Behavioral intentions of an electric vehicle purchase:

Impact of different factors on the purchase behavior of an electric vehicle of German consumers

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Abstract

Demand for electric vehicles has grown rapidly in recent years. One of the main drivers of the increase in demand is the environmental damage owed to traffic. This is because the environment is harmed by the carbon dioxide (CO2) emissions caused by a vehicle without an alternative drive system, like vehicles with a petrol engine. The problem is also well known in Germany. As a measure to reduce CO2 emissions in road traffic, the German government offers incentives in the form of monetary subsidies. Such incentives aim to motivate consumers to purchase an electric vehicle in order to reduce environmental pollution. This dissertation will investigate which factors motivate German consumers to purchase such an electric vehicle. As a tool, this study used the theory of planned behavior (TPB) by Ajzen (1991) after it was extended by Shalender & Sharma (2020) and adapted to the aims of this study. The extension added the predictors of moral norm and environmental concerns to TPB's variables: attitude, subjective norm, and perceived behavioral control. Findings of this study show a significant effect of the five mentioned predictors on purchase behavior. Thus, this research suggests it is important to consider these factors when developing interventions to increase electric vehicle purchase.

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Keywords: Electromobility, purchase behavior, sustainability, theory of planned behavior, Germany

Sumário

A procura de veículos eléctricos tem crescido rapidamente nos últimos anos. Um dos principais motores do aumento da procura são os danos ambientais devidos ao tráfego. Isto porque o ambiente é prejudicado pelas emissões de dióxido de carbono (CO2) causadas por um veículo sem um sistema de condução alternativo, como os veículos com motor a gasolina. O problema é também bem conhecido na Alemanha. Como medida para reduzir as emissões de CO2 no tráfego rodoviário, o governo alemão oferece incentivos sob a forma de subsídios monetários. O objectivo de tais incentivos é motivar os consumidores a comprar um veículo eléctrico, a fim de reduzir a poluição. O objectivo desta dissertação é investigar quais os diferentes factores que levam o consumidor alemão a comprar um veículo eléctrico deste tipo. Como ferramenta, este estudo utilizou a Teoria do Comportamento Planeado (TPB) de Ajzen (1991) após ter sido alargada por Shalender & Sharma (2020) e adaptada aos objectivos deste estudo. A extensão acrescentou os preditores da Norma Moral e Preocupações Ambientais às variáveis do TPB: Atitude, Norma Subjectiva, e Controlo de Comportamento Percebido. Os resultados deste estudo mostram um efeito significativo dos cinco preditores mencionados no comportamento de compra. Assim, esta investigação sugere que é importante considerar estes factores ao desenvolver intervenções para aumentar a compra de veículos eléctricos.

Título: Intenções comportamentais de compra de um veículo eléctrico: Impacto de diferentes factores no comportamento de compra de um veículo eléctrico de consumidores alemães

Autor: Leonard Jörg Engels

Palavras-chave: Electromobilidade, comportamento de compra, sustentabilidade, teoria do comportamento planeado, Alemanha

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Glossary

α	Cronbach's index of reliability
b	Estimated value of unstandardized regression coefficient
df	Degrees of freedom
t	t-statistic; size of difference relative to variation in sample data
β	Estimated value of standardized regression coefficient
&	And
ANOVA	Analysis of variance
CEO	Chief Executive Officer
CO2	Carbon dioxide
EV	Electric vehicle
EU	European Union
F	F distribution, Fisher's F ratio
H	Hypothesis
kWh	Kilowatt-hour
M	Sample mean
MJ	Mega Joule
N	Total number of cases
p	p-value
r	Estimation of the Spearman correlation coefficient
R^2	Multiple correlation squared; measure of strength of association
RQ	Research Question
SD	Standard Deviation
SE	Standard Error
TPB	Theory of planned behavior
ETPB	Extended theory of planned behavior

1. Introduction

> We have to boost electromobility, otherwise we won't meet the CO2 goals. - Harald Krüger, BMW CEO (Hägler, 2019, p.1)

Climate emissions and other pollutants pose a threat to climate protection. Transport emissions, generated by vehicles among other causes, are considered to be part of this threat. In 2020, greenhouse gas emissions from the transport sector amounted to 146 million tons of CO2 in Germany (Environment Federal Office Germany, 2021). In order to counteract and reduce the negative environmental impact of car traffic and to make a significant contribution to climate protection, electric vehicles have been considered, produced, and introduced on the road at an enormous pace in recent years. The reason for this is that an electric vehicle does not emit CO2 while driving and thus contributes to climate protection. (BMU, 2020, 2021; Environment Federal Office Germany, 2021)

1.1 Problem Statement

The current discussion on the subject of climate protection and the associated measures to reduce greenhouse gas emissions have created incentives for consumers to consider the purchase of an electric vehicle (Fridays for Future, 2021; Rudolph, 2016). The "Trendmonitor Germany" study indicates that two-thirds of German consumers are interested in buying an electric vehicle. Interest in electric vehicles is particularly widespread among young people up to 29 years of age (77%), among men (72%), and also among the higher income groups (net household income per month > EUR 2,500: 80%) (Staat, 2018).

In the Trend Monitor study, which was conducted by the market research institute Nordlight Research, the question of why, in other words, why consumers are interested in purchasing an electric vehicle, remains unanswered. The reason is that there was no data collection carried out as part of the study with regard to the connection between interest and purchase intention (Staat, 2018). A representative survey by E.ON and KantarEMNID found that, even though most Germans show an interest in buying, "only 16 percent of Germans would buy an electric vehicle" (E.ON & KantarEMNID, 2019, p. 7). This paper investigates the unanswered why and the relationship between the factors and intentions of German consumers to purchase an electric vehicle on the basis of the theory of planned behavior (TPB) (Ajzen, 1991). The TPB is about predicting people’s behavior. TPB proposes that the best predictor of behavior is intention, and intention in turn is predicted by attitude, social norms, and perceived behavioral control. There have been various modifications of this theory, which are also adapted to this thesis and which cover the determinants of the moral norms and the environmental concerns (Ajzen, 1991; Davis

et al., 1989; Goh et al., 2017; Manstead, 2000; Shalender & Sharma, 2020). In the determinant of the environmental concerns, the topic of sustainability is placed in the foreground. There are many factors that influence the purchase of an electric vehicle, but this study focuses only on three: social responsibility, economic aspects, and the environmental component. In this context, the following research question is analyzed: Which factors have the greatest influence on the intention to purchase an electric vehicle among German consumers?

The problem statement can be divided into three main research questions:

RQ1: Does the environmental awareness of German consumers have a significant impact on the intention to purchase an electric vehicle?

RQ2: Does social responsibility have a significant impact on the intention to purchase an electric vehicle?

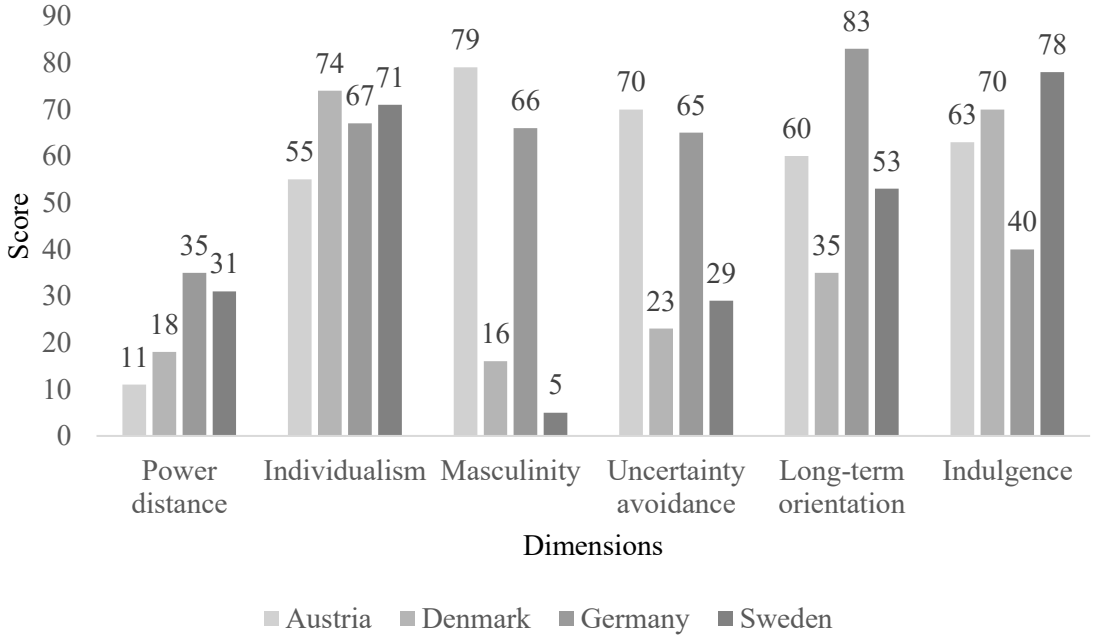
RQ3: Do economic claims have a significant impact on the intention to purchase an electric vehicle?

1.2 Relevance

This thesis contains three main contributions. First, it contributes to the existing literature and studies on the factors and decision factors that influence the purchase of an electric vehicle by focusing on the German consumer in contrast to the existing studies. Similar studies dealing with this topic have already been published in countries like Denmark, Sweden, and Austria. (Haustein & Jensen, 2018; Schmuck, 2020). The relevance of this thesis is underlined by the cultural differences of the mentioned countries with Germany, which are proven by Hofstede's six dimensions. Geert Hofstede has developed six dimensions to describe and characterize national cultures: Power distance, individualism, uncertainty avoidance, masculinity, long-term orientation, and indulgence. (Hofstede, 2001). For example, the value of the dimension of masculinity and long-term orientation of Germany is more than twice as high as that of Finland. Austria and Germany also differ in various areas, like in masculinity and indulgence. The two countries also differ in the area of long-term orientation, which is nearly one-third higher in Germany than in Austria (Hostede Insights, 2021):

Figure 1

Hofstede's Insights country comparison (own illustration based on Hofstede Insights (2021))



The aspect of long-term orientation plays a significant role in the decision to adapt an electric vehicle. Countries with a higher long-term orientation tend more towards the adaptation of an electric vehicle (Qian & Yin, 2017). Thus, it is important to see whether the results of similar previous studies extend to the German case.

