954	-0.1234	-0.1235	-0.1698	-0.1154	0.0859	-0.0091	0.0008	-0.0929	0.3899
Scale_pers~c	0.5725	-0.2388	-0.1722	-0.0130	-0.2225	0.1414	0.3310	-0.1755	-0.0820	0.2255	0.3179
Scale_prof~c	0.5070	-0.1438	-0.1949	0.0022	-0.1975	0.2082	0.3592	-0.1263	-0.0884	0.3071	0.3548
Scale_imag~s	0.5375	0.1386	-0.2895	-0.2920	0.0445	0.2181	-0.2771	0.1354	-0.0850	-0.0862	0.3635
Scale_life~e	0.6388	-0.1184	-0.1469	-0.1566	-0.0444	0.1324	-0.0997	-0.1306	-0.0336	0.0531	0.4813
Scale_envi~n	0.3756	-0.2983	0.0956	0.1412	-0.0743	0.0162	-0.0399	0.0821	-0.2185	0.1937	0.6415
Scale_less~s	0.6572	-0.1917	-0.0437	0.0677	-0.0267	0.1411	0.0130	-0.0536	0.0621	0.0508	0.4947
Scale_ecof~e	0.4345	0.3360	-0.2312	-0.2490	0.1167	0.1588	-0.3402	-0.0367	0.0130	-0.1376	0.4079
Scale_stat~y	0.4529	0.1439	-0.2323	-0.2415	0.1310	0.2285	-0.4215	0.1882	-0.0960	-0.1262	0.3543
Scale_pena~y	0.4662	-0.0308	-0.1862	0.2137	0.1604	-0.1560	-0.0268	-0.0402	-0.0290	0.0292	0.6473
Scale_subv~s	0.4872	-0.1359	0.1196	-0.0857	0.0127	0.3418	0.1182	0.0105	0.3022	0.0145	0.5000
Scale_will~e	0.4709	-0.1324	-0.1516	0.3304	0.1022	-0.3176	-0.0786	0.1392	-0.1674	0.1162	0.4503
Scale_lowe~e	0.4871	-0.1092	-0.1654	0.0096	0.2659	-0.5475	0.1322	0.2701	0.2414	-0.0384	0.2027
Scale_lowr~s	0.4556	-0.0878	-0.1092	-0.0373	0.3095	-0.5259	0.1379	0.2049	0.3251	-0.0884	0.2245
Evless_price	0.1754	-0.1785	0.2425	-0.0978	-0.0550	0.3960	0.2322	0.1744	0.4498	-0.1150	0.4093
Evless_wal~x	0.1375	0.0819	0.4505	-0.0853	0.3537	0.1613	0.2668	0.3449	-0.2707	-0.1183	0.3356
Evless_les~o	0.3585	-0.0392	0.4760	-0.0885	0.1391	-0.1341	0.0151	-0.5226	0.0212	-0.1372	0.3056
Evless_kno~r	0.3461	0.0458	0.3975	-0.0640	0.2057	-0.1459	-0.0283	-0.5511	0.0221	-0.1429	0.3270
Evless_inf~r	0.2024	0.0859	0.4706	-0.0422	0.3793	0.1638	0.2663	0.1987	-0.2293	0.0028	0.3947
Evless_cos~y	0.0222	0.1305	0.5027	-0.1461	0.1025	-0.0442	-0.1501	-0.1616	0.0128	0.1017	0.6368
Evless_per~r	0.0579	0.2242	0.3674	0.0767	0.0834	-0.0290	-0.3704	-0.1704	0.3364	0.4616	0.3053
Evless_range	-0.0496	0.2884	0.2573	0.2198	0.1991	0.1480	-0.2440	0.3126	0.1996	0.4804	0.3104
Evless_ins~r	0.1294	0.1871	0.4620	-0.1565	0.3657	0.0328	0.0814	0.0837	-0.2479	0.0459	0.4983

Appendix 7: Rotated Factor Loadings and Unique Variances -1 (Chapter 2)

```
. rotate

Factor analysis/correlation                       Number of obs    =      1985
    Method: principal-component factors           Retained factors =        10
    Rotation: orthogonal varimax (Kaiser off)     Number of params =       285
```

Factor	Variance	Difference	Proportion	Cumulative
Factor1	2.48549	0.02878	0.0753	0.0753
Factor2	2.45671	0.11054	0.0744	0.1498
Factor3	2.34617	0.21532	0.0711	0.2209
Factor4	2.13086	0.06787	0.0646	0.2854
Factor5	2.06298	0.09991	0.0625	0.3479
Factor6	1.96307	0.10845	0.0595	0.4074
Factor7	1.85462	0.04592	0.0562	0.4636
Factor8	1.80870	0.40256	0.0548	0.5184
Factor9	1.40614	0.01795	0.0426	0.5611
Factor10	1.38818	.	0.0421	0.6031

LR test: independent vs. saturated: chi2(528) = 1.6e+04 Prob>chi2 = 0.0000

Rotated factor loadings (pattern matrix) and unique variances

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8	Factor9	Factor10	Uniqueness
Age	0.0540	-0.0121	-0.0372	0.0485	-0.0436	0.8996	-0.0352	0.0177	-0.0408	0.0605	0.1751
Children	0.0352	-0.0240	0.0151	0.0146	-0.0043	0.8876	-0.0060	-0.0233	0.0132	-0.0012	0.2091
Factor_Brand	0.7488	0.0588	-0.0611	-0.0262	0.0252	0.1090	-0.0331	0.0603	0.0578	0.0384	0.4093
Factor_Price	-0.0235	-0.0537	0.0156	0.2934	-0.0119	-0.3606	0.0296	-0.0126	0.5471	-0.0673	0.4752
Factor_Drive	0.1126	0.0469	0.0148	0.6471	-0.0196	0.0939	-0.1025	0.0676	-0.0042	0.1613	0.5159
Factor_Des~n	0.7421	0.1075	-0.0416	0.0766	-0.0057	-0.0917	-0.0366	0.0550	-0.0145	0.1111	0.4048
Factor_Con~m	-0.0402	-0.0480	0.0051	0.7516	0.0084	-0.0843	0.1457	0.0417	0.2500	-0.0312	0.3376
Factor_Perf	0.3840	-0.0666	-0.1686	0.5283	-0.0561	-0.0393	0.1236	0.0450	0.0251	0.0768	0.5121
Factor_Emiss	-0.0798	0.2625	0.0605	0.7006	0.0991	0.1781	0.1319	-0.0322	-0.1415	0.0280	0.3493
Factor_Soc~t	0.6976	-0.0112	0.3546	-0.0598	0.0194	0.1019	0.0687	-0.0207	-0.1133	0.0035	0.3551
Factor_Reput	0.7403	-0.0607	0.2133	0.0174	0.0439	0.0652	0.0333	-0.0279	-0.0590	-0.0324	0.3899
Scale_pers~c	0.0377	0.7966	0.0608	0.0528	0.0920	-0.0480	0.0737	-0.0438	0.0623	-0.1328	0.3179
Scale_prof~c	0.0991	0.7910	0.0475	-0.0108	0.0341	-0.0015	-0.0167	-0.0001	0.0469	-0.0606	0.3548
Scale_imag~s	0.1032	0.1959	0.7537	0.0041	0.0987	-0.0607	-0.0464	0.0273	0.0336	-0.0442	0.3635
Scale_life~e	-0.0237	0.4820	0.4605	0.0775	0.1378	-0.0805	0.1897	-0.0557	0.0503	-0.0254	0.4813
Scale_envi~n	-0.2265	0.3992	0.0632	0.3035	0.0902	-0.1022	-0.0068	0.1270	-0.1119	0.0658	0.6415
Scale_less~s	-0.0909	0.5215	0.2923	0.1964	0.2238	0.0687	0.1559	0.0074	0.1463	0.0225	0.4947
Scale_ecof~e	0.2181	0.0147	0.7174	-0.0547	0.0609	0.0575	0.1274	-0.0444	0.0019	0.0388	0.4079
Scale_stat~y	0.0093	0.0375	0.7932	0.0397	0.0717	-0.0220	-0.0587	0.0627	-0.0001	0.0226	0.3543
Scale_pena~y	-0.0269	0.2695	0.1975	0.1123	0.3799	0.1953	0.1019	-0.0257	-0.1848	0.0102	0.6473
Scale_subv~s	-0.0512	0.3892	0.2175	0.0376	0.1067	0.0572	0.1435	0.1061	0.4901	0.1027	0.5000
Scale_will~e	-0.1083	0.2741	0.1176	0.2998	0.4755	0.0999	-0.0429	0.0197	-0.3449	0.0440	0.4503
Scale_lowe~e	0.0290	0.0902	0.0730	0.0270	0.8823	-0.0457	0.0081	0.0271	-0.0095	-0.0272	0.2027
Scale_lowr~s	0.0351	0.0288	0.0636	-0.0296	0.8667	-0.0316	0.1010	0.0253	0.0723	-0.0175	0.2245
Evless_price	-0.0792	0.1553	-0.0080	0.0223	0.0199	0.0391	-0.0070	0.1449	0.7313	0.0441	0.4093
Evless_wal~x	0.0103	-0.0455	0.0189	0.0551	0.0397	0.0006	0.0225	0.8026	0.1053	-0.0385	0.3356
Evless_les~o	-0.0092	0.0993	-0.0121	0.1113	0.0662	-0.0564	0.8031	0.1279	0.0541	0.0130	0.3056
Evless_kno~r	0.0270	0.0544	0.0437	0.0560	0.0818	0.0203	0.8041	0.0970	-0.0132	0.0311	0.3270
Evless_inf~r	0.0104	0.0647	-0.0088	0.0216	0.0366	0.0396	0.1400	0.7536	0.0712	0.0711	0.3947
Evless_cos~y	0.0462	-0.1440	-0.0261	0.0608	-0.1104	-0.1804	0.3946	0.2061	0.0245	0.3040	0.6368
Evless_per~r	0.0555	-0.0629	-0.0012	0.0479	-0.0299	-0.0218	0.2816	-0.0956	0.0198	0.7715	0.3053
Evless_range	0.0434	-0.1065	0.0145	0.0487	-0.0149	0.1382	-0.2107	0.2052	0.0140	0.7535	0.3104
Evless_ins~r	0.0729	-0.0712	0.0547	-0.0247	-0.0030	-0.0833	0.2403	0.6296	-0.0665	0.1488	0.4983

Appendix 8: Rotated Factor Loadings and Unique Variances -2 (Chapter 2)

Rotated factor loadings (pattern matrix) and unique variances

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8	Factor9	Factor10	Uniqueness
Age						0.8996					0.1751
Children						0.8876					0.2091
Factor_Brand	0.7488										0.4093
Factor_Price									0.5471		0.4752
Factor_Drive				0.6471							0.5159
Factor_Des~n	0.7421										0.4048
Factor_Con~m				0.7516							0.3376
Factor_Perf				0.5283							0.5121
Factor_Emiss				0.7006							0.3493
Factor_Soc~t	0.6976										0.3551
Factor_Reput	0.7403										0.3899
Scale_pers~c		0.7966									0.3179
Scale_prof~c		0.7910									0.3548
Scale_imag~s			0.7537								0.3635
Scale_life~e											0.4813
Scale_envi~n											0.6415
Scale_less~s		0.5215									0.4947
Scale_ecof~e			0.7174								0.4079
Scale_stat~y			0.7932								0.3543
Scale_pena~y											0.6473
Scale_subv~s											0.5000
Scale_will~e											0.4503
Scale_lowe~e					0.8823						0.2027
Scale_lowr~s					0.8667						0.2245
Evless_price									0.7313		0.4093
Evless_wal~x								0.8026			0.3356
Evless_les~o							0.8031				0.3056
Evless_kno~r							0.8041				0.3270
Evless_inf~r								0.7536			0.3947
Evless_cos~y											0.6368
Evless_per~r										0.7715	0.3053
Evless_range										0.7535	0.3104
Evless_ins~r								0.6296			0.4983

(blanks represent abs(loading)<.5)

Appendix 9: Factor Rotation Matrix (Chapter 2)

Factor rotation matrix

	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8	Factor9	Fact~10
Factor1	0.1325	0.5828	0.4967	0.3252	0.4334	0.0234	0.2773	0.1288	0.0886	0.0235
Factor2	0.8490	-0.2690	0.1919	-0.0532	-0.1227	0.2670	0.0216	0.1090	-0.1371	0.2231
Factor3	-0.0398	-0.1914	-0.3098	0.3995	-0.1719	-0.2223	0.4512	0.5088	0.2533	0.3171
Factor4	-0.1577	0.0685	-0.3209	0.4766	0.0654	0.7383	-0.1183	-0.0904	-0.2168	0.1473
Factor5	-0.3273	-0.2123	0.1565	-0.5250	0.3409	0.3328	0.2000	0.4733	-0.1764	0.1600
Factor6	-0.1624	0.2669	0.3213	-0.1263	-0.6462	0.3308	-0.1651	0.2024	0.4290	0.0628
Factor7	0.3155	0.3953	-0.5691	-0.2747	0.1415	0.1199	-0.0612	0.3306	0.2169	-0.3878
Factor8	-0.0041	-0.1971	0.1139	0.2353	0.3018	-0.1490	-0.7680	0.3861	0.1851	0.0798
Factor9	0.0428	-0.1405	-0.1046	-0.1713	0.3392	0.1500	0.0639	-0.4250	0.6997	0.3554
Factor10	0.0186	0.4642	-0.2047	-0.2302	-0.0580	-0.2332	-0.2004	-0.0214	-0.2759	0.7175

Appendix 10: Survey for Empirical Research - English Version

Electric Vehicles - PhD survey

Electric Vehicles - a solution to overcome environmental pollution?

Climate change with its anthropogenic consequences is widely discussed and considered as proven within the scientific community, while defining the greenhouse gas (GHG) CO2 as main driver of global warming. Electric vehicles (EV) are considered an important mean to overcome emissions in the transport sector. There exist different types of EVs, such as cars that are fully battery electric (BEV), or rechargeable/plug-in hybrids (PHEV), and they can be charged by using an electric power source. The first group (BEV) runs entirely on electricity, and hence, produces no emissions during driving. PHEVs have a shorter range to run on electricity and can switch to or combine the internal combustion engine with the battery. In general, types of cars that can be fuelled fully or in part by alternative fuels, e.g. electricity are also defined as Alternative Fuel Vehicles (AFV). In contrast, traditional vehicles called internal combustion engines (ICE) run on petroleum and emit higher amounts of greenhouse gases, resulting from internal combustion engines that burn fossil fuels.

Thank you very much for your time and your help by responding to these questions! This is a complete autonomous survey. Data will only be analysed in an aggregated way. We ask for your honest opinion so we can provide useful conclusions based on your answers.

Please only participate if you´re older than 18 and if you possess a driver's license.