Second, another relevant point of this thesis is that Germany is considered as the country with the largest car manufacturers in the world. In 2020, Volkswagen, a traditional German car manufacturer, ranked first on the list of the world's largest car manufacturers with 10.71 million vehicles sold. Other German car brands, such as BMW (2.52 million vehicles sold) and Daimler (2.82 million vehicles sold) also landed on that list, which maps the 15 largest car manufacturers in the world in 2020 (Handelsblatt, 2020). In the field of electromobility, Europe has the largest share of the world market with 43%, making Europe the world's largest pioneer of e-mobility. Given that Germany is the second-largest market for electric vehicles in the EU and ranks seventh among electric vehicle nations worldwide with 230,000 electric vehicles registered in 2019, it would be interesting to investigate German consumers living in such a car-rich country in terms of their motives for purchasing an electric vehicle (EnBW, 2020; McKinsey & Company, 2018, 2020).

Third, this thesis not only shows the relevance of the German market and the importance of German consumers, it also contributes as an additive source of information and data for existing

literature and for companies, especially automotive companies. This is because it increases the knowledge of automobile manufacturers about the German consumer by illuminating what motivates the German consumer in an EV purchase. This will enable them to identify new approaches and strategies for marketing electric vehicles to achieve, among other things, the goal of higher sale volumes. At the same time, increased sales of EVs would have the added value of making German roads more CO2 free and protecting the environment.

1.3 Structure

This master thesis consists of a theoretical part on the one hand and an empirical part on the other hand, whereby the theory is intended to provide an overview by means of already existing literature and findings from science. The terms electromobility, electric vehicle and the concept of sustainability regarding an electric vehicle are explained to introduce the readership to the topic. In addition, information is provided on promotors, opportunities and risks of electromobility as well as already available statistical data. Furthermore, the theoretical content deals with questions regarding purchasing behavior. Possible factors and the theory of planned behavior (Ajzen, 1991), after it was adapted to the extended theory of planned behavior (Shalender & Sharma, 2020), are used for the empirical part. In the empirical part of the master thesis, an online survey is conducted to analyze the factors that influence the behavior of buying an electric vehicle. For this purpose, the online survey software Qualtrics provided by the Universidade Católica Portuguesa is used, which guarantees anonymity when filling out the questionnaire. With the use of modern internet technology, the rapid availability of data, and simultaneous time savings, this form of survey is resorted to. The data are analyzed using methods of descriptive statistics and significance tests. The linear regression procedure is used to answer the hypotheses since the data are scaled both ordinally and nominally. Finally, the results obtained are discussed and interpreted. A conclusion closes the final chapter of this thesis.

2. Literature Review

This chapter contains the theoretical foundations of this thesis. It serves as a foundation for the evaluation of the empirical study on the impact of different factors on the purchase behavior of an electric vehicle of German consumers. First, an insight into the topics of electromobility and electric vehicles is provided. This is followed by the theory of planned behavior (TPB), which is essential for the evaluation of the survey. Subsequently, the content and methodological adaptation of the model developed by Shalender & Sharma (2020), the extension extended theory of planned behavior (ETPB), is presented.

2.1 Electric vehicle (EV)

Electromobility includes passenger and goods transport vehicles that are powered by electric energy, has at least one electric motor installed, and source most of their energy from the electricity network. This alternative type of engine for electric vehicles thus offers various options for creating mobile transportation that is independent of fossil fuels. (Federal Government of Germany, 2009; Karle, 2020)

There are five different types of vehicles with alternative drive systems. First, there are the battery electric vehicles (BEVs) which are powered entirely by electricity and equipped with large batteries, charged by means of externally pluggable power sources (Federal Government of Germany, 2009; Karle, 2020; Kreyenberg, 2016; Tober, 2016; Yong et al., 2015). Second, the plug-in hybrid electric vehicles (PHEVs) are moved on the one hand by a traditional combustion engine and on the other hand by an electric motor that is also charged by an externally pluggable power source (Federal Government of Germany, 2009; Kampker et al., 2018; Karle, 2020; Sanguesa et al., 2021; Tober, 2016). Third, hybrid electric vehicles (HEVs), which are similar to plug-in hybrid electric vehicles, are powered by a combination of a traditional combustion engine and an electric motor (Federal Government of Germany, 2009). Unlike PHEVs, HEVs cannot be plugged into the electrical grid because the battery is powered by energy generated with the internal combustion engine (Federal Government of Germany, 2009; Kampker et al., 2018; Karle, 2020; Kreyenberg, 2016; Tober, 2016). As a fourth category, the fuel cell electric vehicles (FCEVs) can be mentioned which are equipped with an electric motor that uses a mixture of compressed hydrogen, obtained from natural gas, and oxygen extracted from the air, with water being the only waste (Federal Government of Germany, 2009; Kampker et al., 2018; Karle, 2020; Krems & Kreißig, 2021; Kreyenberg, 2016; Tober, 2016).

As the last and the fifth, the extended-range electric vehicles (ER-EVs) are similar to the BEV's because they have a battery (Federal Government of Germany, 2009; Kampker et al.,

2018). Yet, ER-EVs also have a combustion engine that is used solely to charge the battery and, unlike PHEVs and HEVs, is not connected to the wheels of the vehicle (Federal Government of Germany, 2009; Kampker et al., 2018; Karle, 2020; Kreyenberg, 2016; Sanguesa et al., 2021; Yong et al., 2015)

In this thesis, the focus is on the pure electric vehicle (BEV), which for the sake of clarity has been named EV in this thesis. The reason for focusing on EVs is the increased demand for purely electric vehicles, as evidenced by the results of the "Mobility of the future" study, which shows the increased number of new passenger car registrations in 2020 with purely electric drive compared to the previous year (Burkert et al., 2021).

2.2 The history of electromobility

Electromobility has its origins in the automotive sector, when research into electric vehicles was carried out at the same time as the invention and production of cars with internal combustion engines. In 1881, Gustav Trouvé, a French inventor and engineer, had equipped a three-wheeled bicycle with an electric motor. A year later, in 1882, Werner Siemens presented a carriage powered by an electric motor. The so-called "Lohner-Porsche," developed by Ferdinand Porsche (1900), followed and was considered as the world's first practical electric vehicle. (Karle, 2020; Korthauer, 2013)

Despite being invented at the same time, electric vehicles did not manage to compete with internal combust engine vehicles. The problem at that time was the low range, which could not compete with the combustion engine. As a result, the electric vehicle did not establish itself. Nowadays, the solution to the range problem is illustrated by the use of powerful lithium-ion batteries. Due to the high energy density of lithium cells, these batteries have been used as energy storage devices in automobiles for several years. (Karle, 2020; Korthauer, 2013)

For the first time in the history of electric vehicles, sales of electric vehicles are flourishing in Germany (Nafari & Mazoyer, 2019). This is because vehicles with alternative fuels, such as high-performance lithium-ion batteries, have been subsidized, for instance in Germany since 2019 in order to make road traffic more sustainable (Federal Government of Germany, 2021).

2.2.1 The concept of sustainability in the context of the electric vehicles

Introducing electric vehicles is seen as a way to mitigate the negative environmental impacts of car use (BMU, 2021). This is because the transport sector is currently one of the three largest contributors to carbon emissions. Likewise, it is responsible for more than 30% of daily oil consumption (Harrison & Thiel, 2017). An electric vehicle represents a potential for reducing

the negative environmental consequences of road traffic, such as greenhouse gas emissions, through the reduced emission of hazardous pollutants, particulate matter, and nitrogen emissions, and others (Crabtree, 2019; Mann et al., 2019; Wu et al., 2020). The introduction of electric vehicles is therefore considered sustainable (Erickson et al., 2016; Sperling, 2013; Zeng et al., 2019).

2.2.1.1 The meaning of sustainability

There is still an ongoing discussion, in the scientific community, on the general definition of the term sustainability (Elliott, 2005; Scoones, 2007). In order to make the connection between the subject of this thesis and sustainability more understandable, Carlowitz's definition of the forest management principle was chosen and considered. The reason for this is that the transport sector damages nature (see 2.2.1). Nature is the core of the principle. With the help of the principle, the relevance and urgency of striving for sustainability in the transport sector are made apparent:

> In its original sense, the concept of sustainability describes the use of a regenerable natural system in such a way that this system retains its essential characteristics and its resources can grow again naturally. (Carlowitz, 1732, as cited in Pufé, 2017, p. 37)

This description can be traced back to the Freiberg chief miner Hans Carl von Carlowitz (1645-1714), who defined the idea of sustainability as a "wise way of forest management", which should imply a steady and sustained use of the forest (Carlowitz, 1732, p. 11; Pufé, 2017).

In 1987, when awareness of environmental damage and the urge for sustainable action emerged, the World Commission on Environment and Development first established sustainability as sustainable development in the so-called "Brundtland Report: Our Common Future." and established it as a guiding principle:

> Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. (WCED, 1987, p. 40)

However, there are differences between the concepts of sustainability and sustainable development that must be considered. The difference is that sustainability refers to the state, statics, and permanence, whereas sustainable development implies movement, dynamics, the processual, and the becoming (Grunwald & Kopfmüller, 2012). Sustainable development is also referred to as social change, which was enshrined in the Rio Declaration and Agenda 21 at the United Nations conference (AGENDA 21, 1992; Scoones, 2007; United Nations Conference on Environment and Development, 1992). In Germany, the concept of sustainability gained acceptance on the market in 1995 with the three-pillar model, which gave rise to a further definition consisting of three dimensions. These three dimensions, ecological,

economic, and social, are to be considered equally in the model in order to enable a just life in the world (Corsten & Roth, 2012; Kleine, 2009).