1. I accept to participate in this survey. o

- ◯ Yes
- ◯ No

2. How old are you? (We inquire about the age to assure that respondents are older than 18 years, as it is one of the conditions to participate in this survey) o

3. Do you possess a driver´s license? o

- ◯ Yes
- ◯ No

4. Do you have a car (independently if it is a leasing, financed, property)? o

- ◯ No
- ◯ Yes. Diesel car.
- ◯ Yes. Petrol car.
- ◯ Yes. Plug-in hybrid car (PHEV)
- ◯ Yes. Battery electric car (BEV)
- ◯ Yes. Hybrid car (HEV)
- ◯ Yes. GAS (CNG/ LPG)
- ◯ Yes. Other

5. How likely (in %) is it that you buy an electric vehicle (EV) as your next vehicle (0% not likely at all, 100% certain)? o

6. What is your gender? 0

- ◯ Female
- ◯ Male
- ◯ Others

7. What country are you living in? 0

- ◯ Spain
- ◯ Germany
- ◯ Other (please specify)

8. What area do you live in? 0

- ◯ City Center (urban area)
- ◯ Suburban area
- ◯ Rural area

9. What is your highest level of education? 0

- ◯ Primary education or below
- ◯ High school (Abitur)
- ◯ Bachelor Degree
- ◯ Master Degree
- ◯ Doctor and above

10. What is your annual salary? (gross) 0

- ◯ less than 20.000€
- ◯ 20.000€-34.999€
- ◯ 35.000€-49.999€
- ◯ 50.000€-64.999€
- ◯ 65.000€-79.999€
- ◯ 80.000€-94.999€
- ◯ 95.000€-114.999€
- ◯ 115.000€ or more

11. How many children do you have? 0

- ◯ None.
- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5 or more

12. What type of car would you like to buy as your next one? 0

- ◯ Diesel
- ◯ Gasoline
- ◯ Hybrid
- ◯ Plug-in Hybrid
- ◯ Battery Electric car
- ◯ Gas
- ◯ Others

13. What are the most important factors when buying a new car? Please indicate on a scale from "1 = not important at all" to "10 = most important". 0

	1	2	3	4	5	6	7	8	9	10
Brand	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Price	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Driving Range (distance your car can drive before recharging/refueling)	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Design	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Consumption	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Performance (HP, kwH)	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Emissions	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Social Acceptance	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Reputation	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

14. With regard to the different technologies of a car, if all types of cars cost the same, would you rather buy an electric or Diesel/ Gasoline car? 0

- ◯ Electric vehicle
- ◯ Traditional vehicle (Diesel or Gasoline. ICE - internal combustion engine)

15. How much financial support should be provided in your opinion to convince you to purchase an EV instead of a traditional vehicle? Please indicate in €. (Assumption: price of EV aprox. 40.000€) 0

16. How many km should an electric vehicle be capable of driving before recharging, in order to convince you to purchase an EV (driving range)? 0

17. Please indicate on a scale from 1 (completely disagree) to 5 (completely agree) with the following. (EV = electric vehicle. ICE = internal combustion engine; traditional vehicle) 0

	1 (completely disagree)	2 (disagree)	3 (neutral)	4 (agree)	5 (completely agree)
An electric vehicle fits my personal necessities.	○	○	○	○	○
An electric vehicle fits my professional necessities.	○	○	○	○	○
Driving an electric vehicle would improve my image and social status.	○	○	○	○	○
Driving an electric vehicle would improve my lifestyle.	○	○	○	○	○
It is important to take care of the environment.	○	○	○	○	○
For the purchase of an EV, I am motivated by a lower contamination of an EV (compared to an ICE).	○	○	○	○	○
For the purchase of an EV, I am motivated by an eco-friendly image towards others (others will think that I care about the environment).	○	○	○	○	○
Individuals who purchase an EV have a better status in society.	○	○	○	○	○
A (penalty) tax for ICE would be fair and just.	○	○	○	○	○
The purchase of an electric vehicle should be incentivised by financial advantages.	○	○	○	○	○
I am willing to pay more for a technology with a lower contamination.	○	○	○	○	○
The lower consumption (cost) of an electric vehicle can compensate for a higher initial price of EVs vs. traditional cars.	○	○	○	○	○
The lower running costs for workshop, parts, maintenance etc. can compensate for the higher initial price of electric vehicles vs. traditional cars.	○	○	○	○	○

18. Please indicate from a scale from 1 (completely disagree) to 5 (completely agree) for the following assumptions of why electric vehicles are not sold more often.

Electric vehicles are not sold more often due to... 0

	1 (completely disagree)	2 (disagree)	3 (neutral)	4 (agree)	5 (completely agree)
...the high purchase price.	○	○	○	○	○
... the fact of not having a private parking space to install chargers (Wallbox).	○	○	○	○	○
... the little information provided about electric vehicles.	○	○	○	○	○
...the lack of knowledge about electric vehicles of sales advisors in dealerships	○	○	○	○	○
...the lack of public chargers.	○	○	○	○	○
...the cost of electricity to charge the car.	○	○	○	○	○
...the performance of the electric vehicle.	○	○	○	○	○
...the limited range of electric vehicles.	○	○	○	○	○
...the effort (approval by community) to install a private charger in a shared parking space.	○	○	○	○	○

19. Have you had previous experience with electic vehicles (EVs)? 0

- ○ Yes. Positive experience.
- ○ Yes. Negative experience.
- ○ No. No experience at all.

20. If negative, what are/ were the reasons? 0

Electric Vehicles - PhD survey

Part 2

Thank you so far for all your answers! Your answers and your time is very much appreciated.

For this part, the focus is on pure **BEV – Battery Electric Vehicles.**

As previously stated, this survey guarantees anonymity and strongly suggests that there are no correct or incorrect options in your answers. All data will be analyzed in an aggregated way only and used for research purposes only.

21. I have had a driving experience with a battery electric vehicle (BEV) for at least once. o

- ◯ Yes. Positive experience.
- ◯ Yes. Negative experience.
- ◯ No. No experience at all.

22. I am regularly driving a battery electric vehicle (BEV) (regular experience). o

- ◯ Yes, at least once a month.
- ◯ Yes, at least once a week.
- ◯ Yes, at least three times a week.
- ◯ Yes, every day.
- ◯ No

23. Please indicated on a Scale from 1 (unfavorable) to 5 (favorable): o

	1	2	3	4	5
I consider the adoption (purchase) of a Battery Electric Vehicle BEV as (unfavorable 1 – favorable 5)	◯	◯	◯	◯	◯

24. Please indicated on a Scale from 1 (negative) to 5 (positive): o

	1	2	3	4	5
I consider the adoption (purchase) of a Battery Electric Vehicle BEV as (negative 1 – positive 5)	◯	◯	◯	◯	◯

25. Please indicated on a Scale from 1 (undesirable) to 5 (desirable): o

	1	2	3	4	5
I consider the adoption (purchase) of Battery Electric Vehicle BEV as (undesirable 1 – desirable 5)	◯	◯	◯	◯	◯

26. Please indicated on a Scale from 1 (strongly disagree) to 5 (strongly agree): 0

	1	2	3	4	5
It is environmental-friendly to buy Battery Electric Vehicles (BEVs): (strongly disagree 1 to strongly agree 5)	○	○	○	○	○

27. Please indicated on a Scale from Definitely false (1) to definitely true (5). 0

	1	2	3	4	5
I can buy a BEV if I wanted to.	○	○	○	○	○
The price of a BEV is important to me when I decide to adopt.	○	○	○	○	○
I can find where to buy a BEV if I wanted to.	○	○	○	○	○
It is mostly up to me to buy or not to buy a BEV.	○	○	○	○	○

28. Please indicate on a Scale from 1 (strongly disagree) to 5 (strongly agree) 0

	1 (strongly disagree)	2 (disagree)	3 (neutral)	4 (agree)	5 (strongly agree)
Most people who are important to me think I should adopt a BEV when adopting a vehicle in the near future.	○	○	○	○	○
I think that many people who are important to me expect that I buy an environmentally friendly car such as a BEV.	○	○	○	○	○
People whose opinion I value would prefer that I adopt a BEV when adopting a vehicle in the near future.	○	○	○	○	○
While adopting a new vehicle, I consider the wishes of other people who are important to me.	○	○	○	○	○
If I buy a BEV, then most people who are important to me would also buy a BEV.	○	○	○	○	○

29. Please indicate on a Scale from Definitely false (1) to definitely true (5). 0

	1 (definitely false)	2 (false)	3 (neutral)	4 (true)	5 (definitely true)
I believe it is my moral responsibility to reduce environmental pollution and greenhouse gases emissions.	○	○	○	○	○
If I buy a vehicle, I feel morally obliged to buy a BEV, regardless of what other people do.	○	○	○	○	○
I take environment consequences into account while I adopt a vehicle.	○	○	○	○	○
I feel obliged to take the environmental consequences of vehicle use into account when making adoption choices.	○	○	○	○	○

30. Please indicate on a Scale from 1 (strongly disagree) to 5 (strongly agree) 0

	1 (strongly disagree)	2 (disagree)	3 (neutral)	4 (agree)	5 (strongly agree)
I think we as individuals have the responsibility to protect the environment.	○	○	○	○	○
I am very concerned about the environment.	○	○	○	○	○
I think the environmental issues are becoming more serious in recent years.	○	○	○	○	○
I think we should live in harmony with the environment for achieving sustainable development.	○	○	○	○	○
I take environmental consequences into account while I adopt a vehicle.	○	○	○	○	○

31. Please indicate on a Scale from 1 (strongly disagree) to 5 (strongly agree) 0

	1 (strongly disagree)	2 (disagree)	3 (neutral)	4 (agree)	5 (strongly agree)
I am willing to adopt a BEV when adopting a vehicle in the near future.	○	○	○	○	○
I intend to adopt a BEV when adopting a vehicle in the near future.	○	○	○	○	○
I plan to adopt a BEV when adopting a vehicle in the near future.	○	○	○	○	○

32. Please indicate on a Scale from 1 (strongly disagree) to 5 (strongly agree) 0

	1 (strongly disagree)	2 (disagree)	3 (neutral)	4 (agree)	5 (strongly agree)
I prefer blue to other colors.	○	○	○	○	○
I like the color blue.	○	○	○	○	○
I like blue clothes.	○	○	○	○	○

33. What usage of Battery Electric Vehicle (BEV) do you make? 0

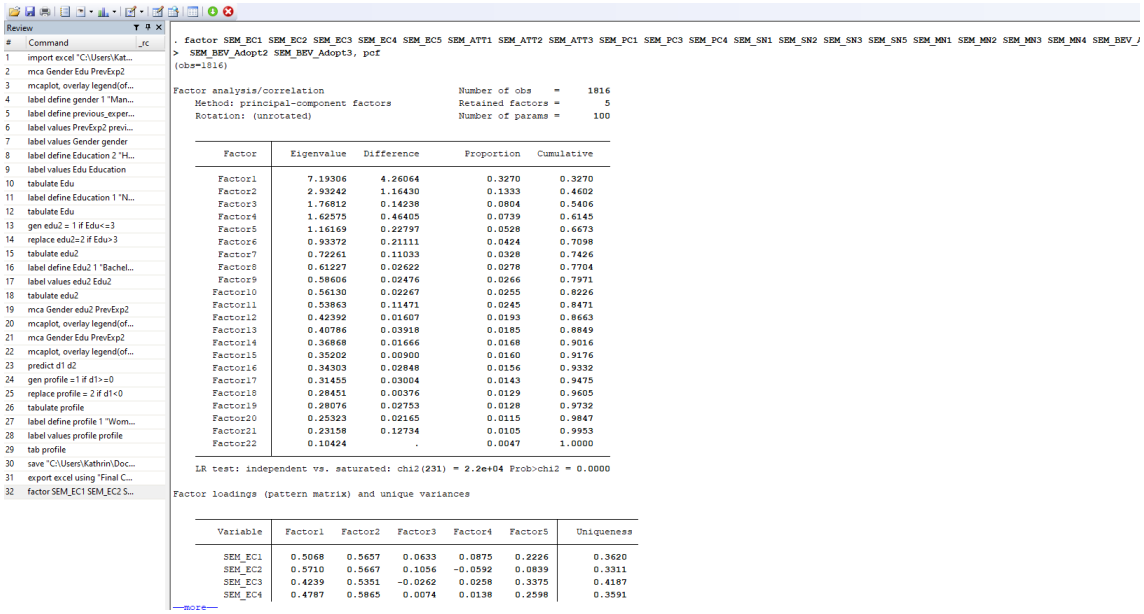
- ○ Never
- ○ Once a year
- ○ Once in 6 months
- ○ Once in 3 months
- ○ Once a week
- ○ Once every 3-4 days
- ○ Every 2-3 days
- ○ Every day

NEW QUESTION

or Copy and paste questions

PREV DONE

Appendix 11: Harmans one-factor test (Chapter 3)



Review

#	Command	_rc
1	import excel "C:\Users\Kat...	
2	mca Gender Edu PrevExp2	
3	mcaplot, overlay legend(of...	
4	label define gender 1 "Man...	
5	label define previous_exper...	
6	label values PrevExp2 previ...	
7	label values Gender gender	
8	label define Education 2 "H...	
9	label values Edu Education	
10	tabulate Edu	
11	label define Education 1 "N...	
12	tabulate Edu	
13	gen edu2 = 1 if Edu<=3	
14	replace edu2=2 if Edu>3	
15	tabulate edu2	
16	label define Edu2 1 "Bachel...	
17	label values edu2 Edu2	
18	tabulate edu2	
19	mca Gender edu2 PrevExp2	
20	mcaplot, overlay legend(of...	
21	mca Gender Edu PrevExp2	
22	mcaplot, overlay legend(of...	
23	predict d1 d2	
24	gen profile =1 if d1>=0	
25	replace profile = 2 if d1<0	
26	tabulate profile	
27	label define profile 1 "Wom...	
28	label values profile profile	
29	tab profile	
30	save "C:\Users\Kathrin\Doc...	
31	export excel using "Final C...	
32	factor SEM_EC1 SEM_EC2 S...	

```
. factor SEM_EC1 SEM_EC2 SEM_EC3 SEM_EC4 SEM_EC5 SEM_ATT1 SEM_ATT2 SEM_ATT3 SEM_PC1 SEM_PC3 SEM_PC4 SEM_SN1 SEM_SN2 SEM_SN3 SEM_SN5 SEM_MN1 SEM_MN2 SEM_MN3 SEM_MN4 SEM_BEV_
> SEM_BEV_Adopt2 SEM_BEV_Adopt3, pcf
(obs=1816)

Factor analysis/correlation                       Number of obs    =      1816
    Method: principal-component factors           Retained factors =         5
    Rotation: (unrotated)                         Number of params =       100
```

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	7.19306	4.26064	0.3270	0.3270
Factor2	2.93242	1.16430	0.1333	0.4602
Factor3	1.76812	0.14238	0.0804	0.5406
Factor4	1.62575	0.46405	0.0739	0.6145
Factor5	1.16169	0.22797	0.0528	0.6673
Factor6	0.93372	0.21111	0.0424	0.7098
Factor7	0.72261	0.11033	0.0328	0.7426
Factor8	0.61227	0.02622	0.0278	0.7704
Factor9	0.58606	0.02476	0.0266	0.7971
Factor10	0.56130	0.02267	0.0255	0.8226
Factor11	0.53863	0.11471	0.0245	0.8471
Factor12	0.42392	0.01607	0.0193	0.8663
Factor13	0.40786	0.03918	0.0185	0.8849
Factor14	0.36868	0.01666	0.0168	0.9016
Factor15	0.35202	0.00900	0.0160	0.9176
Factor16	0.34303	0.02848	0.0156	0.9332
Factor17	0.31455	0.03004	0.0143	0.9475
Factor18	0.28451	0.00376	0.0129	0.9605
Factor19	0.28076	0.02753	0.0128	0.9732
Factor20	0.25323	0.02165	0.0115	0.9847
Factor21	0.23158	0.12734	0.0105	0.9953
Factor22	0.10424	.	0.0047	1.0000

```
LR test: independent vs. saturated: chi2(231) = 2.2e+04 Prob>chi2 = 0.0000

Factor loadings (pattern matrix) and unique variances
```