2.2.1.2 CO2 reduction with electric vehicles

Carbon dioxide emissions can be cited as one of the main causes of global warming. Several studies show the different factors affecting carbon dioxide emissions, such as fossil energy, energy consumption structure, fuel switching, and penetration of renewable energy or urbanization, in which the electric vehicle plays a concise role. (Alam et al., 2007; Chen et al., 2018; Liu, 2009; Parikh & Shukla, 1995; Robaina & Neves, 2021; C. Wang et al., 2013; Zang et al., 2017)

The shift to electric vehicles and their sustainable development should serve to protect the environment by reducing carbon dioxide emissions, provided that their batteries are charged with green electricity, generated by wind turbines, for example (Robaina & Neves, 2021). From an ecological point of view, electric vehicles can contribute to the reduction of greenhouse gases (Sandy Thomas, 2012). As the focus in Germany is on sustainable mobility, especially in the area of cars, the switch to electric vehicles should support the long-term goal of reducing the car's carbon footprint (BMU, 2021). In a brief excursion into the supply chain of an electric vehicle, it becomes apparent against the backdrop of sustainability that it still has a lot of unexploited potentials. In the extraction of raw materials, the potential of regenerating mined resources, reducing the CO2 footprint, especially in the area of production, logistics, and recycling measures is apparent. Estimates show, for example, that ten tons of CO2 emissions are consumed for the production of an EV (Betancourt-Torcat et al., 2019; Dillman et al., 2020; Noori et al., 2015). The disposal of the battery is considered as an example here, as well as the high water and energy consumption caused by the production of an electric vehicle, for instance, the energy consumption for the production of a lithium-ion battery is around 350-650 MJ/kWh (Romare & Dahllöf, 2017; L. Wang et al., 2020). Possibilities for improving production methods are, in the short term, mainly the use of electricity with low CO2 emissions and, in the long term, the successive replacement of chemicals with water in production in order to cause lower greenhouse gas emissions (Romare & Dahllöf, 2017).

Nevertheless, the economic point of view also indicates that there is still potential to be exploited in the context of electric vehicles and sustainability. Projections show that owning an electric vehicle can increase the electricity consumption of a household in an industrialized country by up to 50% (van Vliet et al., 2011). This implies new challenges, such as building charging infrastructure, improving the electricity distribution network, and clarifying legal and

data protection issues related to coordinated "smart" charging systems (van Vliet et al., 2011, p. 3). These challenges are triggered by the integration of a high number of electric vehicles (Hannan et al., 2014; Muneer et al., 2017; Sanguesa et al., 2021).

Therefore, with a special perspective on the ecological view of sustainability, it is important to focus the sustainable development of electric vehicles not only on the current problem of climate change but also to recognize the connections of the present with the future in order to find an environmentally friendly solution (Keichel, 2021).

2.2.2 Electric vehicle market of Germany

Electromobility is held up as a success factor for climate-friendly mobility and innovation not only in Germany but also worldwide (Paris Action Agenda, 2015). With the help of regeneratively generated electricity, which is to be used by as many EVs as possible in the future, CO2 emissions will be reduced (Mühlbäck & Hendrikx, 2015). Currently, around 70 electric vehicle models from German car manufacturers (as of 2021) are commercialized and available on the German market. To charge these, Germany has around 46,200 publicly accessible charging points. In addition, the German federal government provides temporary incentives (until the end of 2025), such as subventions or the expansion of the charging infrastructure, for the purchase of an electric vehicle. In 2020, subventions were applied for 255,338 electric vehicles in Germany. In 2021, 258,000 vehicles have received a government subvention. It was noted that the number of newly registered electric vehicles tripled in 2020. Among the cars registered in 2020, about 194,000 all-battery electric vehicles (EVs) have been newly registered. In the first half of 2021, EVs accounted for around 149,000 and plug-in hybrids 164,000 new registrations. For Germany, this means that every fourth newly registered vehicle is a vehicle equipped with an alternative drive system. Germany is considered a strong growth market in the field of electromobility (BMWi, 2021; kba, 2021). This is underlined by the fact that forecasts predict one million electric vehicles on Germany's roads by the end of 2022 (Burkert et al., 2021).

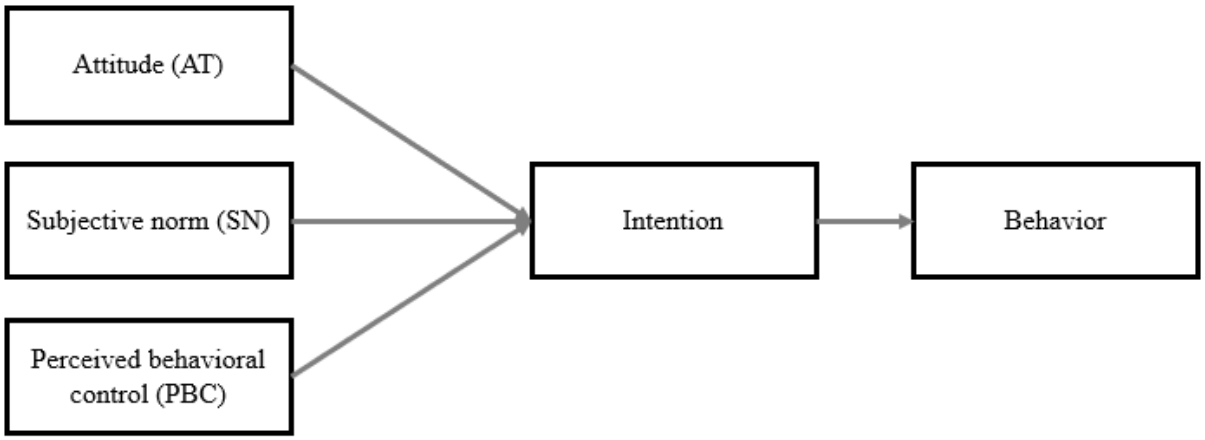
2.3 Theory of planned behavior (TPB)

In this thesis, the factors that impact the purchase of an electric vehicle by Germans are investigated. In order to predict such a purchase, in practice, the purchase behavior is determined in connection with the attitudes, subjective norm and perceived behavioral control of a person by means of the TPB, which is considered an extension of the theory of reasoned action (TRA) (Ajzen, 1991; LaCaille, 2013). Social psychologist Icek Ajzen established this theory (TPB), which deals with the predictable behavior of a person towards an object, a

circumstance, or a person. This theory aims to predict behavior and proposes that a useful predictor of behavior is intention to engage in that behavior. TPB posits that intention, in turn, is predicted by attitude (AT), subjective norm (SN), and perceived behavioral control (PBC) (Ajzen, 1985, 1991). These determinants are elaborated in the subsequent sections.

Figure 2

Theory of planned behavior (TPB) (own illustration based on the model of Ajzen (1991)



2.4 Extended theory of planned behavior (ETPB)

In recent years, the model of planned behavior has been changed and modified in many directions. The goal is to increase the explanatory power while maintaining reliability of the theory.

In modifying the model, the importance of moral norms on pro-environmental behavior came to the foreground. Social psychologist Ajzen stated that moral norm plays an important role in the model because it influences consumer decision-making (Ajzen, 1991). Manstead`s suggested that the German consumer has a higher motivation to purchase a vehicle, in other words, to pay more when they fulfill their moral obligation to the environment, which was underscored with the research by Dr. Martin Achtnicht (Achtnicht, 2012; Manstead, 2000). At the same time, Wang and others (2014) investigated and identified the effect of the moral norm in predicting customers' intention to purchase electric vehicles (Y. Wang et al., 2014). Still, other studies have related moral norms and environmental behavior. For example, the Nordlund and others (2016) study found higher environmental awareness and moral norms among electric vehicle owners (Nordlund et al., 2016). In the same year, the survey of Kaplan et al.'s (2016) study found that positive attitudes and moral norms contributed to electric vehicle adoption in Germany, Austria, and Denmark (Kaplan et al., 2016).

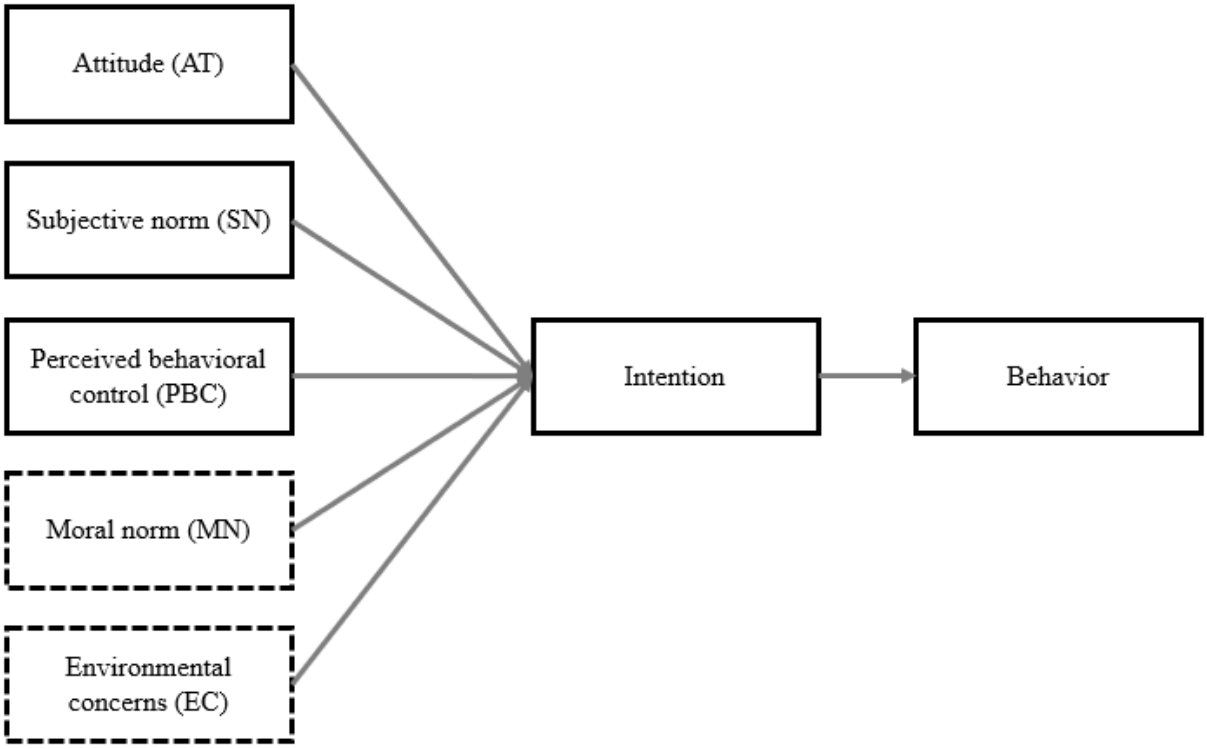
Previous research has shown that environmental concern is also important in predicting environmental behavior. Manstead found out that, in addition to a moral obligation to the environment in decision making, people feel empathy and emotion toward the natural environment. Therefore, Manstead considered it necessary to include the factor of emotions in the theory of planned behavior (Manstead, 2000). In terms of purchasing behavior, research by Kahn (2007) and Egbue and Long (2012) stated that consumers who care and are concerned about the environment are more likely to purchase an electric vehicle (Egbue & Long, 2012; Kahn, 2007). There are other studies that confirm the findings of the aforementioned studies (Dhar et al., 2015; Ziegler, 2012). In the study by Mohamed and others (2016), similar research was conducted as in the previously mentioned studies. However, the study also found that Theory of planned behavior (TPB) determinants directly influenced respondents' behaviors related to environmental intentions, and environmental concerns indirectly influenced the relationship. Here, the study examined the TPB and emphasized the relationship between behavioral intentions and environmental values with their research (Mohamed et al., 2016).

The results of these many studies encourage the inclusion of the determinant of environmental concerns in the model (Davis et al., 1989; Goh et al., 2017). The determinant of the moral norm is integrated for customer analysis and for the purpose of better understanding (Ajzen, 1991). Thus, the extended TPB model (Shalender & Sharma, 2020) is applied to better understand the purchase intention of the German population for electric vehicles.

The extended theory of planned behavior (ETPB) was already established in Shalender and Sharma's (2020) study on adoption intention of electric vehicles in India. In the study of Shalender & Sharma the adoption intention of electric vehicles in India was investigated (Shalender & Sharma, 2020). In this study, the extended theory of planned behavior by Shalender and Sharma (2020) proved to be a useful tool for predicting electric vehicle adoption intention, which is the reason why the ETPB was also adapted to the current study of German consumer's EV purchase intentions.

Figure 3

Extended theory of planned behavior (own illustration based on the model of Ajzen (1991), adapted from Shalender & Sharma's (2020) model of EV adoptation intention)



2.4.1 Attitude (AT)

Attitude (AT) is the general affective evaluation of behavior (Ajzen, 1991; Graf, 2013). Similarly, attitude is considered to be "a person's degree of favorableness or favorableness toward a psychological object" (Ajzen & Fishbein, 1980, p. 34). Ajzen found that customers' attitudes and perceptions influence buying behavior (Ajzen, 1991). The importance of attitude in the purchase decision was also underlined by Manstead's research (Manstead, 2000). In the same way, a study concluded that people with a positive attitude towards electric vehicles are willing to spend more money on the purchase of an environmentally friendly vehicle and that they engage with the topic of electric vehicles at an early age and try to adopt them as early as possible (Hidrue et al., 2011). Similarly, the researcher Ziegler determined that consumers who are positively inclined toward an electric vehicle represent more potential as electric vehicle buyers than those with negative attitudes (Ziegler, 2012).

2.4.2 Subjective norm (SN)

The variable subjective norm (SN) is understood as the interpretation of behavior, what important reference persons expect from the person. Ajzen thus assumes that social influences, more precisely the perceived expectations of others, have an influence on the formation of a

person's intentions (Ajzen, 1991; Graf, 2013). The positive influence of the subjective norm on the purchase decision is proven by a large number of studies. Subjective norm has an influence on the decision to purchase an electric vehicle, especially to meet social expectations (Lane & Potter, 2007). The influence on purchasing behavior is also underlined by Lieven and others (2011) (Lieven et al., 2011). Many researchers believe that people who feel that other people expect them to perform a certain action are more likely to perform that action because of social pressure (Lai et al., 2015; Schuitema et al., 2013; Y. Wang et al., 2014).

2.4.3 Perceived behavioral control (PBC)

Perceived behavioral control is defined as the subjectively perceived difficultness or easiness of performing a behavior (Ajzen, 1991; Graf, 2013). Researchers stated that consumer openness to change can lead to a sense of control, which can influence electric vehicle purchase behavior (Axsen & Kurani, 2012). Further research showed that the first contact or experience with an electric vehicle positively influences the purchase intention. The reason for this is the perceived control triggered on the basis of the self-controlled experience with the electric vehicle. (Carley et al., 2013). Researchers found out that positive behavioral intention can be identified, based on the control of an electric vehicle. That means that high perceived control towards electric vehicles increases behavior intention. (Dhar et al., 2015; Egbue & Long, 2012; Ozaki & Sevastyanova, 2011; Shalender, 2018)

2.4.4 Moral norm (MN)

In the extension of the theory of planned behavior (ETPB), the variable of the moral norm is included (Shalender & Sharma, 2020). This is a responsibility that the person feels for the execution of an action (Schwartz, 1977). The moral norm is better understood by the norm activation model, the origin of moral norm (Schwartz, 1977). This model pictures that the activation of the moral norm is linked to two triggers: One is a person's realization of their behavior and its consequences on society, and the other is the urge to make a positive contribution to an issue (Bamberg & Möser, 2007; Stern et al., 1999). In relation to the thesis topic, it has already been researched that consumers who have a strong value system are more inclined to purchase an EV than consumers with less strong values (Lane & Potter, 2007). Similarly, people who feel responsible for society, for instance, in terms of the well-being of a society, were found to be more likely to purchase EVs (Graham-Rowe et al., 2012). Compared to the subjective norm (SN), the moral norm (MN) is intrinsic and based on moral values, which is not influenced by any external pressure (Achtnicht, 2012; Y. Wang et al., 2014).

2.4.5 Environmental concerns (EC)

As a second added variable of the ETPB (Shalender & Sharma, 2020), environmental concerns are examined. This relates to the awareness of various environmental issues. Mostly, such issues include environmental problems or open questions that should lead to their solution (Schuitema et al., 2013). This determinant represents the change in customer behavior when it comes to the topic of environmentally friendly products, services or processes (Ajzen & Fishbein, 1980; Bamberg & Möser, 2007; Hines et al., 1987; Mohamed et al., 2016). Several studies have identified the influence of environmentally conscious behavior. For example, a study conducted in the United Kingdom found that environmentally conscious people are positive about owning an EV (Skippon & Garwood, 2011). Similarly, in the target market of this study, research was sought that revealed drivers of Germany perceive the factor of the environment as an important decision factor when purchasing a vehicle (Lieven et al., 2011). At the same time, Egbue and Long (2012) concluded that consumers are convinced that the reduced CO2 consumption of electric vehicles will prevent further environmental damage (Egbue & Long, 2012).

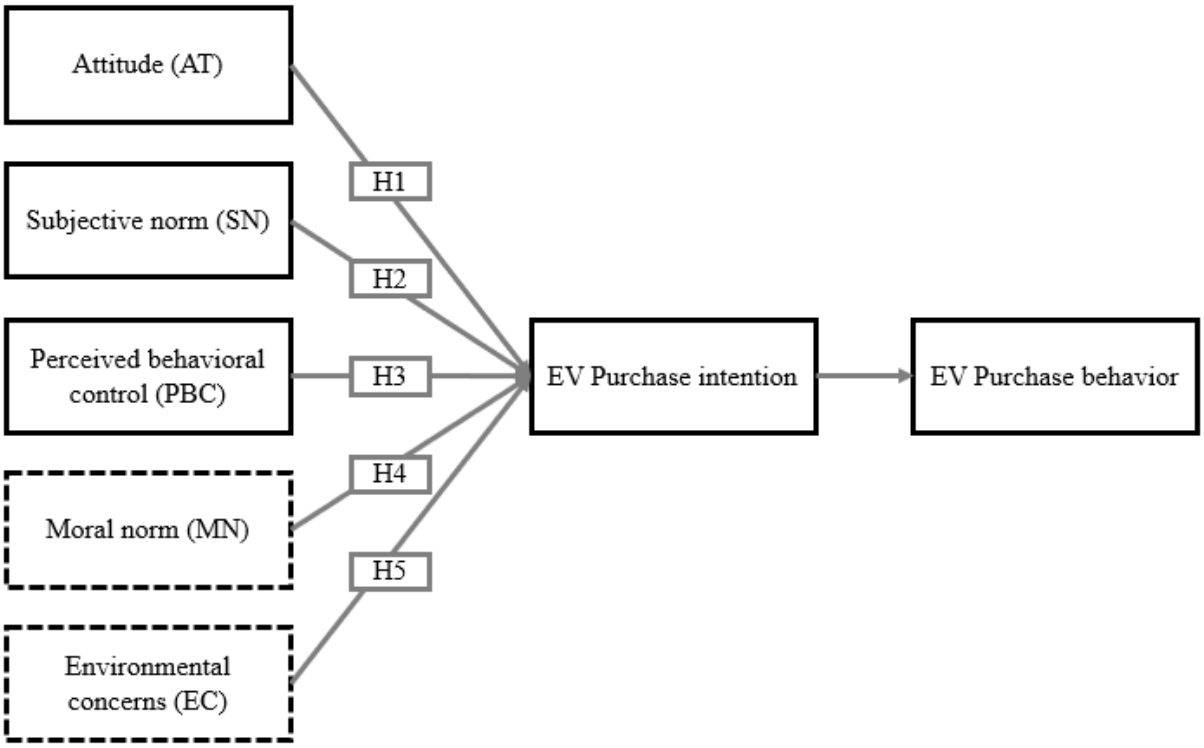
2.5 Hypothesis and conceptual model

Figure 4 is a visual representation of the formulated hypotheses, based on the literature collected and the theoretical framework:

1. The purchase attitude of a German consumer increases the intention to purchase an EV. (H1)
2. The subjective norm of a German consumer increases the intention to purchase an EV. (H2)
3. The perceived behavioral control of a German consumer increases the intention to purchase an EV. (H3)
4. The moral norm of a German consumer increases the intention to purchase an EV. (H4)
5. The environmental concern of a German consumer increases the intention to purchase an EV. (H5)

Figure 4

Creation of hypothesis (own illustration based on the model of Ajzen (1991), adapted from Shalender & Sharma's (2020) model of EV adoption intention)



3 Methodology

This study aims to find out which factors influence the purchasing behavior of an EV among German consumers. The chapter describes the methodological procedure for answering the dissertation's questions and testing its hypotheses. In the beginning, the samples and the research design of the online study are presented. This is followed by an explanation of the research material and the measurement instruments used, as well as a description of the structure and implementation of the empirical study.