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Uniqueness
SEM_EC1	0.5068	0.5657	0.0633	0.0875	0.2226	0.3620
SEM_EC2	0.5710	0.5667	0.1056	-0.0592	0.0839	0.3311
SEM_EC3	0.4239	0.5351	-0.0262	0.0258	0.3375	0.4187
SEM_EC4	0.4787	0.5865	0.0074	0.0138	0.2598	0.3591

```
--more--
```

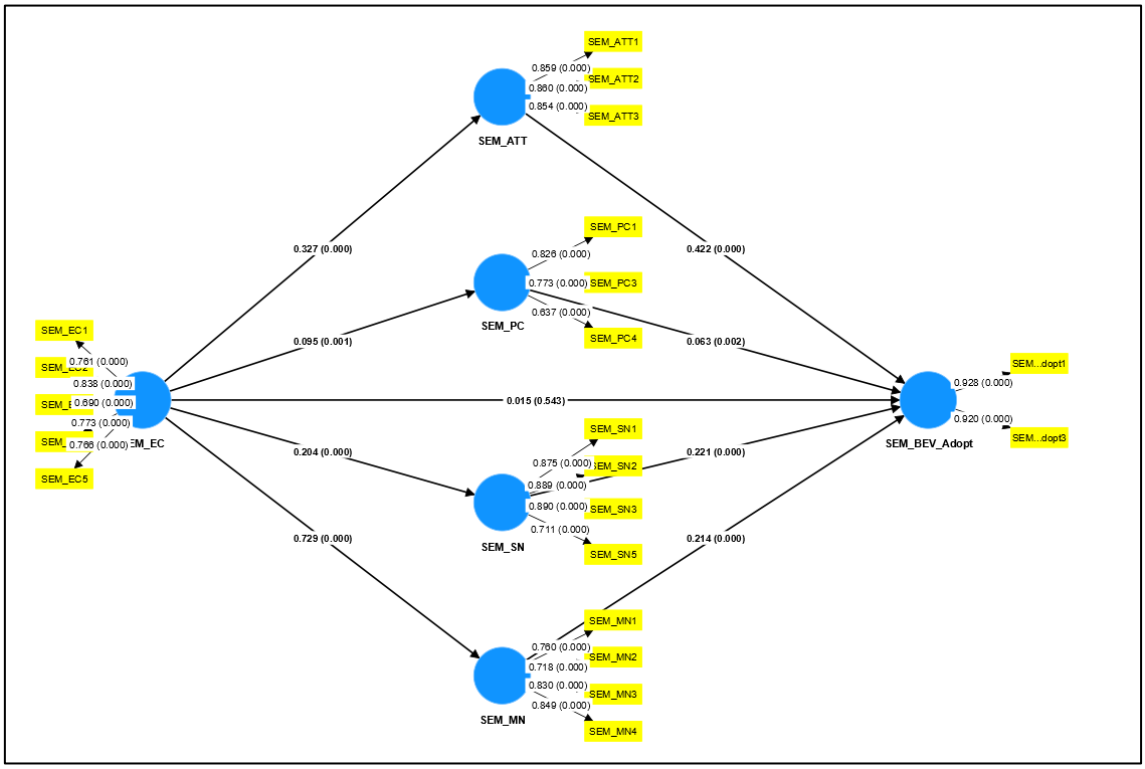
Appendix 12: Loading items SEM (Chapter 3)

	SEM_ATT	SEM_BEV_Adopt	SEM_EC	SEM_MN	SEM_PC	SEM_SN
SEM_ATT1	0.838					
SEM_ATT2	0.847					
SEM_ATT3	0.842					
SEM_ATT4	0.613					
SEM_BEV_Adopt1		0.897				
SEM_BEV_Adopt2		0.958				
SEM_BEV_Adopt3		0.928				
SEM_EC1			0.762			
SEM_EC2			0.837			
SEM_EC3			0.693			
SEM_EC4			0.775			
SEM_EC5			0.763			
SEM_MN1				0.759		
SEM_MN2				0.721		
SEM_MN3				0.829		
SEM_MN4				0.848		
SEM_PC1					0.696	
SEM_PC2					0.402	
SEM_PC3					0.743	
SEM_PC4					0.558	
SEM_SN1						0.865
SEM_SN2						0.880
SEM_SN3						0.882
SEM_SN4						0.471
SEM_SN5						0.722

Appendix 13: Convergent Validity Outer Loadings all items included except AI2 (Chapter 3)

	SEM_ATT	SEM_BEV_Adopt	SEM_EC	SEM_MN	SEM_PBC	SEM_SN
SEM_ATT1	0,838					
SEM_ATT2	0,846					
SEM_ATT3	0,843					
SEM_ATT4	0,616					
SEM_BEV_Adopt1		0,929				
SEM_BEV_Adopt3		0,919				
SEM_EC1			0,763			
SEM_EC2			0,838			
SEM_EC3			0,694			
SEM_EC4			0,776			
SEM_EC5			0,762			
SEM_MN1				0,760		
SEM_MN2				0,718		
SEM_MN3				0,830		
SEM_MN4				0,849		
SEM_PBC1					0,676	
SEM_PBC2					0,430	
SEM_PBC3					0,742	
SEM_PBC4					0,546	
SEM_SN1						0,865
SEM_SN2						0,880
SEM_SN3						0,882
SEM_SN4						0,472
SEM_SN5						0,723

Appendix 14: Bootstrapping Path coefficients (Chapter 3)



Appendix 15: sFrancia Test Stata Results (Chapter 3)

sfrancia SEM_ATT1 SEM_ATT2 SEM_ATT3 SEM_ATT4 SEM_PC1 SEM_PC2 SEM_PC3 SEM_PC4 SEM_SN1 SEM_SN2 SEM_SN3 SEM_SN4 SEM_SN5 SEM_MN1 SEM_MN2 SEM_MN3 SEM_MN4 SEM_EC1 SEM_EC2 SEM_EC3 SEM_EC4 SEM_EC5 SEM_BEV_Adopt1 SEM_BEV_Adopt2 SEM_BEV_Adopt3

Variable	Obs	W'	V'	z	Prob>z
SEM_ATT1	1,816	0.99113	10.204	5.528	0.00001
SEM_ATT2	1,816	0.99210	9.088	5.252	0.00001
SEM_ATT3	1,816	0.99305	7.986	4.945	0.00001
SEM_ATT4	1,816	0.98202	20.671	7.208	0.00001
SEM_PBC1	1,816	0.99428	6.582	4.485	0.00001
SEM_PBC2	1,816	0.97471	29.080	8.020	0.00001
SEM_PBC3	1,816	0.99614	4.444	3.550	0.00019
SEM_PBC4	1,816	0.99309	7.947	4.933	0.00001
SEM_SN1	1,816	0.99866	1.537	1.023	0.15316
SEM_SN2	1,816	0.99933	0.770	-0.623	0.73321
SEM_SN3	1,816	0.99745	2.935	2.562	0.00520
SEM_SN4	1,816	0.99354	7.425	4.772	0.00001
SEM_SN5	1,816	0.99832	1.927	1.561	0.05924
SEM_MN1	1,816	0.97292	31.142	8.183	0.00001
SEM_MN2	1,816	0.99788	2.432	2.115	0.01720
SEM_MN3	1,816	0.98696	14.996	6.444	0.00001
SEM_MN4	1,816	0.99076	10.624	5.624	0.00001
SEM_EC1	1,816	0.96390	41.507	8.867	0.00001
SEM_EC2	1,816	0.98907	12.571	6.024	0.00001
SEM_EC3	1,816	0.96017	45.798	9.101	0.00001
SEM_EC4	1,816	0.96499	40.259	8.795	0.00001
SEM_EC5	1,816	0.99188	9.339	5.317	0.00001
SEM_BEV_Ad~1	1,816	0.98843	13.299	6.159	0.00001
SEM_BEV_Ad~2	1,816	0.99863	1.579	1.088	0.13837
SEM_BEV_Ad~3	1,816	0.99912	1.011	0.026	0.48967

Appendix 16: Published Paper Transportation Research Part D

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Consumers' preferences for electric vehicles: The role of status and reputation

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ABSTRACT

This paper provides insight into motivational reasons for consumers' preferences for Electric Vehicles (EVs) assuming equal and different prices between EVs and traditional vehicles. Referring to consumer behavior, it shows that reputation-driven consumers prefer EVs only when the purchase price is more expensive than that of other vehicles, thus suggesting that true environmental concern is attenuated by reputation motives; and that the desirability of EVs as sustainable products only increases if prices are more expensive. It provides insights into the influence of sociodemographic variables, car attributes and external environmental factors. The study offers an empirical approach with a sample set of more than 2.000 responses. Different logit models are estimated to explore the factors influencing the preference for an EV. It is found that age, being male, having children, education, living in urban areas, and previous experience positively influence EV adoption. Better infrastructure and information availability help to promote EVs.

1. Introduction

Climate change with its anthropogenic consequences is widely-debated by the public, and considered proven within the scientific community (Jochem et al., 2015). EVs are defined as a possible solution to overcome environmental concerns; however, the transport sector is responsible for 24% of direct CO_2 emissions from fuel combustion (IAE, 2020). Although greenhouse gas emissions (GHG) from the EU transport sector decreased in 2020, this decrease refers to the decrease in activity due to the Covid-19 pandemic, and road transport remains the main GHG contributor of all transport emissions (EEA, 2021). According to some sources, road transport emissions have even increased despite slow but steady progress in electrification (IAE, 2020). Air pollution in cities and the growing environmental concerns of consumers have led to an increased demand for responsible action on the part of both businesses and consumers. Many governments around the world are trying to promote EVs to increase their market diffusion. In recent years, Plug-in Hybrid Electric Vehicles (PHEVs) and Battery Electric Vehicles (BEVs) have become more prominent in the field of sustainable transportation. However, despite the growing demand, the market share of EVs is still limited, counting for only 2.7% for BEV and 4.9% for PHEVs of all cars registered in Spain in 2021 (MSI Iberia, 2022).

In order to increase the market share of EVs, it is crucial to analyze and understand consumer perception and behavior. Consumer behavior is shaped by social, economic, and environmental concerns that lead to new consumer demands and therefore require

Abbreviations: AFCVs, Alternative Fuel Vehicles; BEVs, Battery Electric Vehicles; CO_2, Carbon dioxide; EFA, Exploratory Factor Analysis; EU, European Union; EVs, Electric Vehicles; GHG, Greenhouse Gases; HEVs, Hybrid Electric Vehicles; ICE, Internal Combustion Engine; ICEVs, Internal Combustion Engine Vehicles; PHEVs, Plug-in Hybrid Electric Vehicles.

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different strategies for companies (Hofenk et al., 2019). More and more attention is being paid to sustainable consumer research; however, it is still underrepresented, and more research is needed. Based on these arguments, in this manuscript the authors analyze consumer behavior towards EVs as a sustainable innovation and analyze consumer preferences if all cars cost the same.

In detail, this paper addresses the following research questions:

1. In line with previous literature, what are the factors that influence the preference and adoption of EVs? By answering this question, the research is able to answer the following:
   a. What does a Spanish consumer of EVs look like (sociodemographic variables)?
   b. What effect do experience, governmental incentives, information availability, and other car attributes have on EV preference?

In this case, the dependent variable focuses on a variable that includes whether a consumer prefers to buy an electric or others, more traditional cars (1 = Yes, EV; 0 = No EV). This research question adds further evidence to the existing literature on potential consumers in Spain, a Southern European country where such profiling is lacking. Moreover, it compares previous results and fulfills future research recommendations for the "experience" variable.

2. In order to shed light on the importance of consumer behavior, are consumers' status, reputation, and image driven when adopting EVs?
   a. With respect to the different technologies of a car, if all types of car technology cost the same, would a consumer prefer to buy an electric or gasoline/diesel car?
   b. Are consumers rather driven by reputation when purchasing an EV?

In this case, the dependent variable focuses on consumer preferences if EVs cost the same as other cars, that is to say, if all cars have the same purchase price, regardless of technological differences. This research question helps to obtain results on the importance of status and reputation.

The present study contributes to the literature by gaining insights into consumer behavior for EVs, especially by analyzing consumers' behavior and preferences with equal and different prices for EV compared to Internal Combustion Engine Vehicles (ICEV). Consistent with previous literature, it also identifies the sociodemographic characteristics of EV consumers, focusing on experience while applying a structured and comprehensive approach to include environmental aspects and car attributes.

The explanatory research is based on a solid theoretical foundation related to consumer behavior. Based on the theoretical framework and the empirical study, car attributes and external attributes, environmental settings that could influence the preference for EVs are discussed. Current literature has analyzed the factors of EV adoption and their motivators and barriers; however, this paper provides a holistic overview of different factors for EV adoption and a better understanding of consumer behavior and car preferences if EVs cost the same as other cars. The results show clear policy implications, indicating the importance of the availability of information on EVs, a better infrastructure to charge EVs, and governmental incentives to promote EVs.

To accomplish the aforementioned objectives, the rest of the paper is organized as follows. First, in Section 2 a review of the literature is presented, then the conceptual model guiding this research is presented, followed by the hypotheses. Section 3 explains the variables extracted from the survey and Section 4 shows the empirical results of both research questions. In this section, special emphasis is placed on consumer behavior in relation to status- and reputation-driven factors. Finally, Section 5 shows the main conclusions as well as the limitations of the current research and future lines of research.

2. Literature review, conceptual model, and hypotheses

2.1. Different types of EVs

In order to develop a search related to the topic of interest, it is necessary to explain that "EV" is a general term for electric vehicles and includes different types of electric technologies. Table 8 in the appendix explains the different types of EVs so that we can specify the coverage of the present research. This study focuses on EVs in general.

2.2. Past Research, theoretical framework, and respective hypothesis

In order to identify relevant studies that help to accomplish the objectives of this research, a literature review was conducted (see Table 9). The search for research studies published in peer-reviewed journals included keyword combinations such as Electric Vehicles, preference, adoption, consumer behavior, and consumer attitudes. It is important to note that this paper aims to analyze consumer behavior for EV preferences from a Marketing and managerial perspective, thus excluding engineering papers and other areas irrelevant to this research.

An increasing amount of research on consumers' purchase intentions and preferences is found as well as the role of self-image when purchasing green products (e.g., Hahnel et al., 2014; Ozaki, 2011; Lane and Potter, 2007; Hur et al., 2013; Herberz et al., 2020; Griskevicius et al., 2010; Hafner et al., 2017). According to previous literature, consumer behavior plays an important role in the adoption of new technologies, such as EVs, which are considered a sustainable solution. In this research, it is of interest to investigate consumers' motivations and preferences for sustainable behavior.

The paper distinguishes itself from other papers in its approach of systematically applying a comprehensive analysis of EV

consumers with respect to three subcategories (consumers' demographic variables, car attributes, environmental settings) and then by comparing the model to a second model with another dependent variable representing the impact of consumer preferences if EVs cost the same as other cars. Our results highlight the importance of symbolic attributes, such as status, reputation and image, in opting for EVs.

Based on the literature review, we have identified three pillars that aggregate different variables that influence the preference for EVs: (1) the consumer, (2) car attributes, and (3) environmental settings. By doing so, we aim to answer the research questions stated above via a holistic approach. Li et al. (2017a, 2017b) applied a systematic structured approach and divided their systematic literature review also into three types: (1) demographic, (2) situational, and (3) psychological factors. Likewise, Lane and Potter (2007) illustrated the factors for the adoption of EV with situational and psychological factors, whereby situational factors include environmental settings, such as regulations or infrastructure, and psychological factors include attitudes, symbols, influences, etc.