3.1 Design

In the following study, a questionnaire was sent to German residents. The questionnaire collected information about the respondents via self-assessments and was sent and made available exclusively online via a link generated by the online tool Qualtrics.

3.2 Data collection

Access to the online questionnaire was provided to the target group via a link generated by Qualtrics. The link was distributed on social networks of the personal network of the author of this study, such as WhatsApp and Facebook, as well as via e-mail, and advertised with a short introductory statement (Appendix A) under the survey title "Factors that influence and motivate the purchase of an electric vehicle". The participants were also asked to share the study with others. To start the study, participants read a brief explanation of the background of the survey as well as a brief introduction to the procedure. Afterward, they read information about how their data would be handled to guarantee that it was kept confidential and anonymous and gave their consent to participate in the study. Completing the survey required approximately five to eight minutes. The survey had a field time of four weeks (21st of October – 14th of November 2021). The complete questionnaire, including introductory text, and instructions, can be found in the appendix (Appendix A).

3.3 Sample characteristics

In total, 230 people accessed the online survey via the Qualtrics link. All completed the questionnaire online. The total of 230 participants who completed the online survey was reduced to a total sample of $N = 211$ after the initial evaluation of the data set. Participants who had missing data ($N = 14$) or who were not from Germany ($N = 5$) were excluded as the research question of this thesis refers exclusively to and examines the German population.

The valid participants of the online study were between 20 and 70 years old. Most participants stated they were between 20 and 30 years old (64.0%), followed by those between 30 and 40 years old (24.6%) and those between 40 and 50 years old (5.2%). Eleven participants

indicated they were between 50 and 60 years old (5.2%) and two participants indicated an age of 60 and 70 years old (0.9%). From the valid sample, 46.0% were female and 54.0% were male. None of the participants made the indication of another gender. Most subjects indicated the "Master's degree" as their highest educational status (N = 105, 49.8%), followed by a "Bachelor's degree" (N = 86, 40.8%). Eight participants (3.8%) mentioned a "Postgraduate" education, seven participants (3.3%) "Other" as an educational degree, and five subjects (2.4%) stated a "Professional degree" as their highest educational status. The highest number of subjects were "Employed full time" (37.0%), followed by the occupation as "Student" (35.5%) and "Employed part-time" (12.3%). Twenty-two probands (10.4%) were "Self-employed" and both, "Retired" and "Unemployed not looking for work" were each four participants (1.9%). Two participants were "Unemployed looking for work" (0.9%). None was "Disabled". Because only participants from Germany were considered, as already justified, 100% of the participants to be studied (N = 211) were from Germany.

3.4 Measuring instruments

The relevant constructs of this study were operationalized exclusively via already existing questionnaires established in empirical research. Therefore, the overall questionnaire comprises six scales and, including sociodemographic information, a total of 25 items. For elaborating the parameters of influence of different factors on the purchase behavior of an EV of the German consumers and for measuring the theory of the planned behavior model, the scales created in 2020 by Shalender and Sharma (2020) for predicting the intention to adopt EVs in India were used and slightly modified (the word "adopt" was exchanged with "purchase") to adapt them to the EV purchase context of this research. These tools are presented below.

3.4.1 Questionnaire and scales to predict intention to adopt electric vehicles

In order to find out which factors influence the purchase behavior of an EV, the questionnaire of Shalender and Sharma (2020) has proven to be useful. The measures of the mentioned questionnaire are summarized and adapted from previous studies (Bagozzi, 2004; Gadenne et al., 2011; Han et al., 2010; Jakovcevic & Steg, 2013; Ramayah et al., 2012; C. Wang et al., 2013). The questionnaire is characterized by comprehensibility and ease of completion, which is ensured with its clear structure. The measurement instrument is a self-completion questionnaire and measures the different factors that may influence the purchase of an EV in the following six dimensions: Attitude toward EV adoption intention, subjective norms, perceived behavioral control, moral norms, environment concerns, and EVs adoption intention.

The questionnaire is fully adopted in this study, but the wording is minimally modified as "adoption" becomes "purchase" to better answer the research question in this study. The following scales as well as all previous and upcoming scales can only be answered with one answer, single-choice. The full questionnaire can be found in the appendix A.

3.4.2 Instrument to measure the attitude towards EVs purchase intention

First, the attitude toward EV purchase intention was determined using three items. The participants were asked to give their consideration for purchasing an EV. They had to answer the same statement "I consider a purchase of an EV" three times with three different attributes (unfavorable/favorable, negative/positive, undesirable/desirable). The response was registered using a Likert-scale from 1 (unfavorable, negative, and undesirable, depending on item) to 5 (favorable, positive, and desirable, respectively; Shalender & Sharma, 2020).

In the current study, this scale showed a Cronbach's α of 0.883. According to Gliem and Gliem (2003), a Cronbach's α of 0.8 demonstrates a good reliability.

3.4.3 Instrument for measuring subjective norms

Subjective norms were measured using a four-item scale from Shalender and Sharma (2020):

- "The people who are important to me want me to purchase EV in the near future."
- "While purchasing a new vehicle, I consider the wishes of other people who are important to me."
- "If I purchase EV, people who are important to me will also purchase the EV."
- "The people who influence my opinions prefer that I should purchase the EV while purchasing a vehicle in the future."

The participants' assessment was based on a Likert-scale ranging from 1 (*Strongly disagree*) to 5 (*Strongly agree)* (Shalender & Sharma, 2020). The current sample showed regarding to the evaluation of Gliem and Gliem (2003), an "acceptable" Cronbach's $\alpha = 0.797$.

3.4.4 Instrument for measuring perceived behavioral control

The perceived behavioral control was measured using a three-item scale from Shalender and Sharma (2020):

- "I can find where to buy EV when I decide to purchase it."
- "The price of EV is important when I decide to purchase it."
- "The repair and maintenance of the EV are important when I decide to purchase it."

In this study, an “acceptable” reliability was found for this scale, $\alpha = 0.711$ (Gliem & Gliem, 2003).

3.4.5 Instrument for measuring the moral norms

Moral norms were measured using a three-item scale from Shalender and Sharma (2020)

- “I believe it is my moral responsibility to reduce environmental pollution and greenhouse gases emissions.”
- “I feel morally obliged to adopt EV irrespective of what others think of me.”
- “I consider environment consequences while I purchase a vehicle.”

In this study, an “acceptable” reliability was found for this scale, $\alpha = 0.715$ (Gliem & Gliem, 2003).

3.4.6 Instrument for measuring the environmental concerns

Environmental concerns were measured using a three-item scale from Shalender and Sharma (2020):

- “I think the individuals and the society have the responsibility to protect the environment.”
- “I think the environmental issues are becoming more serious in recent years.”
- “I think we should live in harmony with the environment to achieve sustainable development”

In this study, a “good” reliability was found for this scale, $\alpha = 0.893$ (Gliem & Gliem, 2003).

3.4.7 Instrument for measuring the EVs purchase intention

Finally, EVs purchase intention was measured using a three-item scale from Shalender and Sharma (2020):

- “I am willing to purchase EV when purchasing a vehicle in the future.”
- “I intend to purchase EV when purchasing a vehicle in the future.”
- “I plan to purchase EV when purchasing a vehicle in the future.”

In this study, an “excellent” reliability was found for this scale, $\alpha = 0.910$ (Gliem & Gliem, 2003).

3.5 Control variables

The first surveyed data to be filled in included the socio-demographic data on age, gender, origin, educational and working status. These data were collected as possible control variables and to group the data set.

3.6 Pretest

A pretest was conducted one day before the survey was published and shared by sending the online survey to two different WhatsApp groups to check whether the survey via the link works, can be understood and successfully completed. The online questionnaire to be completed in the pretest had $N = 5$ (40,0 % female, 60,0 % male and 0,0% others. Between 20 and 30 years old were 80.0% of the participants and 20.0% were between 30 and 40 years old. After the pretest was successful, the online questionnaire was published.

4 Results

This chapter deals with the preparation of the collected data and the statistical analysis. In particular, the descriptive statistics are presented and the hypotheses formulated in chapter two are tested through regression analysis.

4.1 Data preparation

The statistical program IBM SPSS Statistics 26 was used for data preparation and statistical analysis. The data collected could be transferred to SPSS and processed there with the help of an automatic data export from the online tool Qualtrics. For the scales described earlier (see 3.4.2) for recording attitude, subjective norm, perceived behavioral control, moral norm, environmental concerns, and purchase intention, the interval scale level was assumed, since the answer options of the five-point Likert-scale used were assigned numerical values from one to five and the difference between these values can be interpreted. After reverse coding the negatively worded items, the numerical values of the individual items for each scale were summed and a mean value was calculated in relation to the respective scale. These mean or total scores of each scale represent, as in the original study, the operationalization of the variables under study.

Also, the reliability of the scales of this experiment was measured with the help of the Cronbach's alpha measuring instrument (see 3.4.3 - 3.4.7). It was found that the Cronbach's alpha of all scales varied from 0.7 (> 0.7) to 0.8 (> 0.8), which according to Gliem and Gliem (2003) indicates acceptable to good reliability.