2.2.1. Consumers' variables & behavior

In general, the literature has shown contradictory results for demographic variables of EV consumers. Previous studies have provided evidence that females are more environmentally concerned than men are and thus more willing to buy green products (Johansson-Stenman and Martinsson, 2006; Knez et al., 2014; Prakash et al., 2014; Jansson et al., 2017; Simsekoglu and Nayum, 2018; Yang et al. 2019). Sovacool et al. (2019) explained, based on "gendering of (electric) mobility" references going back to 1880, that the gender discussion was already prevalent in the earliest discussions about automobiles when EVs were more common and had a larger market share. Plötz et al. (2014)found that it is rather men who are the first buyers of EVs.

H1: Females are more likely to prefer EVs than men.

Regarding the variable age, the results of the current literature are inconsistent. On the one hand, the existing literature shows evidence that green consumers are rather young (Hackbarth and Madlener, 2016; Hidrue et al., 2011; Knez et al., 2014; Laroche et al. 2001; Mukherjee and Ryan, 2020; Sanitthangkul et al., 2012). In contrast, other authors have found that older consumers are willing to purchase an EV (Jansson et al., 2017; Zhang et al., 2011). Plötz et al. (2014) and Peters and Dütschke (2014) found that middle-aged men are the most likely group of private EV buyers. Johansson-Stenman and Martinsson (2006) concluded that age had a positive influence, claiming that older people buy this type of green product.

H2: The younger the consumer, the higher the likelihood of preferring an EV over an ICEV.

There is evidence in the literature that individuals with higher education are more environmentally concerned and thus more willing to purchase an EV (Hidrue et al., 2011; Jansson et al., 2017; Mukherjee and Ryan, 2020; Sanitthangkul et al., 2012; Olson, 2013). Nayum and Klöckner (2014) found that higher education had a positive impact on the purchase of more fuel-efficient cars. However, there are also research studies that show a negative influence of education on EV adoption, meaning that less educated consumers are more likely to purchase EVs (Hackbarth and Madlener, 2016; Johansson-Stenman and Martinsson, 2006; Zhang et al., 2011).

H3: Higher education leads to an increased probability of preferring an EV over an ICEV.

For the variable income, different effects have been found in different studies. Bjerkan et al. (2016) concluded that income levels matter only when consumers compare the usage costs of BEVs and ICEVs. When the purchase cost of a BEV and ICEV is similar, people with lower incomes favor the option with lower usage costs. In line with this, Plötz et al (2016; 2017); Junquera et al. (2016), and Erdem et al. (2010) found that consumers with higher incomes were more likely to adopt an EV. In contrast, Nayum and Klöckner (2014) found that household income had a negative effect on purchasing a fuel-efficient vehicle. In accordance with this, Gleim and Lawson (2014) found through cluster analysis that the group with the highest average income did not have the highest purchase intention toward green products. Sanitthangkul et al. (2012) found no significant influence of income in determining the attitude toward eco-cars, which is in line with the studies by Egbue and Long (2012), Knez et al. (2014), Hidrue et al. (2011).

H4: Higher income leads to an increased probability of preferring an EV.

With reference to the living area of consumers, Mukherjee and Ryan (2020) showed that BEV owners tended to live in urban centers with very high population densities. In contrast, Plötz et al. (2014) found that the most likely group of EV buyers lived in rural or suburban areas. However, as is later stated in the limitations section, it is important to consider whether more educated people rather live in urban areas and less educated people in rural areas, which could also affect whether or not they own an EV. In addition, there are more cities that limit access to the city center to cars with reduced or no CO_2 emissions, which could also affect the decision concerning which car technology to buy.

H5: Living in urban areas leads to an increased probability of preferring an EV.

It is also of interest whether having children, that is to say a family with more family members, increases the preference for an EV (Zhang et al., 2011; Nayum and Klöckner, 2014).

H6: Having children leads to an increased probability of preferring an EV.

Furthermore, car ownership seems to positively influence the purchase intention toward EVs. Zhang et al. (2011) showed that the number of vehicles owned by a family increased the willingness to purchase an EV. Nayum and Klöckner (2014) showed that a higher number of cars in the household positively impacted the purchase of more fuel-efficient cars. Hidrue et al. (2011) investigated the fact of owning multiple cars and found that it decreased the probability of being in the groups supporting EVs. It is also important to consider that nowadays the younger generation tends not to purchase a car of their own. This fact could influence the later results of the research as younger people do not necessarily own cars anymore.

H7: Possessing a car (independent of model) leads to an increased probability of preferring an EV.

Another important factor to consider is the impact of experience on EV uptake. As Liu et al. (2020) summarized, there are several studies analyzing the impact of experience on the adoption of BEVs but without general consensus. There are several studies that have

investigated the role of direct BEV experience for its adoption or purchase intention (Günther et al., 2019; Liu et al., 2020; Nayum et al., 2016; Schmalfuß et al., 2014; Schmalfuß et al. 2017; Peters and Dütschke, 2014; Jensen et al., 2013). Individuals with BEV experience accepted higher purchase prices and showed a higher willingness to pay more for a BEV compared to individuals who had no experience (Larson et al., 2014; Peters and Dütschke, 2014). Hahnel et al. (2014) summarized from other authors that previous experience positively influenced the willingness to drive an EV. Herberz et al. (2020) concluded that first-hand experience with an unfamiliar technology helps to incentivize the purchase of sustainable products. The study by Xu et al. (2020) showed that consumers' EV driving experience had a significantly positive effect on consumers' intention to adopt EVs. Skippon et al. (2016) analyzed the influence of having had experience with a BEV and found that willingness to consider a BEV declined after experiencing this type of car in a controlled trial. Bühler et al (2014) found a positive significant effect of experience on the general perceptions on EVs but not on purchase intentions for EVs. Rauh et al. (2020) showed that practical driving experience, together with range-related knowledge, reduced so-called range anxiety or stress, resulting in experience as a means to overcome range anxiety as a barrier.

H8: Having had previous experience leads to an increased probability of preferring an EV.

As previously mentioned, consumer behavior and attitudes toward sustainable behavior are gaining more attention, and studies highlight the importance of self-image when purchasing green products. Hahnel et al. (2014) explained that consumers use products to define and express their self-image and match it with the "value-expressive attributes of the products." (p. 318) Johansson-Stenman and Martinsson (2006) explained that individuals often want others to have a good impression of them with social approval and esteem, in other words, to use products to make people believe that they are more environmentally friendly and socially responsible than they really are. Individuals focus more on positive self-image than they care to admit, as "being motivated largely by status concerns is perceived to be an unfavorable character trait." (Johansson-Stenman and Martinsson, 2006, p.131). The authors defined this behavior as self-deception and explained that pretending to be very concerned about the environment can lead to a better self-image, as others value the fact of "being" environmentally friendly. Rahmani and Loureiro (2019) showed that consumers buy EVs more for reputational issues rather than for environmental reasons. Ozaki (2011) has given evidence that people focus on their identity, image, values, and norms when adopting green technology, which is consistent with the study by Laroche et al. (2001). Moreover, Lane and Potter (2007) highlighted the importance and role of a car as a status symbol, and found evidence that consumers want others to know about their green vehicle, which should positively affect their image. Hur et al. (2013) explained that green products can represent the consumers image or socially responsible values, and their use can show to which consumer group they belong. Hahnel et al. (2014) showed that the activation of pro-environmental values leads to lower price sensitivity to higher purchase prices of EVs. However, as Herberz et al. (2020) mentioned, it is important to keep in mind that "changing consumer behavior can be difficult, especially in conservative, slow-changing sectors such as the transportation domain" (p.102). Interestingly, Griskevicius et al. (2010) showed the interrelations of environmental behavior and status and found that "(…) a desire for status can spur self-sacrifice [that] also presents a powerful tool for motivating prosocial and proenvironmental action." (Griskevicius et al. 2010, p.402).

H9: Reputation- and status-driven consumers are more likely to prefer EVs.

2.2.2. Car attributes

There is a common understanding that a high purchase price is one of the main reasons why consumers hesitate to adopt EVs. The initial purchase price of EVs is usually higher than that of conventional cars, and the market share and diffusion of EVs may not increase if the purchase price does not decrease (Bjerkan et al., 2016; Cecere et al., 2018; Egbue and Long, 2012; Knez et al., 2014; Lane and Potter, 2007; Lieven et al., 2011; Ozaki, 2011). Ozaki (2011) has explained that individuals see green alternatives as too expensive, and Lieven et al. (2011) confirmed that "price is the top priority for both conventional and the electric vehicles (…)" (p. 139). Bjerkan et al. (2016) concluded that purchase cost reduction is the strongest incentive to promote BEV adoption.

H10 A higher list price for EV lowers the preference for EVs.

At the same time, lower consumption and lower maintenance costs can offset a higher purchase price (Egbue and Long, 2012; Gallagher and Muehlegger, 2011; Lane and Potter, 2007).

H11 Lower consumption and lower maintenance costs compensate for the higher purchase price of EVs and leads to an increased probability of preferring an EV.

In terms of car attributes, it has been shown that a higher range leads to higher acceptance of EVs and that a limited range has a negative impact on EV adoption, distribution, acceptance and usage (Barkenbus, 2020; Cecere et al., 2018; Egbue and Long, 2012; Günther et al., 2019; Hackbarth and Madlener, 2016; Hidrue et al. 2011; Hoen and Koetse, 2014; Lieven et al., 2011; Schneidereit et al. 2015). Hereby, range refers to the distance an EVs can travel before the battery needs to be recharged. Cecere et al. (2018) have suggested that manufacturers improve the quality of EVs' batteries to increase driving range in order to achieve greater diffusion of EVs. Franke and Krems (2013) has shown that, in particular, experienced EV drivers seek average and maximum range, while inexperienced drivers show weak affect towards range needs. Range anxiety is associated with higher range preferences, according to the trial study conducted by Franke and Krems (2013). Hereby, range anxiety refers to the fear of running out of battery before reaching a charging station.

H12 A higher range of EVs, leads to an increased probability of preferring an EV.

2.2.3. Environmental settings

Several authors have shown the importance of the development of charging infrastructures in order to promote EVs and have concluded that the availability of a functioning charging infrastructure is significantly related to BEV markets (Barkenbus, 2020; Hardman et al., 2018; Li et al., 2017a; Sierzchula et al., 2014). Oliveira et al. (2019) also pointed out the importance of including charging/ fueling infrastructure in future research for EV. Martínez-Lao et al. (2016) illustrated the need for "structured

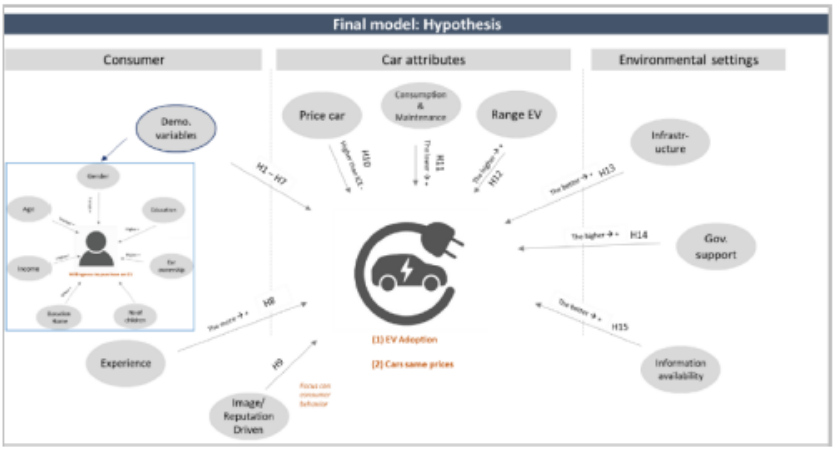

Fig. 1. Final model Overview.

implementation strategies" (p. 970) with public charging stations to enhance electric mobility. Hoen and Koetse (2014) demonstrated that charging potential and recharge time are limiting factors for preference choices for Alternative Fuel Vehicles (AFVs). Harrison and Thiel (2016) concluded that minimal infrastructural objectives could be advantageous; however, in their scenarios, the provision of charging points appeared to be weaker than other vehicles subsidies.

H13 Better infrastructure (charging stations, wallbox installations) the context shows leads to an increased probability of preferring an EV.

There are several studies showing the importance of governmental supports to further promote EV (Cordera et al., 2019; Gallagher and Muehlegger, 2011; Hardman et al., 2017; Li et al., 2019; Turcksin et al., 2013). Wang et al. (2017) divided policy measures into three categories, such as financial incentives, information provision, and convenience policy measure and displayed that all three catalogs are significantly related to EV adoption intention. Hackbarth and Madlener (2016) found that governmental purchase price subsidies were not sufficiently valued by consumers, although non-monetary government incentives and vehicle tax exemptions could increase the likelihood of choosing an AFV. Similarly, Mukherjee and Ryan (2020) has shown that financial incentives can especially encourage younger consumers with lower savings and also showed the positive impact of exclusive bus lanes or free parking while recharging. Zhang et al. (2011) found a negative influence of government policies on EV adoption.

H14 Governmental support for EVs leads to an increased probability of preferring an EV.

In order to overcome other barriers for EV adoption, it is necessary to improve the availability and diffusion of information about low emission cars. Some authors have shown that consumers are often resistant to new technologies because of their novelty, unfamiliarity, and uncertainty (Hidrue et al, 2011; Ozaki, 2011; Egbue and Long, 2012; Turcksin et al., 2013). Rezvani et al. (2015) showed that so-called "engaged green" consumers pursued a more technology-oriented lifestyle and were open to change. Rahmani and Loureiro (2019) found mistrust and misconceptions about this technology to be other reasons for a lack of interest.

H15 More available information combined with the know-how of dealers, leads to an increased probability of preferring an EV.

This literature review provides a comprehensive overview of existing studies that analyze the variables that motivate or hinder EV adoption. As stated by Nayum and Klöckner (2014), it is important not only to include sociodemographic factors but also psychological factors to avoid misguidance for industry and policy decisions.

2.3. Hypotheses and model

Following the literature review, our hypotheses refer to the following categories: (1) demographic factors including individual variables and experience, and consumer behavior; (2) car attributes, such as range, price, etc.; and (3) situational factors, such as environmental settings. Table 9 in the appendix shows the hypotheses with the respective study references.

2.3.1. Final model

Fig. 1 shows the final model, which is a logit regression, for this research in a visual approach. This study differs from previous studies by not only offering a complete overview of demographic variables of consumers but also by taking into consideration car attributes and environmental settings in the same model, with the objective of analyzing the factors that influence consumer intention to adopt EVs. Additionally, and more importantly, it analyzes the impact on consumer behavior if EVs cost the same as other cars, namely if EVs are not more expensive than traditional vehicles.

The model is built on the following:

Table 1
Overview Variables.