4.2 Descriptive statistics and hypothesis testing

Descriptive statistics were collected prior to hypothesis testing. These provided the following results:

Table 1

Descriptive statistics

Variables	Descriptive statistics		
	Mean	*SD*	*N*
Purchase intention	3.8483	.95350	211
Attitude	3.6730	.86677	211
Subjective norm	2.6457	.85274	211
Perceived behavioral control	4.2575	.65185	211
Moral norm	3.9763	.86921	211
Environmental concern	4.5213	.63241	211

In order to test which hypotheses can be confirmed, a multiple linear regression was conducted. The purchase intention (BI_m) was the dependent variable and the attitude (AT_m), subjective norm (SN_m), perceived behavioral control (PBC_m), moral norm (MN_m) and environmental concerns (EC_m) were the independent variables.

Correlation between the predictors could already be seen in the literature (see 2.3). For instance, the correlation between moral norm and environmental concerns (see 2.3) or attitude and environmental concerns (see 2.3.1). When running the multiple linear regression, it was apparent that there was multicollinearity in the correlation, as some of the predictor variables had a significant and strong correlation ($p < 0.001$, $r > 0.30$) with each other (Appendix C). Therefore, a separate linear regression was performed for every single independent variable with the dependent variable.

4.2.1 The effect of the attitude on purchase intention

Hypothesis 1 (H1) predicts that as the purchase attitude of a German consumer becomes more positive, the intention to purchase an EV also increases. The effect of purchase attitude was significant, $b = 0.47$, $SE = 0.07$, 95% confidence interval [0.33, 0.60], $t = 6.76$, $p < .001$ and $\beta = 0.42$. These results support H1 by indicating that a positive purchase attitude is a significant predictor of higher EV purchase intention.

4.2.2 The effect of the subjective norm on the purchase intention

Hypothesis 2 (H2) posits that the more German consumers believe there is a subjective norm in favor of EVs, the higher the intention to purchase an EV. A significant effect of subjective norm on purchase intention was determined, $b = 0.22$, $SE = 0.08$, 95% confidence interval [0.07, 0.37], $t = 2.93$, $p < .005$ and $\beta = 0.20$. Thus, the results support H2 by indicating that subjective norm is a significant predictor of higher EV purchase intention.

4.2.3 The effect of the perceived behavioral control on the purchase intention

Hypothesis 3 (H3) states that the higher the perceived behavioral control of a German consumer, the higher the purchase intention of an EV. The effect of perceived behavioral control was significant, $b = 0.40$, $SE = 0.1$, 95% confidence interval [0.21, 0.60], $t = 4.15$, $p < .001$, and $\beta = 0.28$. These results of this linear regression show that perceived behavioral control is a significant predictor of EV purchase intention.

4.2.4 The effect of the moral norm on the purchase intention

Hypothesis 4 (H4) states that the more German consumers perceived EV purchase to be a moral norm, the higher their intention to purchase an EV. A significant effect of moral norm on the purchase intention could be measured, $b = 0.50$, $SE = 0.07$, 95% confidence interval [0.37, 0.63], $t = 7.38$, $p < .001$, and $\beta = 0.46$. Thus, in line with H4, moral norm is a significant predictor for the purchase intention.

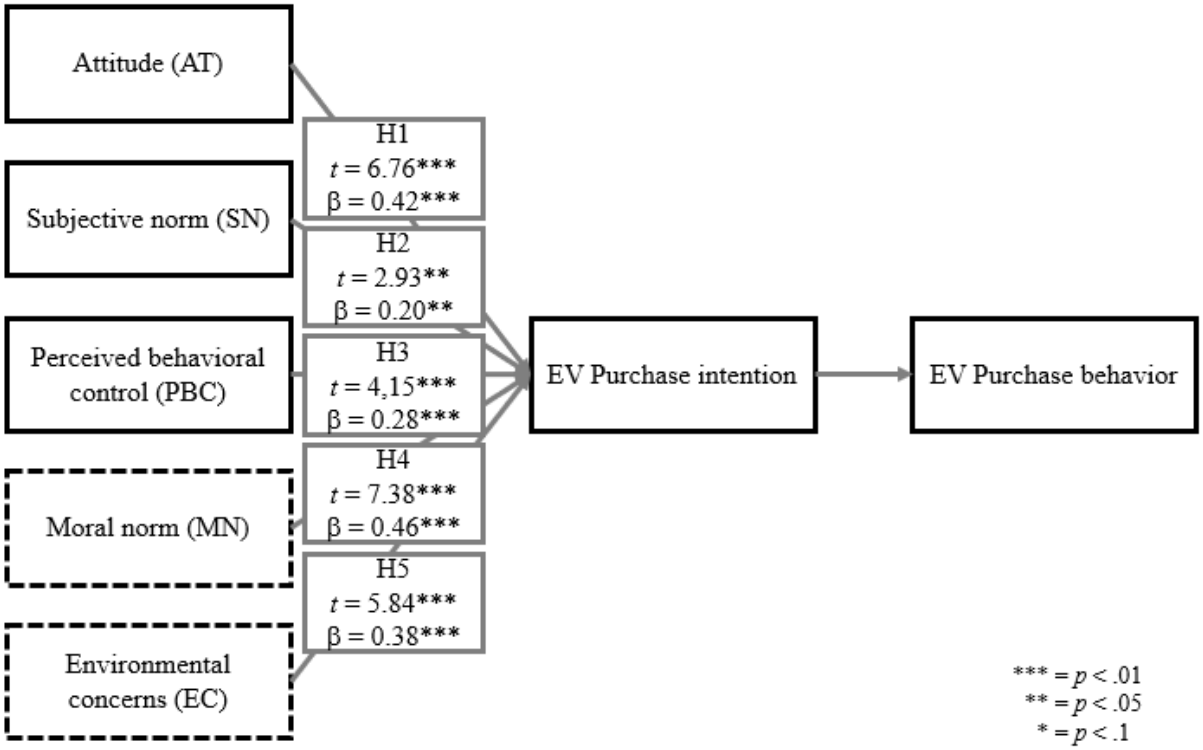
4.2.5 The effect of the environmental concern on the purchase intention

The last hypothesis (H5) states that the intention to purchase an electric vehicle increases with the growing environmental awareness of German consumers. The effect of environmental concerns was significant, $b = 0.57$, $SE = 0.1$, 95% confidence interval [0.37, 0.76], $t = 5.84$, $p < .001$, and $\beta = 0.38$. These results support H5 as they indicate that environmental concerns are a significant predictor of the purchase intention of an EV.

4.2.6 Tested hypothesis embedded in the extended theory of planned behavior

Figure 5

Tested hypothesis



5 Discussion

5.1 Research findings and main conclusions

The supply of electric vehicles has increased significantly in Germany. As the reason for this, the environmental damage caused by the transport sector can be mentioned. Electric vehicles are no longer new innovations in Germany. Instead, they are being taken seriously by the political side, the German government. The German government wants to reduce the environmental damage. In order to achieve such reduction at the soonest possible time, the German government has been promoting the transition from engine motors to electric vehicles since 2019.

The aim of this work was to understand the influencing factors in the purchase decision of an EV. In order to find out how the purchase decision for the range of electric vehicles in Germany is caused, the factors behind the purchase of an electric vehicle of the German population were investigated in this research. To exceed the scope of this thesis, it is specialized in five main factors (see Figure 5). These five factors were applied as a tool to answer the research questions and are taken from the extended theory of planned behavior (ETPB; (Shalender & Sharma, 2020)).

The results of this study supported Hypothesis 1 (H1), which stated that the purchase attitude of a German consumer increases the intention to purchase an EV. Similarly, Hypothesis 2 (H2), which predicts that the subjective norm of German consumer increases the impact on intention to purchase an EV, has been supported. Hypothesis 3 (H3), which states that the perceived behavioral control of a German consumer increases the impact on intention to purchase an EV, was also confirmed. Considering the influence of the moral norm, Hypothesis 4 (H4) predicted that it influences the purchase intention of German consumers, which was also confirmed. Lastly, results confirmed Hypothesis 5 (H5), which predicted the influence of the environmental concern of a German consumer on the purchase intention of an EV. All five hypotheses have a high significance according to the results. Thus, it can be stated that the extended theory of planned behavior supports purchase intention with all the established factors.

Based on the results, it can be assumed that German consumers with a degree of favorableness to an EV are positively inclined to purchase an EV. Thus, the results show, similar to the study of Egbue & Long (2012) and Hidrue et. al. (2011), consumers with a positive attitude toward electric vehicles are willing to spend money on the purchase of an EV. The difference in this study is the focus on German consumers. Subjective norm also has an

influence on the purchase of an EV. One reason for this can be the social expectations, which have already been suspected by Lane & Potter (2007). That is, if the social environment expects the German consumer to purchase an EV as their next vehicle, the German consumer will probably be influenced by this. At the same time, it can be suggested that perceived behavioral control (PBC) has an influence on the purchase of an EV. As the reason for this, the openness to change, which can lead to a sense of control and influences the purchase of an EV can be mentioned (Axsen & Kurani, 2012). Moral norms can equally have an impact on EV purchases among German consumers. This may mean, consumers who feel responsible for society, for instance, are more inclined to purchase an EV (Graham-Rowe et al., 2012). The reason for this can be that the consumer has the perception that with an EV they will pollute the environment less and thus relieve society a bit. Last, the environmental concerns of a German consumer may influence the purchase of an EV. It can be assumed that consumers who care about the environment and are convinced that it will be relieved by electric vehicles will buy an electric vehicle as their next car (Lieven et al., 2011).

But the variables also influence each other (see 4.2). For instance, the higher the moral norm and perceived behavioral control of a German consumer, the higher their environmental concerns.

Finally, it can be stated that the research questions RQ1 – RQ3 (see 1.1), which ask about the significant impact on the intention to purchase an electric vehicle based on the factors of environmental awareness, social responsibility, and the economic aspects can be answered positively.

5.2 Implications with focus on academic and managerial relevance

The study's results are suitable and relevant not only for the academic context but also for the management context. Electric vehicles and their adaptation and integration into the market have already been studied from different perspectives (see 2.4). However, this study examines the purchase intentions, especially of the German consumer, in the context of the extended theory of planned behaviors (Shalender & Sharma, 2020). Electric vehicles have been present among car manufacturers for several decades but have only been widely commercialized in recent years. Similarly, monetary incentives for the purchase of an electric vehicle have only been made available by the German government since 2019 (see 2.2.2). Due to this, the research portfolio in the area of purchasing behavior or factors for buying an electric vehicle is not yet fully elaborated. The present study points out that in investigating the factors influencing the

purchase of an EV, an adaptation of the extended theory of planned behavior (Shalender & Sharma, 2020) expresses itself as a suitable tool.

Academic relevance lies in the fact that this study attempts to fill the research gap on German consumers with regard to their purchase intention of an EV. It can be used as a first impulse because it focuses on the purchase intention from a superficial perspective, where the first five factors (Attitude, etc.) are investigated. By validating the results of the regression conducted, it is suggested all these five factors, attitude, subjective norm, perceived behavioral control, moral norm, and environmental concerns, have an influence on the purchase intention of the German consumer. These five factors of the extended theory of planned behavior have an influence on purchase intention, which is also shown by the existing literature (see 2.4). Unlike the literature, this study and its results focus exclusively on German consumers and purchase of EVs. Although this study takes only a small step to fill the research gap about German consumers in the electric vehicle market, it contributes to the superficial understanding of which behaviors influence German consumers to purchase an electric vehicle. As a result, this study opens up future research opportunities in this area of study.

However, this study offers implications not only for the academic context but also for the management context. In particular, organizations or companies dealing with the topic of electric vehicle and their demand can gain practical implications from this study. The findings are particularly relevant for organizations and companies operating or aiming to enter the German market, which can be justified by the focus on the German consumer. This study provides such companies with an impetus on how to market electric vehicles. It is because the study provides results on the factors which can motivate the German consumer to purchase an EV. For instance, individual factors could be addressed in marketing by advertising the environmental friendliness of a car. It could increase the environmental concern. The results of this study are predominantly dominated by a sample of academic participants. More than 90% of the results are from participants who have studied or are studying (see 3.4). Therefore, the results can contribute an impulse and part for creating potential customer personas and their customer journeys. In general, the results of the present study can deliver first insights about the potential EV customer, which consequently would have to be elaborated further. Nevertheless, a first impulse or a direction can be pointed out, in which further research has to be conducted.

5.3 Limitations and future studies

The relationships observed in the present study can be attributed to previous findings and the underlying theories, namely the theory of planned behavior (Ajzen, 1991), and indicate that

conclusions can be drawn from the results, but the level of the factor details of the conclusions is missing. Regarding external validity, it should be noted that it is not possible to generalize the results to the totality of all German consumers because not all population groups are represented in the sample. As described in chapter 5.2, over 90% of the survey participants have an academic background and the gender distribution is also not representative. Most of the participants were male (54.0%), followed by female participants (46.0%), and none (0.0%) were from another gender. Therefore, a study should be conducted with a survey that carries a much larger scope and includes a higher degree of diversity. At the same time, there is the potential for participant selection. This is because by surveying only drivers, that means, consumers who have a driver's license, it would be possible to better narrow the target group. Interviewing experts who have knowledge about the topic of demand for EVs also seems to be important for this research topic in order to be able to gather well-founded, experienced, and fact-based results.

It has already been mentioned in 5.2 that the results scratch the superficial level. In order to achieve more tangible results, future research that explores more in-depth is recommended. Specifically related to the approach of this thesis, which examines purchase intention using the extended theory of planned behavior (Shalender & Sharma, 2020), there is an opportunity to examine each variable of the theory (attitude, subjective norm, perceived behavioral control, moral norm, and environmental concern) in more detail, which means going more in depth into the variables and set up more items for each. As can be seen in the results, all variables have a significant influence on the purchase of an EV. To concretize and specify this impact, an investigation of each variable in a separate study is recommended.

The results of this study provide a first impulse, which impacts different factors have on the purchase behavior of an electric vehicle of the German customer, but many factors are not considered, what could influence the purchase behavior. In addition to environmental awareness, social responsibility, and economic and ecological demands, consumers also consider other factors when purchasing a vehicle. Factors such as usefulness, ease of use, or facilitating conditions play an important role, especially for EVs, which also need to be explored for the German consumer (Tu & Yang, 2019). Especially for EVs, the consumer is faced with new challenges, such as the dependence on charging infrastructure, the facilitating conditions (Tu & Yang, 2019). Therefore, it suggests itself for a follow-up study to consider such variables.

6 Conclusion

Regardless of the results and conclusions are drawn from this study, the topic of demand for electric vehicles is relevant. Due to the fact that the commercialization of EVs is just coming out of the starting blocks, this thesis deals with a young and in the future even more important research area. Although the study is only a first approach towards a better understanding of the German consumer regarding their purchase behavior for an electric vehicle, this thesis aims to be a helpful basis for follow-up studies.

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8 Appendix

Appendix A: Survey

Dear Participant,

Thank you for taking the time to complete my questionnaire. Please answer as honestly as possible. All answers will be kept anonymous and confidential, which means your answers cannot be linked to your identity. Please respond immediately without interruptions or distractions and please pay attention to all questions you are asked. This survey will take approximately 3-5 minutes to complete.

I am a final year student of the Master International Management (M.Sc.) at Católica Lisbon, School of Business and Economics. This questionnaire was developed as part of my Master's thesis, which deals with the factors that influence and motivate the purchase of an Electric vehicle (EV).

I would highly appreciate your participation and responses to this survey.

Thank you in advance.

Yours sincerely,

Leonard Engels

P.S. If you have any questions or comments, please feel free to contact me at the following email address: 152120040@alunos.lisboa.ucp.pt

Do you agree to participate in this study?

- [ ] I agree (1)
- [ ] I disagree (2)

What is your gender?

- [ ] Female (1)
- [ ] Male (2)
- [ ] Prefer not to say (3)
- [ ] Other (4) _____

Where do you come from?

- ○ Germany (1)
- ○ Other (2) _____

How old are you?

- ○ 20-30 years old (1)
- ○ 30-40 years old (2)
- ○ 40-50 years old (3)
- ○ 50-60 years old (4)
- ○ 60-70 years old (5)

What is your educational status?

- ○ Professional degree (e.g. "Abitur") (1)
- ○ Bachelor's degree (2)
- ○ Master's degree (3)
- ○ Postgraduate (4)
- ○ Other (5) _____

What is your current working status?

- ○ Self-employed (8)
- ○ Employed full time (1)
- ○ Employed part time (2)
- ○ Unemployed looking for work (3)
- ○ Unemployed not looking for work (4)
- ○ Retired (5)
- ○ Student (6)
- ○ Disabled (7)

	Unfavorable (1) (1)	Somewhat unfavorable (2) (2)	Neither favorable nor unfavorable (3) (3)	Somewhat favorable (4) (4)	Favorable (5) (5)
I consider a purchase of an EV (Electric vehicle) (6)	○	○	○	○	○
	Negative (1) (1)	Somewhat negative (2) (2)	Neither positive nor negative (3) (3)	Somewhat positive (4) (4)	Positive (5) (5)
I consider a purchase of an EV (Electric vehicle) (6)	○	○	○	○	○
	Undesirable (1) (1)	Somewhat undesirable (2) (2)	Neither desirable nor undesirable (3) (3)	Somewhat desirable (4) (4)	Desirable (5) (5)
I consider a purchase of an EV (Electric vehicle) (6)	○	○	○	○	○

	Strongly disagree (1) (1)	Somewhat disagree (2) (2)	Neither agree nor disagree (3) (3)	Somewhat agree (4) (4)	Strongly agree (5) (5)
The people who are important to me want me to purchase an EV in the near future. (1)	○	○	○	○	○
While purchasing a new vehicle, I consider the wishes of other people who are important to me. (2)	○	○	○	○	○
If I purchase an EV, people who are important to me will also purchase an EV. (3)	○	○	○	○	○
The people who influence my opinions prefer that I should purchase the EV while purchasing a vehicle in the future. (5)	○	○	○	○	○

	Strongly disagree (1) (1)	Somewhat disagree (2) (2)	Neither agree nor disagree (3) (3)	Somewhat agree (4) (4)	Strongly agree (5) (5)
I can find out where to buy an EV when I decide to purchase it. (1)	○	○	○	○	○
The price of an EV is important when I decide to purchase it. (2)	○	○	○	○	○
The repair and maintenance of the EV are important when I decide to purchase it. (3)	○	○	○	○	○

	Strongly disagree (1) (1)	Somewhat disagree (2) (2)	Neither agree nor disagree (3) (3)	Somewhat agree (4) (4)	Strongly agree (5) (5)
I believe it is my moral responsibility to reduce environmental pollution and greenhouse gas emissions. (1)	○	○	○	○	○
I feel morally obliged to purchase an EV regardless of what others think of me. (2)	○	○	○	○	○
I take into account environmental consequences while I purchase a vehicle. (5)	○	○	○	○	○

	Strongly disagree (1) (1)	Somewhat disagree (2) (2)	Neither agree nor disagree (3) (3)	Somewhat agree (4) (4)	Strongly agree (5) (5)
I think the individuals and the society have the responsibility to protect the environment. (1)	○	○	○	○	○
I think the environmental issues are becoming more serious in recent years. (2)	○	○	○	○	○
I think we should live in harmony with the environment to achieve sustainable development. (5)	○	○	○	○	○

	Strongly disagree (1) (1)	Somewhat disagree (2) (2)	Neither agree nor disagree (3) (3)	Somewhat agree (4) (4)	Strongly agree (5) (5)
I am willing to purchase an EV when purchasing a vehicle in the future. (1)	○	○	○	○	○
I intend to purchase an EV when purchasing a vehicle in the future. (2)	○	○	○	○	○
I plan to purchase an EV when purchasing a vehicle in the future. (3)	○	○	○	○	○

Appendix B: Descriptive Statistics

Table 1

Reliability Statistics (Cronbach's Alpha)