Variable	Question	Definition	Descriptive
Yes_EV_1_0	Based on the variable Future_EV: Would you rather buy an electric or Diesel/Gasoline car as your next future car? (Dummy variable)	0-50% = 0 –> No EV 51%-100% = 1 –> Yes EV	0 = 64%/ 1 = 36% Std deviation: 30.23524 Min: 0 Max: 100
Car_sameprice	With regard to the different technologies of a car, if all types of cars cost the same, would you rather buy an electric or Diesel/ Gasoline car?	1 = Electric vehicle, 0 = Traditional vehicle (Diesel or Gasoline. ICE - internal combustion engine)	1 = 82%, 0 = 18%
Driver_License	Do you possess a driver's license?	1 = Si/Yes, 0 = No	90% Yes/ 10% No
Age	How old are you?	indication of age	Min: 18/ Max. 87 Average 31 Std deviation: 13.00326
Gender	What is your gender?	0 = female, 1 = male	0 = 54% 1 = 46%
Own_Car	Do you have a car (independently if it is a leasing, financed, property)?	0 = No, 1 = Yes, Petrol car, 2 = Yes, Diesel Car, 3 = Others	0 = 26%/ 1 = 36%/ 2 = 30% 3 = 8%
Type_car	What type of car would you like to buy as your next one?	1 = Gasoline/Gasolina, 2 = Diesel, 3 = Battery Electric car/ Vehículo eléctrico de batería (BEV), 4 = Plug in Hybrid/Vehículo híbrido enchufable (PHEV), 5 = Others	1 = 21%/ 2 = 13%/ 3 = 17%/ 4 = 21%/ 5 = 28%
Future_EV	How likely (in %) is it that you buy an electric vehicle (EV) as your next vehicle (0% not likely at all, 100% certain)?	Indication in %	mean = 46%
Area	What area do you live in?	1 = City Center (urban area) / 2 = suburban area/ 3 = rural area	1 = 56%/ 2 = 31%/ 3 = 13%
Edu	What is your highest level of education?	2 = High school (Abitur), 3 = Bachelor Degree, 4 = Master Degree, 5 = Doctor and above	2 = 18%/ 3 = 38%/ 4 = 27%/ 5 = 17%
Salary	What is your annual salary? (gross income)	1 = <20.000€, 2 = 20.000€-34.999€, 3 = 35.000€-49.999€, 4 = 50.000€-64.999€, 5 = 65.000€ or more	1 = 61%/ 2 = 14%/ 3 = 9%/ 4 = 6%/ 5 = 10%
Children	How many children do you have?	0 = none; 1 = 1; 2 = 2; 3 = 3; 4 = 4; 5 = 5 or more	0 = 79%/ 1 = 7%/ 2 = 11%/ 3 = 3%/ 4 = 0,14/ 5 = 0,05
PrevExp2	Have you had previous experience with electric vehicles (EVs)? Response	0 = No. No experience at all./ 1 = Yes	0 = 78%/ 1 = 22%

- Dependent variables: "EV Adoption" and "Cars same price".
- Independent variables: Demographic variables, car attributes, environmental settings

$$EV = b_0 + b_1 Age + b_2 Educ + b_3 Gender + b_4 Income + b_5 Owncar + b_6 Area + b_7 Children + b_8 Exper + b_9 Image + b_{10} Pricecar + b_{11} Consump + b_{12} Range + b_{13} Infrastructure + b_{14} Govsupport + b_{15} Infoavail + e$$

3. Empirical analysis

In this section, we focus on the data set with which we worked and the analyses performed. The main techniques are: (i) factor analysis, which helps to reduce variables, and (ii) logit to determine the relevance of the factors for increasing the probability of considering purchasing an EV.

3.1. Data Collection: The survey

Data were collected via a web-based survey (Survey Monkey Platform, Premium member) through an online questionnaire. Distribution of the survey and participation were completely anonymous and without any remunerative aspects. Before issuing the final survey, an intense check-control process was carried out. The survey was sent to six experts from the automotive industry and four other persons, who were invited to comment. This improved the quality of the survey. The common method of online invitations sent via email was applied. The study was sent out from Barcelona, Spain and was conducted online during the months of March until May 2021. After passing several evaluation committees at the University of Autonoma de Barcelona, the survey was finally approved to be sent in both English and Spanish to the UABs data set. This data set consists of students, professors, and administrative employees.

The survey was not distributed through a paid-based platform due to lack of funding. Throughout the entire process, the utmost attention was paid to a careful sample design with a focus on controlling sampling errors and avoiding biases that could be introduced unconsciously. Subsequently, sample validation was also conducted to ensure that the sample was representative of the population, as explained in the following.

Regarding the sampling method, a quota sampling approach was developed for contacting people from the University Autonoma of Barcelona with the goal of obtaining a "quota" of each stratum of the population, according to gender and age (sampling people

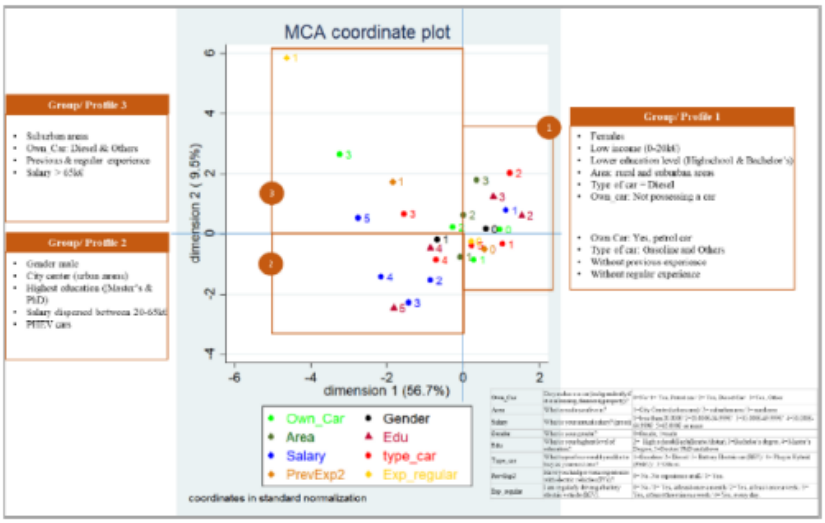

Fig. 2. Results MCA Analysis.

between 18 and 87 years old), in order to be more representative of the population of interest (Barcelona, Spain). Based on official sources from the National Institute of Statistics (INE, 2022) and focusing on the gender and age of the population for Barcelona from 18 years until 87 years with a sample of 4.46 million habitants, 48.4% were male and 51.6% were female. In order to determine the sample size, we considered an infinite population, a confidence level of 95%, with $p = q = 0.5$ and a sampling error of $+$ 2%, which supposed a theoretical sample size of 2,400 observations.

The questionnaire consisted of two parts: the first part gave information on the profile of the respondents, including gender, age, education, income, and residential location, and the second part contained measurement items of additional variables of experience, preferences in cars, etc. In total, 2,198 answers were collected. In order to ensure the quality of the sample, 50 answers were excluded due to missing values for variables that will be used later to perform the two different factor analyses to be applied, resulting in a total sample of 2,148 responses.

The overall sample ranged in age from 18 to 87, with an average age of 31 years, which is a fairly young sample. When tabulating the sample by gender and age, we obtained 45.67% males and 54.32% females on the basis of 2,115 valid answers. The majority had an income of less than 20,000€ and up to 35,000€. Referring to official sites of population distribution in Spain (INE, 2022), the majority lived in urban areas, with 56% living in urban areas/ city areas and 31% in sub-urban areas, for a total of 87%. Comparing this figure to the Spanish Urban population (INE, 2022) an 80% of the population lives in urban areas in 2020. The difference with respect to the proportions in the population is $+$ 2.7%. This sampling error is slightly above the theoretical one, so we consider that the sample obtained is an acceptable representation of the population of interest.

3.2. Data and Description of variables

In order to achieve the objectives of this work, the variables as found in Table 1 were defined.

The dependent variable "EV" asked about the preference for an EV or "other" and was changed into a binary variable for the sake of simplicity, with 1 as opting for an EV as a future car, and 0 for opting for "other". Interestingly, 64% would rather buy an "other" vehicle than an EV. If all vehicles cost the same, 82% would opt for an EV (variable "car_sameprice"). Ninety percent of respondents possessed a driver's license, and 26% did not possess their own vehicle.

4. Empirical results

4.1. Most important factors when buying a new car

When analyzing the direct question "What are the most important factors when buying a new car? Indicate on a scale from "1 = not important at all" to "10 = most important," the factors price, driving range, and consumption (refers to fuel consumption) showed the highest importance. Interestingly, social acceptance had the lowest importance. This is an important finding for the following analysis when prices are assumed to be the same for all vehicles.

Table 2
Categories new variable "Profile".

New variable "Profile"		Description	
Category 1 Females with low income, low education level living in suburban and rural areas	profile = 1 if d1 > 0	• Females • Low income (0–20 k€) • Low education level (Highschool and Bachelors Degree) • Area: rural and suburban areas • Type_car = Diesel • Own_car: Not possessing a car • Own Car: Yes, gasoline car • Type_car: Gasoline + Others • Without previous experience • Without regular experience	Frequency 1.244 58%
Category 2 Males with high education in city center and higher income	profile = 2 if d1 < 0 and d2 < 0	• Males • City center • Highest education (Masters and PhD) • Income dispersed between 20 and 65 k€ • PHEV cars	Frequency: 583 27%
Category 3 Male with highest income living in suburban areas with experience	profile = 3 if d1 < 0 and d2 > 0	• Suburban areas • Own_Car: Diesel and Others • Previous and regular experience • Income > 65 k€	Frequency: 323 15%

4.2. Exploratory Factor analysis

Due to the relationships among the explanatory quantitative variables, and with the purpose of avoiding future problems of collinearity in the explanatory analysis, we first conducted an Exploratory Factor Analysis (EFA) with all quantitative predictor variables (33 variables in total). These included those that loaded on factors listed in Table 10 in the appendix, with a total of nine car-factor importance items (measured on a 10-point Likert scale in response to the question, "What are the most important aspects when buying a new car?") and another 22 EV opinion items (measured on a 5-point Likert scale of agreement/disagreement). Additionally, the quantitative variables "age" and "children" were included in the EFA. Principal component factor analysis with varimax rotation was implemented. We considered only factors with an eigenvalue > 1 (number# of factors was 10). With 10 factors, we captured 60.31% of the total information contained in the original variables (kMO value: 0.753 and Bartlett's test for sphericity Chi-squared = 16470.16***, df = 528). In Table 12 and 13 in the appendix, we show the rotated factor loadings, eigenvalues, and the percentage of variance explained by each factor obtained through factor analysis.

4.3. Multiple correspondence analysis (MCA)

Due to possible relationships between the qualitative variables and in order to avoid future problems of collinearity in the explanatory analysis, we performed a Multiple Correspondence Analysis (MCA) for the qualitative variables (see Fig. 2). We worked with two dimensions because graphing is more intuitive. Furthermore, the principal inertia of dimension 1 was 0.024, and the principal inertia of dimension 2 was 0.004. The percentages of original information captured by these two dimensions were, respectively, 56.74% and 9.53%, with the cumulative percentage being 66.27%. For the MCA all qualitative variables were selected to check the possible dimensions and to provide a first interpretation.

In the upper right in Fig. 2 as "Group/Profile 1," we find the gender "female" and the income category 0–20 k€, combined with a lower education level (2) with High School (Bachillerato) and Bachelor. These individuals live in rural and suburban areas and do not own a car. In the same dimension of the coordinate plot < 0 are grouped individuals who own a gasoline car and would choose gasoline or others as future cars and who do not have any EV experience yet. On the left-hand side dimension, we find individuals who can be grouped into "Profile 2," that is, males living in the city center with the highest education level (master's and PhD) and a dispersed income level of 20 k€ – 65 k€. Individuals who are grouped into "Profile 3" are those living in suburban areas, owning diesel cars & others, with previous and regular EV experience and the highest salary at > 65 k€. Although MCA helps to detect and represent underlying structures of categorical variables in order to define groups of individuals with a similar profile, it is possible that the groups included individuals who did not fit 100% into the profile definition.

In summary, MCA helped to reduce qualitative variables in only one variable "profile" with three subcategories (see Table 2). Later, in the regression analysis, the categories represented the initial variables.

4.4. Relationship between profiles and factors

As the factors were quantitative variables and profile was a qualitative variable with three categories, through one-way ANOVA, we tested whether the population means of the new quantitative variables (which were the factors obtained) were equal for the categories

Table 3
Oneway factors.

oneway (factorX) ANOVA profile, tab	F	Prob > F (p-value)	Variances homogeneity Prob > chi2
Factor 1: Reputation-Driven	6.32	0.0018	0.528
Factor 2: Fitting necessities	10.26	0.0000	0.137
Factor 3: Social status	6.29	0.0019	0.279
Factor 4: Performance	0.70	0.4946	0.068
Factor 5: Price compensation	0.75	0.4702	0.147
Factor 6: Life Stage	283.048(a)	0.0000	0.0000
Factor 7: Lack of knowledge	21.98	0.0000	0.578
Factor 8: Missing infrastructure	2.305 (a)	0.1002	0.024
Factor 9: Price of EV	19.19	0.0000	0.564
Factor 10: Range Anxiety	4.10	0.0167	0.301

(a)F value of applying fstar option. Based on the fact that variances homogeneity is not given for the factor "Life Stage" and "Missing infrastructure", the F-value represents the one obtained through fstar command in Stata.

Table 4
Logit regression Model 1 Option 1.

Model 1 Option 1: Dependent Variable EV					
Definition Factor	Coef	Std. Err.	P>|z|	Lower limit ci 95%	Upper limit ci 95%
Factor 1: Reputation-Driven	0.0844426	0.0540744	0.118	−0,0215	0.1904
Factor 2: Fitting necessities	1.012105	0.0661058	0.000	0.8825	1.1416
Factor 3: Social status	0.1690223	0.0535709	0.002	0.0640	0.2740
Factor 4: Performance	0.4864028	0.0588977	0.000	0.3709	0.6018
Factor 5: Price compensation	0.4599024	0.056502	0.000	0.3491	0.5706
Factor 6: Life Stage	0.2579496	0.0519183	0.000	0.1561	0.3597
Factor 7: Lack of knowledge	-0.0025247	0.0543732	0.963	−0.1090	0.1040
Factor 8: Missing infrastructure	-0.0412599	0.0535949	0.441	−0.1436	0.0637
Factor 9: Price of EV	-0.1288551	0.0556772	0.021	−0.2379	−0.0197
Factor 10: Range Anxiety	0.0311045	0.0531473	0.558	−0.0730	0.1352
_cons	-0.7759184	0.0560567	0.000	−0.8857	−0.6660

Log likelihood: −1073.1354.
Number of observ: 1985.
LR chi2(10): 448.26.
Prob > chi2: 0.0000.
Pseudo R2: 0.1728.

of the variable "profile" (see Table 3).

All factors except "performance," "price compensation," and "missing infrastructure" showed a statistically significant difference in the means corresponding the three categories of "profiles." Therefore, only these factors, each unrelated to the variable "profile," were selected for the logit regression that included the profile variable to avoid potential collinearity. The close relationship between the profiles and factor 6 (life stage) probably arises because both represent socio-demographic differences.

4.5. Estimation of the explanatory model: Analysis

After defining the factors and the new categorical variable "profile," we checked their relations with the other variables before estimating the model. In order to overcome multicollinearity, we tested the variables for possible correlation problems between them. We related and hypothesized the factors obtained through EFA that did not show any multicollinearity with the variable "profile" and the preference for EV in the future. The analysis of this study includes robustness assessments, factor analysis, and multivariate logit analyses of the individuals' attitudinal and behavioral opinion towards EV.

In order to determine how the obtained factors and the profiles impacted on the dependent variable, attending to the nature of this variable, logit regression was implemented. There were two different approaches due to the relationship identified between "factors" and "profile": (1) used only the factors as explanatory variables (see 4.5.1) and, (2) worked with "profile" and factors not related to profile as explanatory variables (see 4.5.2). Option (2) helped us to verify and strengthen the results of option (1,) at least for the factors which were not related to profile. It is noteworthy to highlight that the survey asked about preferences and beliefs, so the interpretations were limited to the relationship between opinions and preferences.

4.5.1. Option 1: Logit regression only with factors

In a first assessment, a logit regression was performed only with the factors defined above. The Pseudo R-squared shown in the following tables refers to McFaddens R^{*2} and is a measure of goodness of fit. The overall fit of the model was significant and the correctly classified observations were 72.80% (66.17% "yes" and 75.28% "no"). All factors except the factors "reputation-driven",

Table 5
Logit Regression Model 1 Option 2 (with "profile").