Variables	Reliability Statistics (Cronbach's Alpha)	
	Cronbach's Alpha	*N of Items*
Attitude	.883	3
Subjective norm	.797	4
Perceived behavioral control	.711	3
Moral norm	.715	3
Environmental concern	.893	3
Purchase intention	.910	3

Table 2

Demographic Statistics (I/II)

Demographic Statistics		Demographic Statistic Values			
		Frequency	*Percent*	*Valid Percent*	*Cumulative Percent*
Participants (total)	211				
Gender	Female	97	45.8	46.0	46.0
	Male	114	53.8	54.0	100.0
Nationality	Germany	211	100.0	100.0	100.0
Age	20-30	135	63.7	64.0	64.0
	30-40	52	24.5	24.6	88.6
	40-50	11	5.2	5.2	99.1
	50-60	11	5.2	5.2	99.1
	60-70	2	.9	.9	100.0
Educational status	Professional degree (e.g. Abitur)	5	2.4	2.4	2.4
	Bachelor's degree	86	40.6	40.8	43.1
	Master's degree	105	49.5	49.8	92.9
	Postgraduate	8	3.8	3.8	96.7
	Other	7	3.3	3.3	100
Working status	Self-employed	78	36.8	37.0	37.0
	Employed full time	26	12.3	12.3	49.0
	Employed part time	2	.9	.9	50.2
	Unemployed looking for work	4	1.9	1.9	52.1
	Unemployed not looking for work	4	1.9	1.9	54.0
	Retired	75	35.4	35.5	89.6
	Student	22	10.4	10.4	100.0

Table 3

Demographic Statistics (II/II)

Demographic Statistics	Demographic Statistic Values						
	N	*Minimum*	*Maximum*	*Sum*	*Mean*	*SD*	*Variance*
Gender	211	1	2	325	1.54	.500	.250
Nationality	211	1	1	211	1.00	.000	.000
Age	211	1	5	326	1.55	.885	.782
Education	211	1	5	559	2.65	.743	.553
Work	211	1	8	798	3.78	2.631	6.924
Valid N (listwise)	211						

Appendix C: Analysis of the data

Table 1

Correlations

Correlation/Variables		Correlations					
		BI_m	*AT_m*	*SN_m*	*PBC_m*	*MN_m*	*EC_m*
Pearson Correlation	BI_m	1	0.424	0.199	0.276	0.455	0.375
	AT_m	0.424	1	0.299	0.274	0.243	0.297
	SN_m	0.199	0.299	1	0.066	0.149	0.08
	PBC_m	0.276	0.274	0.066	1	0.34	0.61
	MN_m	0.455	0.243	0.149	0.34	1	0.54
	EC_m	0.375	0.297	0.08	0.61	0.54	1
Sig. (1-tailed)	BI_m	.	0	0.002	0	0	0
	AT_m	0	.	0	0	0	0
	SN_m	0.002	0	.	0.171	0.015	0.124
	PBC_m	0	0	0.171	.	0	0
	MN_m	0	0	0.015	0	.	0
	EC_m	0	0	0.124	0	0	100
N	BI_m	211	211	211	211	211	211
	AT_m	211	211	211	211	211	211
	SN_m	211	211	211	211	211	211
	PBC_m	211	211	211	211	211	211
	MN_m	211	211	211	211	211	211
	EC_m	211	211	211	211	211	211

Table 2

Coefficients

Coefficients	Unstandardized Coefficients		Standardized Coefficients			95,0% Confidence Interval for B	
	B	*SE*	*Beta*	*t*	*Significance*	*Lower Bound*	*Upper Bound*
Constant	.304	.450		.675	.501	-0	1.192
AT_m	.325	.070	.295	4.648	.000	.187	0.463
SN_m	.061	.068	.054	.893	.373	-.073	0.194
PBC_m	.036	.107	.025	.339	.735	-.175	0.247
MN_m	.344	.076	.313	4.533	.000	-.194	0.493
EC_m	.148	.123	.098	1.205	.230	-.094	0.391

a. Dependent variable: BI_m

Table 3

Regression – Model summary (Attitude (AT_m) & Purchase intention (BI_m))

				Change Statistics				
R	*R²*	*Adjusted R²*	*SE of Estimates*	*R² Change*	*F Change*	*df1*	*df2*	*Significance F Change*
.424	.180	.176	.86575	.180	45.729	1	210	.000

a. Predictors (Constant), AT_m

Table 4

Regression - ANOVA (Attitude (AT_m) & Purchase intention (BI_m))

Regression	Regression Values				
	Sum of Squares	*Df*	*Mean Square*	*F*	*Significance*
Regression	34.275	1	34.275	45.729	.000
Residual	156.650	210	.750		
Total	190.925	211			

a. Dependent Variable: BI_m
b. Predictors: AT_m

Table 5

Regression - Coefficients (Attitude (AT_m) & Purchase intention (BI_m))

Regression	Unstandardized Coefficients		Standardized Coefficients			95,0% Confidence Interval for B	
	B	*SE*	*Beta*	*t*	*Significance*	*Lower Bound*	*Upper Bound*
Constant	2.136	.260		8.214	.000	1.624	2.649
AT_m	.466	.069	.424	6.762	.000	.330	.602

a. Dependent variable: BI_m

Table 6

Regression – Model summary (Subjective norm (SN_m) & Purchase intention (BI_m))

				Change Statistics				
R	*R²*	*Adjusted R²*	*SE of Estimates*	*R² Change*	*F Change*	*df1*	*df2*	*Significance F Change*
.199	.039	.035	.93674	.039	8.583	1	210	.004

a. Predictors (Constant), SN_m

Table 7

Regression - ANOVA summary (Subjective norm (SN_m) & Purchase intention (BI_m))

Regression	Regression Values				
	Sum of Squares	*Df*	*Mean Square*	*F*	*Significance*
Regression	7.531	1	7.532	8.583	.004
Residual	183.393	210	.877		
Total	190.925	211			

a. Dependent Variable: BI_m
b. Predictors: SN_m

Table 8

Regression - Coefficients (Subjective norm (SN_m) & Purchase intention (BI_m))

Regression	Unstandardized Coefficients		Standardized Coefficients			95,0% Confidence Interval for B	
	B	*SE*	*Beta*	*T*	*Significance*	*Lower Bound*	*Upper Bound*
Constant	3.261	.211		15.478	.000	2.845	3.676
SN_m	.222	.076	.199	2.930	.004	.073	.372

a. Dependent variable: BI_m

Table 9

Regression – Model summary (Perceived behavioral control (PBC_m) & Purchase intention (BI_m))

				Change statistics				
R	R²	Adjusted R²	SE of Estimates	R² Change	F Change	df1	df2	Significance F Change
.276	.076	.072	.91867	.076	17.227	1	210	.000

a. Predictors (Constant), PBC_m

Table 10

Regression - ANOVA summary (Perceived behavioral control (PBC_m) & Purchase intention (BI_m))

Regression	Regression Values				
	Sum of Squares	*Df*	*Mean Square*	*F*	*Significance*
Regression	14.539	1	14.539	17.227	.000
Residual	176.386	210	.844		
Total	190.925	211			

a. Dependent Variable: BI_m
b. Predictors: PBC_m

Table 11

Regression - Coefficients (Perceived behavioral control (PBC_m) & Purchase intention (BI_m))

Regression	Unstandardized Coefficients		Standardized Coefficients			95,0% Confidence Interval for B	
	B	*SE*	*Beta*	*t*	*Significance*	*Lower Bound*	*Upper Bound*
Constant	2.130	.419		5.085	.000	1.304	2.956
PBC_m	.404	.097	.276	4.151	.000	.212	.595

a. Dependent variable: PBC_m

Table 12

Regression – Model summary (Moral norm (MN_m) & Purchase intention (BI_m))

				Change statistics			
R	*R²*	*Adjusted R²*	*SE of Estimates*	*R² Change*	*F Change*	*df1*	*df2*	*Significance F Change*
.455	.207	.203	.85128	.207	54.460	1	210	.000

a. Predictors (Constant), MN_m

Table 13

Regression - ANOVA summary (Moral norm (MN_m) & Purchase intention (BI_m))

Regression	Regression Values				
	Sum of Squares	*Df*	*Mean Square*	*F*	*Significance*
Regression	39.466	1	39.466	54.460	.000
Residual	151.459	210	.725		
Total	190.925	211			

a. Dependent Variable: BI_m
b. Predictors: MN_m

Table 14

Regression - Coefficients (Moral norm (MN_m) & Purchase intention (BI_m))

Regression	Unstandardized Coefficients		Standardized Coefficients			95,0% Confidence Interval for B	
	B	*SE*	*Beta*	*t*	*Significance*	*Lower Bound*	*Upper Bound*
Constant	1.865	.276		6.781	.000	1.323	2.407
MN_m	.499	.068	.455	7.380	.000	.366	.632

a. Dependent variable: MN_m

Table 15

Regression – Model summary (Environmental concern (EC_m) & Purchase intention (BI_m))

				Change statistics				
R	*R²*	*Adjusted R²*	*SE of Estimates*	*R² Change*	*F Change*	*df1*	*df2*	*Significance F Change*
.375	.140	.136	.88611	.140	34.156	1	210	.000

b. Predictors (Constant), EC_m

Table 16

Regression - ANOVA summary (Environmental concern (EC_m) & Purchase intention (BI_m))

Regression	Regression Values				
	Sum of Squares	*Df*	*Mean Square*	*F*	*Significance*
Regression	26.819	1	26.819	34.156	.000
Residual	164.105	210	.785		
Total	190.925	211			

c. Dependent Variable: BI_m

d. Predictors: EC_m

Table 17

Regression - Coefficients (Environmental concern (EC_m) & Purchase intention (BI_m))

Regression	Unstandardized Coefficients		Standardized Coefficients			95,0% Confidence Interval for B	
	B	*SE*	*Beta*	*t*	*Significance*	*Lower Bound*	*Upper Bound*
Constant	1.293	.441		2.930	.004	.423	2.164
EC_m	.565	.097	.375	5.844	.000	.374	.756

a. Dependent variable: EC_m