Model 1 Option 2					
Yes_EV_1_0	Coef	Std. Err.	P>|z|	Lower limit ci 95%	Upper limit ci 95%
_Iprofile_2 (Male city center)	. 8,744,242	0.112426	0.000	0.6540	1.0947
_Iprofile_3 (Male highest salary)	. 8,970,306	0.1370163	0.000	0.6284	1.1655
Factor 4:Performance	. 3,974,305	0.053762	0.000	0.2920	0.5028
Factor 5: Price compensation	. 3,600,625	0.0513426	0.000	0.2594	0.4606
Factor 8: Missing infrastructure	-0.0329299	0.0496468	0.507	−0.1302	0.0643
_cons	−1.011134	0.0683952	0.000	−1.1451	−0.8770

Log likelihood: −1199.7339.
Number of obs = 1985.
LR chi2(5) = 195.06.
Prob > chi2 = 0.0000.
Pseudo R2 = 0.0752.

Table 6
Logit Regression Model 2 Option 1 ("Car_sameprice").

Model 2: Dependent Variable: Car_sameprice					
Car_sameprice2	Coef	Std. Err.	p-value	Lower limit ci 95%	Upper limit ci 95%
Factor 1: Reputation-Driven	-0.4422998	0.0741533	0.000	−0,5876	−0.2969
Factor 2: Fitting necessities	1.369866	0.0856904	0.000	1.2019	1.5378
Factor 3: Social status	0.4801909	0.0733781	0.000	0.3363	0.6240
Factor 4: Performance	0.3579716	0.06851	0.000	0.2236	0.4922
Factor 5: Price compensation	0.4091105	0.0711792	0.000	0.2696	0.5486
Factor 6: Life Stage	0.0783293	0.070079	0.264	−0.0590	0.2156
Factor 7: Lack of knowledge	0.2137138	0.0676224	0.002	0.0811	0.3462
Factor 8: Missing infrastructure	-0.2510928	0.0717101	0.000	−0.3916	−0.1105
Factor 10: Range Anxiety	-0.2778786	0.0743539	0.000	−0.4236	−0.1321
_cons	2.152514	0.0894543	0.000	1.9771	2.3278

Log likelihood: −656.81695.
Number of observ: 1981.
LR chi2(9) = 546.18.
Prob > chi2 = 0.0000.
Pseudo R2 = 0.2937.
Info: Factor 9 not included in this model (Price).

"lack of knowledge," "missing infrastructure" and "range anxiety" showed a significant effect (see Table 4). The more the EV fit the personal and professional "necessities," the higher the probability of preferring an EV as their next car. If consumers perceived that an EV could fit their professional and personal necessities, the higher the probability of purchasing one. "Social status" represented the understanding that an EV improves social status and image in society. The greater the attention paid to social status, the higher the probability of preferring an EV over a gasoline/ diesel vehicle as the next future car. Thus, status-driven consumers were more akin with one another in preferring and purchasing EVs compared to non status-driven consumers. The "performance" factor included car attributes, such as range, performance, consumption and emissions, and the better these data were for the vehicle, the higher the probability of preferring an EV. The factor "price compensation" showed a positive coefficient and included variables that defined that lower consumption and lower maintenance compensated the higher purchase price of the EV. Consumers were more willing to purchase EVs if they perceived that the lower maintenance and consumption compensated for the initial purchase price. The "life stage" factor included the consumer's age and number of children, and the positive coefficient indicated that the older and the more children the consumer had, the higher the preference for an EV. The "price" factor included aspects related to the higher price for EVs and showed a negative coefficient, which means that the higher the price for EV, the lower the probability of purchasing an EV as their next car.

4.5.2. Option 2: Logit regression with "Profile" and not related factors

The global fit of the model considering the factors and profile was significant, and the correctly classified observations were 67.51% (58.75% "yes" and 69.72% "no"). As for the newly introduced variable "profile," we can see that belonging to profile 2 or 3, instead of profile 1, increased the preference for an EV as the next car compared to an ICEV (see Table 5). As explained above, profile 1 was made up of females with lower education levels and lower income, while profile 2 and 3 were made up of men with higher salaries and who owned cars. We can see that all categories were statistically significant, which means that profile 2 and 3 individuals were more likely to prefer an EV than the group of individuals assigned to profile 1.

In order to analyze the impact on the dependent variable, only the factors not related to profile were introduced: "performance," "price," and "missing infrastructure" (see Table 5). Two of these three factors were statistically significant. "Performance" showed

statistical significance with a positive coefficient, so the better the technical data of an EV, the higher the preference for this type of technology. This coincided with the positive, significant results of the factor "price compensation".

4.6. Consumer behavior when assuming equal prices

In order to deepen the analysis of consumer attitudes, the hypothetical situation that EVs cost the same as other cars was introduced. Therefore, a new dependent variable "car_sameprice" was introduced, which refers to the question that if EVs cost the same as other cars, which car would the consumer prefer. As previously explained, the variable "price" has a statistical significance impact on the purchase intention of EV and is therefore important to analyze. This approach helped to provide evidence on consumer behavior and to shed further light on the importance of reputation and image when adopting an EV. As previously explained, two different approaches to explanatory variables were used: (1) used only factors (see 4.6.1) and; (2) used "profile" and not related factors (see 4.6.2).

4.6.1. Option 1: Logit regression only with factors

First, a logit regression was conducted (see Table 6). The global fit of the model considering nine factors (factor price was excluded) was significant and the correctly classified observations were 85.71% (87.67% "yes" and 68.02% "no"). The factor "price" was excluded from this model as the dependent variable itself supposed that EVs cost the same as other cars. Factors "fitting necessities," "social status," "performance," "price compensation," and "lack of knowledge" showed statistical significance with positive signs. The factors "reputation-driven", "missing infrastructure" and "range anxiety" were statistically significant with negative coefficients. The factor "life stage" was not statistically significant in this model.

The factor "reputation driven," which had not shown a significant effect on the preference for EV in the first model, was significant in the second model with a negative coefficient, meaning the more consumers were driven by reputation (based on the vehicle's brand, design, social acceptance, and reputation), the less they opted for an EV in the situation that EVs cost the same. This is in line with the significance level of the factor "social status" in the first model. Considering the situation that all cars cost the same and the significance level of this factor, it showed that reputation-driven consumers were influenced by the higher price of an EV. Thus, reputation-driven consumers seemed to prefer higher-priced EVs to increase their status and reputation. As previously shown, this is in line with the study by Griskevicius et al. (2010), explaining that status motives increased the desirability of green products when they cost more than non green products.

The factors "fitting necessities," "social status," "performance," and "price compensation" can be interpreted in the same way as in Model 1. The factor "life stage", representing age and having children, showed a positive effect on the preference for an EV, without statistical significance if we assumed that car prices were the same. "Lack of knowledge," which had no significant effect on the probability of increasing one's preference for EVs according the first model, now became positive and significant. Therefore, if EVs cost the same as other cars, and the more information and knowledge about EVs was provided, it seems that consumers had a higher probability of preferring EVs over other cars. Factor "missing infrastructure" now showed a negative coefficient, which was interpreted as if infrastructure was lacking, consumers showed a decreasing probability of preferring EVs, assuming that the car prices were the same. The same happened for "range anxiety," which showed no significant effect on the probability of preferring EVs according to the first model, but when the assumption about the same price for all cars was introduced, "range anxiety" showed a negative coefficient, which led to the assumption that the worse the range, the lower the probability of preferring an EV. In summary, the results of the first option of the second model give additional information on factors that were not statistically relevant in the first model.

4.6.2. Option 2: Logit regression with "Profile" and not related factors

In line with the previous approach in Model 1 Option 2, the new dependent variable was also compared with the created variable "profile" and the factors "performance," "price compensation," and "missing infrastructure," which were factors not related to profile (see Table 7). The overall fit of the model considering the three factors and "profile" was significant, and the correctly classified observations was 82.23% (82.28% "yes" and 66.67% "no"). Category 2 of the newly created variable "profile" showed statistical relevance, meaning that male consumers living in the city center showed a higher probability of buying an EV compared to female

Table 7
Logit Regression Model 2 Option 2 "Car_sameprice" (with "profile").

Car_sameprice	Coef	Std. Err.	P>|z|	Lower limit ci 95%	Upper limit ci 95%
_Iprofile_2 (Male city center)	0.3754224	0.1471205	0.011	0.0870	0.6637
_Iprofile_3 (Male highest salary)	0.1087161	0.1722673	0.528	−0.2289	0.4463
Factor 4: Performance	0.2885597	0.0565134	0.000	0.1777	0.3993
Factor 5: Price Compensation	0.3249849	0.0583146	0.000	0.2106	0.4392
Factor 8: Missing infrastructure	-0.2060537	0.0620898	0.001	−0.3277	−0.0843
_cons	1.488456	0.0775327	0.000	1.3364	1.6404

Log likelihood: −892.87321.
Number of obs = 1981.
LR chi2(5) = 74,07.
Prob > chi2 = 0.0000.
Pseudo R2 = 0.0398.

consumers with lower income and education, living in suburban and rural areas. However, category 3 of the variable "profile," which referred to male consumers with the highest salary living in suburban areas and having had previous experience with EV, showed no statistical significance; thus, the coefficients tended to suggest that for this consumer group there was no influence on the preference for EV if these type of cars cost the same as the others.

In contrast to Model 1, "missing infrastructure" now showed statistical significance with a negative coefficient in both logit options, assuming that consumers' preferences for EVs were lower with a missing infrastructure for recharging. "Price compensation" was interpreted to mean that lower consumption and lower maintenance costs can compensate for the higher purchase price for EVs. "Performance" referred to technical data, such as range and performance, and the better these data were, the higher the preference for an EV.

In summary, when comparing all four models, the price comparable models showed slightly better prediction accuracy, which strengthens the present approach of conducting a second model with the control variable of prices. In the following, the pseudo R2 and accuracy of the four models are summarized.

- Model 1 Option 1: pseudoR2 = 0.17, accuracy (correctly classified preferences) = 72.80%
- Model 1 Option 2: pseudoR2 = 0.08, accuracy (correctly classified preferences) = 67.51%
- Model 2 Option 1: pseudoR2 = 0.29, accuracy (correctly classified preferences) = 85.71%
- Model 2 Option 1: pseudoR2 = 0.04, accuracy (correctly classified preferences) = 82.23%

4.7. Results of hypotheses for both models

In comparison to the first model (assuming different prices), the second model (assuming equal prices) provided further statistical relevance. It is noteworthy that reputation-driven consumers showed negative statistical relevance in the second model based on Factor 1 "reputation-driven," meaning that if prices were the same for all vehicles, the probability of preferring an EV over an ICE vehicle would decrease. Griskevicius et al. (2010) also found that status motives increased the preference for green products, especially when these products cost more than non green products. Griskevicius et al. (2010) and Hafner et al. (2017) have suggested that people might not agree that image matters when adopting EV when asked directly. Therefore, the role of image and reputation is highly complex, and consequently consumers responses regarding those variables might not reflect the real attitude. This is an important finding for further research on consumer behavior. For five of our hypotheses, we found statistical evidence in only one of the two models, which raises the possibility that the positive tests may have been "false positives" due to the increased probability of getting a positive result when conducting multiple hypothesis tests. In order to overcome this issue, we applied the Bonferroni test as the technique when conducting multiple analyses on the same dependent variable with the chance of increasing error rate, and thus increasing the probability of incorrectly rejecting the true null hypothesis by coming about a significant result by chance. However, we found no concerning impact. Table 11 in the appendix shows the hypotheses' results.

4.7.1. Consumer hypotheses

Regarding Hypothesis 1, "Females are more likely to prefer EVs than men," this assumption can be rejected in both models, as profiles 2 and 3, which included male consumers, showed a positive sign compared to group 1 in which women were prevalent; thus, in this sample men seemed more likely to prefer EVs. As previously explained, it is important to consider that not each individual who responded to the survey fit 100% the definition of the different groups created from MCA. If this result is accepted with some caution, Hypothesis 1 is to be rejected, and this outcome is in line with Plötz et al. (2014). As for the variable age, our result suggests rejecting Hypothesis 2 based on Model 1, as the factor "life stage," which included the variable "age," showed a positive sign, meaning that the older the consumers were, the higher the probability of preferring an EV. This result supports the findings by Johansson-Stenman and Martinsson (2006), Zhang et al. (2011), Plötz et al. (2014), Peters and Dütschke, (2014) and Jansson et al. (2017). As previously explained, this hypothesis was rejected in the first model, and statically was not significant in the second model. Hypothesis 3 can be accepted with the different profile categories created through MCA that showed a positive impact of belonging to profile 2 or 3 (higher education) compared to profile 1 (lower education). Thus, a higher level of education led to a higher probability of preferring an EV, which is in line with the current literature (Hidrue et al., 2011; Sanitthangkul et al., 2012; Olson, 2013; Jansson et al., 2017; Mukherjee & Ryan, 2020; Nayum and Klöckner, 2014). The same applies for Hypothesis 4, according to which a higher income leads to a higher probability of preferring an EV, in accordance with Bjerkan et al. (2016), Plötz et al. (2016), Plötz et al. (2017), Junquera et al. (2016), Erdem et al. (2010). Hypothesis 5 is to be accepted based on the different profile categories, which showed that people living in urban areas (profile 2) were more likely to purchase an EV than those living in rural areas (profile 1). This result is in line with Mukherjee and Ryan (2020)) and adds further evidence concerning this variable. Hypothesis 6 states that consumers who have children (more household members) are more likely to buy an EV, as the results of Zhang et al. (2011), Nayum and Klöckner (2014), Plötz et al. (2014) showed. This was confirmed in both models, based on the positive significance of factor 6. Also, the fact of owning a car, as Hypothesis 7 assumes, can be accepted in both models and provides further evidence for what Zhang et al. (2011) and Nayum and Klöckner (2014) found. As for Hypothesis 8, having had previous experience seemed to increase the preference for EVs and therefore, Hypothesis 8 can be accepted based on the result of the previously defined profiles. The positive impact of having had previous experience confirms former findings found for this variable, among others by Xu et al. (2020), Liu et al. (2020) and Schmalfuß et al. (2017) and Jensen et al.

(2013). Hypothesis 9 deals with the question of whether reputation- and status-driven people have a higher probability of preferring an EV, aiming to provide further contribution to the literature especially based on the research by Hahnel et al. (2014), Johansson-Stenman & Martinsson (2006), Rahmani and Loureiro (2019), Ozaki (2011), Laroche et al. (2001), Lane and Potter (2007), and Hur et al. (2013). This can be accepted based on the significant level of the factor "social status" in Model 1 Option 1. Consumers believe that an EV improves their image, reputation, and social status. The result regarding the impact of status was reinforced in Model 2 Option 1, where "social status" again showed a positive statistical significance. More interestingly, the factor "reputation-driven" now in Model 2 Option 1 showed a statistical significance with a negative coefficient, leaving room for interpretation that reputation-driven consumers only prefer EVs if these types of vehicles are more expensive. Once EVs cost the same as other vehicles, they seemed not to be a preferred option for this consumer group. This is an interesting result and can serve as useful evidence for future research.

4.7.2. Car attributes hypotheses

Hypothesis 10 states that a higher purchase price for EV decreases the preference for EVs, and this is to be accepted based on Model 1 due to the statistical significance of the factor "price of EV." This outcome strengthens the results of Egbue and Long (2012), Knez et al. (2014), Lane and Potter (2007), Bjerkan et al. (2016), Ozaki (2011), Lieven et al. (2011), and Cecere et al. (2018). As mentioned above, the factor "price" was not included in Model 2, based on the model's assumption that all cars cost the same. Hypothesis 11, stating that lower consumption and lower maintenance of an EV can compensate for the higher purchase price, represented by the factor "price compensation" was validated in both models. This evidence is in line with the research conducted by Lane and Potter (2007), Gallagher and Muehlegger (2011), Egbue and Long (2012). Hypothesis 12 concerns whether a higher driving range, in the form ofthe distance the vehicle can drive before recharging, increases the preference for an EV. Several authors (see e.g. Hidrue et al. 2011, Lieven et al., 2011; Egbue and Long, 2012; Hackbarth and Madlener, 2016; Barkenbus, 2020) have supported this assumption with their research results. In our analysis, the driving range was represented by both the factors "performance" and "range anxiety," and based on the statistical significance of the factor "performance," Hypothesis 12 is to be accepted in both models. Although the factor "range anxiety" did not show statistical significance in Model 1, it still can be confirmed by the factor "performance" in Model 1. In Model 2, both "range anxiety" and "performance" showed statistical significance. All in all, the hypotheses about the different car attributes helped to better understand consumer behavior and the factors that influence their preferences for EVs.

4.7.3. Environmental settings hypotheses

Hypothesis 13 analyzes the impact of an EV charging infrastructure, which was represented by the factor "missing infrastructure." Several authors found a significant, positive impact of a good infrastructure for charging on the preference for EVs (Sierzchula et al., 2014; Hoen and Koetse, 2014; Li et al., 2017a; Martínez-Lao et al. (2016); Hardman et al., 2018; Oliveira et al., 2019; Barkenbus, 2020). Our results for this variable showed no statistical significance in Model 1 but a statistical significance with a negative coefficient in Model 2 in both logit options. Therefore, Hypothesis 13 is to be accepted based on Model 2. Hypothesis 14 concerns whether governmental supports increase the preference for an EV, which had been investigated in several research studies with positive affirmation (Gallagher and Muehlegger, 2011; Turcksin et al., 2013; Hardman et al., 2017; Wang et al., 2017; Cordera et al., 2019; Li et al., 2019). We showed (Section 4.5.1, Table 4) that people who consider EV prices important (factor 9) are less likely to intend to buy an EV. The 'subventions' variable ("The purchase of an electric vehicle should be incentivized by financial advantages") has a rotated factor loading of 0.490 on factor 9, as shown in Table 12 in the appendix ("Scale_subv-s" for Factor 9). This indicates that the two are associated and, hence, that that price-conscious car buyers may also tend to support subventions for EVs. This is consistent with the hypothesis that governmental supports would increase the preference for an EV through their tendency to reduce the initial purchase price. Since the factor "price of EV" showed statistical significance in Model 1, Hypothesis 14 can be accepted, according to which government support contributes to increasing the preference for an EV. Hypothesis 15 analyzed the impact of information availability reflected in the factor "lack of knowledge," in order to support the positive relationship between information availability and EV preference, as found by Hidrue et al. (2011), Ozaki (2011), Egbue and Long (2012), Turcksin et al. (2013), Rahmani and Loureiro (2019). In Model 1, the factor was not significant; however, it was statistically significant in Model 2 and therefore can be confirmed based on the Model 2.

Comparing both models proved the robustness of the first model and yielded good performance. The second model provided additional validity and improved interpretation and understanding of consumer behavior, showing that reputation-driven consumers are interested in EV as a sustainable product only when prices are more expensive compared to other vehicles. The model revealed that reputation-driven consumers prefer EVs due to their higher purchase price, as they apparently provide some kind of exclusivity. This fact is of great interest and is explained in more detail in our conclusions, Section 5, below. The approach of running two models with two different dependent variables is acceptable in order to provide greater interpretation and a deeper understanding of consumers of EVs when assuming the same price for all vehicles. However, and as stated as a limitation in the last section, future research should focus on different prices within hypothetical choice experiments.

5. Discussion, conclusion and policy implications

In conclusion, this paper presents, in a comprehensive and systematic way, the impact of different variables influencing the preference for EVs with a strong emphasis on consumer behavior. It includes (1) consumers' sociodemographic variables with an

additional focus on experience and consumer behavior, (2) car attributes, and (3) environmental settings, such as governmental support schemes and infrastructure development on the preference for EV, additional to the findings of how consumer preferences would change if purchase prices were the same for both BEV and ICE vehicles. Based on this structural approach, the findings and recommendations help validate the present research literature to improve the utility of future studies. This study explores the role of reputation, status, and image as factors related to whether an individual will prefer an EV over other vehicles. By highlighting the importance of reputation, it gives valuable information about consumers' behavior. Regarding socioeconomic factors, there are contradictory results in the current literature. At the same time, there is a common understanding that sociodemographic variables exert significant influence. In summary, we could show that a higher education and higher salary, as well as having children and living in urban areas, rather than rural areas and owning a vehicle are positively reflected in the preference for an EV.

At the outset, we asked, "What effect does EV experience have on potential EV adoption?" Previous research has shown that experiences can encourage EV adoption (Liu et al., 2020; Xu et al., 2020; Rauh et al., 2020; Schmalfuß et al., 2017; Hahnel et al, 2014; Schmalfuß et al., 2014; Jensen et al., 2013). We found that experience was more common in a particular socio-demographic group: men with higher salaries who live in suburban areas tended to have EV experience. Compared to a reference group of women with less education, lower income, and living in rural or suburban areas, these men in our sample set had more intention to purchase EVs but did not show a clear difference in EV preference (at equal prices with other vehicles). This could be interpreted as showing that lower-income groups tend not to have experimented with EVs (perhaps due to price barriers) but may share preferences for EVs with those who have. However, given those previous research findings that indicate the encouraging effect of EV experiences it may also be the case that intervening to provide EV experiences to individuals who tend to be women with less education and income might encourage EV adoption in this group, particularly as prices of EVs and non-EVs begin to equalize.

Furthermore, our study suggest that the more consumers are driven by reputation, the less they opt for an EV in the situation that EVs cost the same, which is an interesting finding. It is worth considering whether "reputation drive" does not capture the socially desirable aspects of cars other than EVs once "social desirability" is controlled statistically within the model and "purchase price" is removed from the equation (since high-status cars are usually more expensive). A possible follow-up is a moderated multiple regression approach allowing the two variables reputation and price to together explain more, or less, variance than they might do each individually.

Analysis of the heterogeneity of a driver's willingness to purchase an EV is important and useful for public decision-makers, such as governments, to implement correct measures by understanding the market and consumers. Although the study sample is representative of the population of Barcelona with respect to age and gender, it is still useful to take the results into account for policy and decision-making. As other studies have shown (e.g. Gallagher and Muehlegger, 2011; Hardman et al., 2017; Wang et al., 2017; Li et al., 2019), the adoption of EVs is likely to be limited without significant governmental incentives. The potential impact of governmental incentives was validated in both models of this study. Given the low market penetration of EVs, incentives are believed to be a prerequisite to eventually change consumers' environmental behavior. As for the Spanish market, the government put in place the new "MOVES III" support in 2021, which is an aid program to encourage the purchase of electric, plug-in hybrid and fuel cell vehicles; however, it needs certain improvements, on which automotive associations are working. Governments should encourage the availability of information on EVs to clarify misunderstandings about their performance. Additionally, a good infrastructure system should be promoted and implemented.

Overall, the study addresses environmental and sustainability research by focusing on consumer behavior. The hypotheses are tested with two different dependent variables. In doing so, the present study is one of the first to investigate the consumers behavior and preference for EVs using different dependent variables while contrasting previous results concerning sociodemographic variables. The second model highlights the importance of reputation for consumers, when adopting an EV. Being reputation-driven positively influences the preference for EVs only if these cars are more expensive. This result leads to the interpretation that inexpensive sustainable products might undermine a consumers' ability to signal their wealth and purchasing power, and therefore green products are only preferred if they are more expensive. This research can lead to the conclusion that people tend to care more about reputation and social acceptance than about environmental issues. In summary, this study adds value and insights for EV adoption from a consumer perspective and confirms earlier findings while applying new empirical approaches. The research provides a comprehensive analysis of consumers' demographic variables when adopting EVs, car attributes, and external environmental settings, and applies an additional model to analyze consumer behavior by assuming the same prices for all vehicles.

6. Limitations

Although this research shows interesting findings and consequently applicable measures for higher EV adoption, some limitations must be taken into account when interpreting the results. Overall, it should be taken into consideration that it is a study of the relationships between different questionnaire answering patterns and not a study of cause and effect, such as an experiment trial. For future studies, an experiment trial could be applied. Regarding environmental concern, this study included statements to be answered on a Likert Scale, such as "It is important to care for the environment," "For the purchase of an EV, I am motivated by lower contamination compared to an ICEV," etc.; however, future research should focus more on environmental measurements and use as reference the items of the NEP Scale by Dunlap and Van Liere published in 1978. In relation to consumer attitudes and behavior, further research on the connection between EVs and environmental concerns is essential.

The study focuses on EV in general, which also includes HEV and PHEV, where psychological barriers to adaptation are easier to overcome than in the case of pure BEVs, which only run on electricity and have clearer technological differences. It might be treacherous to generalize results from AFVs to BEVs. Therefore, in order to enrich the literature and focus on the most innovative technologies, future studies should mainly focus on BEVs. In line with the study by Noppers et al. (2016), it is critical to keep in mind that people do not necessarily highlight and recognize the importance of symbolic self-attributes, such as the impact on self-identity and social status, when asked directly about important factors for the adoption of sustainable innovations, such as an EV. Consistent with Herberz et al. (2020) and Gleim and Lawson (2014), consumers may admit the importance of a sustainable approach to green products, but they do not always translate this attitude into actual behavior. Future research should further analyze the psychology of consumers to review whether consumers underestimate the importance of symbolic attributes. The present paper applied factor analysis (EFA) and MCA, which implied data reduction in order to create and label different factors and dimensions. This approach helps to reduce correlation between variables; however, it has to be acknowledged that original hypotheses cannot be evinced unambiguously.

Also, it is important to consider that consumer behavior may change over time and it would be interesting to know how status- and image-focused behavior will change once EVs become more accessible to all consumers (see for further information Adnan et al. 2017). It is vital to deal with consumers' attitudes and preferences to be more successful in adopting sustainable means, such as green vehicles. At the same time, it is important to conduct a cross-country comparison to generalize the results. Southern European Countries, such as Spain or Italy, suffer a shortfall of research in this field. Regarding sociodemographic variables, future research should take into consideration the change in transportation patterns in society, e.g., decreasing car ownership and increasing car-sharing options, especially for younger generations (see Efthymiou et al., 2013). At the same time, it is interesting to analyze the relationship between vehicle ownership and household relocations, such as moving to suburban geographies (see Schouten, 2022).

Future research could also analyze in depth the role of the different automotive brands. In the present study, the variable "brand" is included in the factor analyses, but it would be of interest to know whether consumers prefer EVs of a specific brand when adopting luxury brands that might convey social status (is consumer's behavior different when adopting luxury brands, such as Porsche, Mercedes, Audi compared to VW, Renault, KIA, etc.). Despite these limitations, our study does point out a path toward fruitful future research that can be built up from this paper's outcome.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A

See Tables 8-13

Table 8
Deftnition EVs.

Vehicle type	Short name	Description*
Battery Electric Vehicle	BEV	BEVs run entirely by an electric motor which works solely with batteries, and consequently are without any combustion gasoline engine. The batteries are usually larger than the ones for PHEVs and are rechargeable, so that the vehicle can be plugged into an external source of electricity. BEVs can also, like all electric vehicles, recharge their batteries through regenerative braking for which its kinetic energy is converted into electricity when slowing the car down. Such cars are zero emission vehicles.
Plug-in Hybrid Electric Vehicles	PHEV	PHEVs consist of an electric or battery motor in combination with an internal combustionengine; while the battery-powered electric motor is the main power source. The battery is often smaller than the one in pure BEVs. Both HEVs and PHEVs combine the internal combustion engine with the battery and electric motor, but the PHEVs can be recharged from external sources, such as plugging them in at home, regenerative braking, or by gas engine.
Hybrid electric vehicles	HEV	HEV is a hybrid vehicle, and is mainly powered by an internal gasoline combustion engine. The electric motor is only used to complement this combustion engine. Such cars use the electric motor at low speeds and then change into gasoline power, in contrast to PHEVs. Thus, the main power source is still gasoline. In doing so, such cars combine benefits of both kinds of power sources and are considered a combination of low emission and conventional cars.
Fuel-cell electric vehicles	FCEV	FCEVs uses electricity which is created by using a fuel cell powered by hydrogen from an on-board tank that is combined with atmospheric oxygen. These vehicles do not produce tailpipe emissions.
Range-extended electric vehicle	REEV	REEV is powered by an electric motor and an auxiliary power which is a small petrol engine as electric generator to supply the electric motor. The auxiliary combustion engine is used only to supplement battery charging and consequently to increase the vehicles range.

Source: U.S.Department of Transportation (2022); (Tran et al., 2021).

* Further types are existing, but are not explained in more detail here, e.g. hydrogen fuel cell vehicles, natural gas vehicles NGV.

Table 9
References Literature Review.

Category		Hypothesis	Authors (Literature Review)	In contrast
Consumer	H1	Females are more likely to prefer EVs than men.	Johansson-Stenman & Martinsson, 2006; Knez et al., 2014; Prakash et al., 2014; Jansson et al., 2017; Simsekoglu & Nayum, 2018; Yang et al. 2019; Sovacool et al., 2019	Plötz et al., 2014
	H2	The younger the consumer, the higher the likelihood of preferring an EV over an ICE vehicle.	Laroche et al. 2001; Hidrue et al., 2011; Sanitthangkul et al., 2012; Knez et al., 2014; Hackbarth & Madlener, 2016; Mukherjee & Ryan, 2020	Johansson-Stenman and Martinsson, 2006; Zhang et al. 2011; Plötz et al., 2014; Peters & Dütschke, 2014; Jansson et al., 2017
	H3	Higher education leads to an increased probability of preferring an EV over an ICE vehicle.	Hidrue et al., 2011; Sanitthangkul et al., 2012; Olson, 2013; Jansson et al., 2017; Mukherjee & Ryan, 2020; Nayum and Klöckner, 2014	*no significance:* Egbue and Long, 2012 Johansson-Stenman and Martinsson, 2006; Zhang et al., 2011; Hackbarth & Madlener, 2016.
	H4	Higher income leads to an increased probability of preferring an EV.	Bjerkan et al., 2016; Plötz et al., 2016; Plötz et al., 2017; Junquera et al. (2016); Erdem et al., 2010	Nayum and Klöckner, 2014; *no significance:* Sanitthangkul et al., 2012; Egbue and Long, 2012; Knez et al., 2014; Hidrue et al., 2011. Green products: Gleim and Lawson (2014)
	H5	Living in urban areas leads to an increased probability of preferring an EV.	Mukherjee and Ryan, 2020	Plötz et al., 2014
	H6	Having children leads to an increased probability of preferring an EV.	Zhang et al., 2011; Nayum and Klöckner, 2014; Plötz et al., 2014. *household size*	–
	H7	Possessing a car (independent of model) leads to an increased probability of preferring an EV.	Zhang et al., 2011; Nayum and Klöckner, 2014: *number of cars*	Hidrue et al., 2011
	H8	Having had previous experience leads to an increased probability of preferring an EV.	Jensen et al., 2013; Schmalfuß et al., 2014; Peters & Dütschke, 2014; Hahnel et al., 2014; Larson et al., 2014; Peters & Dütschke, 2014; Nayum et al., 2016; Schmalfuß et al. 2017; Günther et al., 2019; Rauh et al., 2020; Herbers et al., 2020;Xu et al., 2020; Liu et al. (2020)	Skippon et al., 2016; Bühler et al., 2014
	H9	Reputation- and status-driven consumers are more likely to prefer EVs.	Hahnel et al., 2014;Johansson-Stenman & Martinsson, 2006; Rahmani and Loureiro, 2019; Ozaki, 2011; Laroche et al., 2001; Lane & Potter, 2007; Hur et al., 2013	–
Car attributes	H10	A higher list price for EV lowers the preference for EVs.	Egbue and Long, 2012; Knez et al., 2014; Lane and Potter, 2007; Bjerkan et al., 2016; Ozaki 2011; Lieven et al., 2011; Cecere et al, 2018	–
	H11	Lower consumption and lower maintenance costs compensate for the higher purchase price of EVs and leads to an increased probability of preferring an EV	Lane and Potter, 2007; Gallagher and Muehlegger, 2011; Egbue and Long, 2012	–
	H12	A higher range of EVs, leads to an increased probability of preferring an EV.	Hidrue et al. 2011, Lieven et al., 2011; Egbue & Long, 2012; Hoen & Koetse, 2014; Schneidereit et al. 2015; Hackbarth & Madlener, 2016; Cecere et al., 2018; Günther et al., 2019; Barkenbus, 2020	For unexperienced drivers: Franke & Krems, 2013
Environ-mental settings	H13	Better infrastructure (charging stations, wallbox installations) the context shows leads to an increased probability of preferring an EV.	Sierzchula et al., 2014; Hoen & Koetse, 2014; Li et al., 2017a; Martínez-Lao et al. (2016); Hardman et al., 2018; Oliveira et al., 2019; Barkenbus, 2020	Weaker than other incentives: Harrison and Thiel, 2016
	H14	Governmental support for EVs leads to an increased probability of preferring an EV.	Gallagher and Muehlegger, 2011; Turcksin et al., 2013; Hardman et al., 2017; Wang et al., 2017; Cordera et al., 2019; Li et al., 2019	Zhang et al., 2011; Hackbarth & Madlener, 2016; For younger consumers: Mukherjee and Ryan, 2020
	H15	More available information combined with the know-how of dealers, leads to an increased probability of preferring an EV.	Hidrue et al, 2011; Ozaki, 2011; Egbue and Long, 2012; Turcksin et al., 2013; Rahmani & Loureiro, 2019	–

Table 10
10 Factors defined through factor analysis.

Factor	Variables	Definition Variables	Question Survey	Definition Factor
Factor 1	Factor_Brand	Brand	What are the most important factors when buying a new car? Please indicate on a scale from "1 = not important at all" to "10 = most important".	Reputation driven
	Factor_Design	Design		
	Factor_SocAccept	Social Acceptance		
	Factor_Reput	Reputation		
Factor 2	Scale_personalnecess	An electric vehicle fits my personal necessities.	Please indicate on a scale from 1 (completely disagree) to 5 (completely agree) with the following. (EV = electric vehicle. ICE = internal combustion engine; traditional vehicle)	Fitting necessities
	Scale_professionalnecess	An electric vehicle fits my professional necessities.		
	Scale_lessemiss	For the purchase of an EV, I am motivated by a lower contamination of an EV (compared to an ICE).		
Factor 3	Scale_image_socialstatus	Driving an electric vehicle would improve my image and social status.	Please indicate on a scale from 1 (completely disagree) to 5 (completely agree) with the following. (EV = electric vehicle. ICE = internal combustion engine; traditional vehicle)	Social Status
	Scale_ecofriendlyimage	For the purchase of an EV, I am motivated by an eco-friendly image towards others (others will think that I care about the environment).		
	Scale_statussociety	Individuals who purchase an EV have a better status in society.		
Factor 4	Factor_Drive	Driving Range (distance your car can drive before recharging/refueling)	What are the most important factors when buying a new car? Please indicate on a scale from "1 = not important at all" to "10 = most important".	Performance
	Factor_Consum	Consumption		
	Factor_Perf	Performance (HP, kwH)		
	Factor_Emiss	Emissions		
Factor 5	Scale_lowerconsumhigherprice	The lower consumption (cost) of an electric vehicle can compensate for a higher initial price of EVs vs traditional cars.	Please indicate on a scale from 1 (completely disagree) to 5 (completely agree) with the following. (EV = electric vehicle. ICE = internal combustion engine; traditional vehicle)	Price compensation
	Scale_lowrunningcosts	The lower running costs for workshop, parts, maintenance etc. can compensate for the higher initial price of electric vehicles vs traditional cars.		
Factor 6	Age	quantitative variable	How old are you	Life Stage
	Children		How many children do you have?	
Factor 7	Bvless_lessinfo	… the little information provided about electric vehicles.	Electric vehicles are not sold more often due to….	Lack of knowledge
	Bvless_knowledgeDealer	…the lack of knowledge about electric vehicles of sales advisors in dealerships	Please indicate from a scale from 1 (completely disagree) to 5 (completely agree) for the following assumptions of why electric vehicles are not sold more often.	
Factor 8	Bvless_wallbox	… the fact of not having a private parking space to install chargers (Wallbox).	Electric vehicles are not sold more often due to….	Missing infrastructure
	Bvless_infrastr	…the lack of public chargers.		
	Bvless_installprivatecharger	…the effort (approval by community) to install a private charger in a shared parking space.	Please indicate from a scale from 1 (completely disagree) to 5 (completely agree) for the following assumptions of why electric vehicles are not sold more often.	
Factor 9	Factor_Price	Price, cost of car	What are the most important factors when buying a new car? Please indicate on a scale from "1 = not important at all" to "10 = most important".	Price/ Financial aspects
	Bvless_price	Electric vehicles are not sold more often due to……the high purchase price.	Electric vehicles are not sold more often due to…. Please indicate from a scale from 1 (completely disagree) to 5 (completely agree) for the following assumptions of why electric vehicles are not sold more often.	
Factor 10	Bvless_perfor	…the performance of the electric vehicle.	Electric vehicles are not sold more often due to….	Range Anxiety
	Bvless_range	…the limited range of electric vehicles.	Please indicate from a scale from 1 (completely disagree) to 5 (completely agree) for the following assumptions of why electric vehicles are not sold more often.	

Table 11
Hypothesis Results Model 1(assuming different prices) vs Model 2 (assuming equal prices).

Category		Hypothesis	Results Model 1 (assuming different prices)	Results Model 2 (assuming equal prices)
Consumer	H1	Females are more likely to prefer EVs than men.	Rejected (Profile category 2 and 3 are males)	Rejected (Profile category 2 are males)
	H2	The younger the consumer, the higher the likelihood of preferring an EV over an ICE vehicle.	Rejected (Factor 6)	not significant (Factor 6)
	H3	Higher education leads to an increased probability of preferring an EV over an ICE vehicle.	Accepted (Profile)	Accepted (Profile)
	H4	Higher income leads to an increased probability of preferring an EV.	Accepted (Profile)	Accepted (Profile)
	H5	Living in urban areas leads to an increased probability of preferring an EV.	Accepted (Profile)	Accepted (Profile)
	H6	Having children leads to an increased probability of preferring an EV.	Accepted (Factor 6)	Accepted (Factor 6)
	H7	Possessing a car (independent of model) leads to an increased probability of preferring an EV.	Accepted (Profile)	Accepted (Profile)
	H8	Having had previous experience leads to an increased probability of preferring an EV.	Accepted (Profile)	Accepted (Profile)
	H9	Reputation- and status-driven consumers are more likely to prefer EVs.	Accepted (Factor 3) Not significant (Factor 1)	Accepted (Factor 3 and Factor 1)
Car attributes	H10	A higher list price for EV lowers the preference for EVs.	Accepted (Factor 9)	Not included
	H11	Lower consumption and lower maintenance costs compensate for the higher purchase price of EVs and leads to an increased probability of preferring an EV	Accepted (Factor 5)	Accepted (Factor 5)
	H12	A higher range of EVs, leads to an increased probability of preferring an EV.	Accepted (Factor 4) Not significant (Factor 10)	Accepted (Factor 4) Accepted (Factor 10)
Environ-mental settings	H13	Better infrastructure (charging stations, wallbox installations) the context shows leads to an increased probability of preferring an EV.	not significant (Factor 8)	Accepted (Factor 10)
	H14	Governmental support for EVs leads to an increased probability of preferring an EV.	Accepted (Factor 9)	(Factor 9 not included)
	H15	More available information combined with the know-how of dealers, leads to an increased probability of preferring an EV.	not significant (Factor 7)	Accepted (Factor 7)

Table 12
Rotated factor loadings and unique variances – 1 Rotated factor loadings (pattern matrix) and unique variances.

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8	Factor9	Factor10	Uniqueness
Age	0.0540	−0.0121	−0.0372	0.0485	−0.0436	0.8996	−0.0352	0.0177	−0.0408	0.0605	0.1751
Children	0.0352	−0.0240	0.0151	0.0146	−0.0043	0.8876	−0.0060	−0.0233	0.0132	−0.0012	0.2091
Factor_Brand	0.7488	0.0588	−0.0611	−0.0262	0.0252	0.1090	−0.0331	0.0603	0.0578	0.0384	0.4093
Factor_Price	−0.0235	−0.0537	0.0156	0.2934	−0.0119	−0.3606	0.0296	−0.0126	0.5471	−0.0673	0.4782
Factor_Drive	0.1126	0.0469	0.0148	0.6471	−0.0196	0.0939	−0.1025	0.0676	−0.0042	0.1613	0.5189
Factor_Des − n	0.7421	0.1075	−0.0416	0.0766	−0.0057	−0.0917	−0.0366	0.0550	−0.0145	0.1111	0.4048
Factor_Con − m	−0.0402	−0.0480	0.0051	0.7516	0.0084	−0.0843	0.1457	0.0417	0.2500	−0.0312	0.3376
Factor_Perf	0.3840	−0.0666	−0.1606	0.5283	−0.0561	−0.0393	0.1236	0.0450	0.0251	0.0768	0.5121
Factor_Emiss	−0.0796	0.2625	0.0605	0.7006	0.0991	0.1781	0.1319	−0.0322	−0.1415	0.0280	0.3493
Factor_Soc − t	0.6976	−0.0112	0.3546	−0.0590	0.0194	0.1019	0.0687	−0.0207	−0.1133	0.0035	0.3551
Factor_Reput	0.7403	−0.0607	0.2133	0.0174	0.0439	0.0652	0.0333	−0.0279	−0.0590	−0.0324	0.3099
Scale_pers − c	0.0377	0.7966	0.0608	0.0528	0.0920	−0.0480	0.0737	−0.0438	0.0623	−0.1328	0.3179
Scale_prof − c	0.0991	0.7910	0.0475	−0.0108	0.0341	−0.0015	−0.0167	−0.0001	0.0469	−0.0606	0.3548
Scale_imag − s	0.1032	0.1959	0.7537	0.0041	0.0987	−0.0607	−0.0464	0.0273	0.0336	−0.0442	0.3635
Scale_life − e	−0.0237	0.4820	0.4605	0.0775	0.1378	−0.0805	0.1897	−0.0557	0.0503	−0.0254	0.4813
Scale_envi − n	−0.2265	0.3992	0.0632	0.3035	0.0902	−0.1022	−0.0060	0.1270	−0.1119	0.0658	0.6415
Scale_less − s	−0.0909	0.5215	0.2923	0.1964	0.2238	0.0687	0.1559	0.0074	0.1463	0.0225	0.4947
Scale_ecof − e	0.2181	0.0147	0.7174	−0.0547	0.0609	0.0575	0.1274	−0.0444	0.0019	0.0383	0.4079
Scale_stat − y	0.0093	0.0375	0.7932	0.0397	0.0717	−0.0220	−0.0587	0.0627	−0.0001	0.0226	0.3543
Scale_pena − y	−0.0269	0.2695	0.1975	0.1123	0.3799	0.1953	0.1019	−0.0257	−0.1848	0.0102	0.6473
Scale_subv − s	−0.0512	0.3892	0.2175	0.0376	0.1067	0.0572	0.1435	0.1061	0.4901	0.1027	0.5000
Scale_will − e	−0.1083	0.2741	0.1176	0.2998	0.4755	0.0999	−0.0429	0.0197	−0.3449	0.0440	0.4503
Scale_lowe − e	0.0290	0.0902	0.0730	0.0270	0.8823	−0.0457	0.0081	0.0271	−0.0095	−0.0272	0.2027
Scale_lowr − s	0.0351	0.0288	0.0636	−0.0296	0.8667	−0.0316	0.1010	0.0253	0.0723	−0.0175	0.2245
Evless_price	−0.0792	0.1553	−0.0080	0.0223	0.0199	0.0391	−0.0070	0.1449	0.7313	0.0441	0.4093
Evless_wal − x	0.0103	−0.0455	0.0189	0.0551	0.0397	0.0006	0.0225	0.8026	0.1053	−0.0385	0.3356
Evless_les − o	−0.0092	0.0993	−0.0121	0.1113	0.0662	−0.0564	0.8031	0.1279	0.0541	0.0130	0.3056
Evless_kno − r	0.0270	0.0544	0.0437	0.0560	0.0818	0.0203	0.8041	0.0970	−0.0132	0.0311	0.3270
Evless_inf − r	0.0104	0.0647	−0.0088	0.0216	0.0366	0.0396	0.1400	0.7536	0.0712	0.0711	0.3947
Evless_cos − y	0.0462	−0.1440	−0.0261	0.0608	−0.1104	−0.1804	0.3946	0.2061	0.0245	0.3040	0.6368
Evless_per − r	0.0555	−0.0629	−0.0012	0.0479	−0.0299	−0.0218	0.2816	−0.0956	0.0190	0.7715	0.3053
Evless_range	0.0434	−0.1065	0.0145	0.0487	−0.0149	0.1382	−0.2107	0.2052	0.0140	0.7535	0.3104
Evless_ins − r	0.0729	−0.0712	0.0547	−0.0247	−0.0030	−0.0833	0.2403	0.6296	−0.0665	0.1488	0.4903

Table 13
Rotated factor loadings and unique variances −2 Rotated factor loadings (pattern matrix) and unique variances.

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8	Factor9	Factor10	Uniqueness
Age						0.8996					0.1751
Children						0.8876					0.2091
Factor_Brand	0.7488										0.4093
Factor_Price									0.5471		0.4752
Factor_Drive				0.6471							0.5159
Factor_Des − n											0.4048
Factor_Con − m				0.7516							0.3376
Factor_Perf				0.5283							0.5121
Factor_Emiss				0.7006							0.3493
Factor_Soc − t	0.6976										0.3551
Factor_Reput	0.7403										0.3099
Scale_pers − c		0.7966									0.3179
Scale_prof − c		0.7910									0.3548
Scale_imag − a			0.7537								0.3635
Scale_life − e											0.4813
Scale_envi − n											0.6415
Scale_less − a		0.5215									0.4947
Scale_ecof − e			0.7174								0.4079
Scale_stat − y			0.7932								0.3543
Scale_pena − y											0.6473
Scale_subv − a											0.5000
Scale_will − e											0.4503
Scale_lowe − e					0.8823						0.2027
Scale_lowr − a					0.8667						0.2245
Evless_price									0.7313		0.4093
Evless_wal − x								0.8026			0.3356
Evless_les − o							0.8031				0.3056
Evless_kno − r							0.8041				0.3270
Evless_inf − r								0.7536			0.3947
Evless_cos − y											0.6368
Evless_per − r										0.7715	0.3053
Evless_range										0.7535	0.3104
Evless_ins − r								0.6296			0.4983

(blanks represents abs(loading) < 0.5).

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