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The Effect of Economic, Social and Psychological Factors on the Transport Behavior of Polish Citizens - A Conjoint Analysis Approach

PhD dissertation prepared under supervision of
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STRESZCZENIE

Wpływ czynników ekonomicznych, społecznych i psychologicznych na zachowania transportowe mieszkańców Polski - podejście Conjoint Analysis

[Welte-Bardtholdt, Cordula]

Wzrastający ruch drogowy jest odpowiedzialny za zmiany klimatyczne i związane z nimi problemy, takie jak hałas i konsekwencje zdrowotne, a samochód jest jednym z najbardziej preferowanych środków transportu w podróżach indywidualnych (Haubold, 2014). Zatem ruch drogowy powinien stać się bardziej zrównoważony. Celem rozprawy jest zbadanie, w jakim stopniu wypowiedzi respondentów na temat hipotetycznej sytuacji odpowiadają ich rzeczywistym zachowaniom. W tym celu zastosowane zostanie podejście conjoint analysis. Jako podstawę teoretyczną wybrano model EBM z 1995 roku (Engel et al. 1995). Skupiono się tutaj na etapach "wpływy środowiskowe", "różnice indywidualne", "ocena alternatyw" oraz na "wybór". Zebrano dane socjodemograficzne, informacje o aktualnym statusie podróży, sytuacji życiowej, stanie psychicznym i doświadczanych uczuciach podczas podróży aktualnym środkiem transportu oraz aspekty osobowości, ponadto respondenci mogli wybrać pomiędzy innymi środkami transportu niż samochód w dwóch hipotetycznych sytuacjach, możliwa była również opcja bez wyboru. W badaniu internetowym, które zostało przeprowadzone w Polsce w okresie od grudnia 2021 do marca 2022 roku, wzięło udział łącznie n=918 osób. Dane zostały przeanalizowane metodą Partial Least Square Structural Equation Modeling (PLS-SEM) z wykorzystaniem programu SmartPLS V.3. Wyniki pokazują, że stan psychiczny/odczucia podczas podróży aktualnym środkiem transportu, instrumenty polityki transportowej, posiadanie prawa jazdy, doświadczenie w car sharingu oraz płeć mają istotny wpływ na wybór środka transportu i aktualne zachowania podróżne. Dlatego też procesy psychologiczne są ważnymi czynnikami, które należy uwzględnić w planowaniu zrównoważonego transportu. Wyniki conjoint pokazały, że transport publiczny i car sharing były najczęściej wybieranymi środkami transportu; w przyszłości twórcy polityki powinni skupić się na uatrakcyjnieniu tych opcji. Jednakże jedna trzecia respondentów wybrała opcję "brak wyboru/inne", więc

dalsze badania byłyby tu ważne. Ponadto można by wykazać, że wyższe ceny benzyny i parkowania, jak również niższe udogodnienia mogą prowadzić do przejścia na inne środki transportu. Te oraz zachęty ze strony pracodawców mogłyby pomóc w uczynieniu tej zmiany obiecującą.

Słowa kluczowe: Model EBM, Choice Based Conjoint, Doświadczone uczucia, PLS-SEM, Transport

ABSTRACT

The Effect of Economic, Social and Psychological Factors on the Transport Behavior of Polish Citizens - A Conjoint Analysis Approach

[Welte-Bardtholdt, Cordula]

Increasing traffic is responsible for climate change and related problems such as noise and health consequences, and the car is one of the most favored means of transport for individual travel (Haubold, 2014). Thus, traffic should become more sustainable. The objective of the thesis is to investigate to what extent statements made by the respondents about a hypothetical situation correspond to their actual behavior. For this purpose, a conjoint analysis approach will be applied. The EBM model of 1995 (Engel et al. (1995) was chosen as the theoretical basis. Here, the focus was put on the stages "environmental influences", "individual differences", "evaluation of alternatives" and on "choice”. Socio-demographic data, information on current travel status, live situation, mental state and experienced feelings while traveling with the current transport mode, and aspects of personality were collected, further, respondents could choose between other transport modes than the car in two hypothetical situations, the non-choice option was also possible. A total of n=918 people participated in the web-based survey, which was conducted in Poland between December 2021 and March 2022. The data was analyzed by Partial Least Square Structural Equation Modeling (PLS-SEM) using SmartPLS V.3. The results show that mental state/experienced feelings while traveling by current mode, transport policy instruments, driver's license ownership, car sharing experience, and gender have a significant influence on transportation mode choice and current travel behavior. Thus, psychological processes are important factors to consider in sustainable transportation planning. The conjoint results showed that public transport and car sharing were the most frequently chosen modes of transport; in the future, policy makers should focus on making these options more attractive. However, one third of the respondents chose the option "no choice/other, so further research would be important here. Furthermore, it could be shown that higher prices for gasoline and

parking as well as lower amenities could lead to a switch to other modes of transportation. These and incentives from employers could help to make the switch promising.

Keywords: EBM Model, Choice Based Conjoint, Experienced Feelings, PLS-SEM, Transport

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LIST OF PUBLICATIONS

Mühlfelder, Manfred/Welte-Bardtholdt, Cordula: *Analyse und Organistionsdiagnostik im Betrieblichen Gesundheitsmanagement*. Edition 1101-01 (2014): SRH FernHochschule Riedlingen, Riedlingen University

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INTRODUCTION

The development of mobility in recent decades and its effects have shown that the transport of people and goods, in addition to today's advances and advantages, has underestimated effects on the environment and health, especially in the case where environmentally harmful means of transport are chosen to commute. Above all, individual transport is largely responsible for this. For many people, the conventional car is still the preferred means of transport, even though there are now many environmentally friendly alternatives. The choice of mode of transport is not only a rational decision, but it is also an emotional one. If a behavior is practiced over a longer period, habit plays an increasingly important role. Thus, choice decisions are not only rational, but influenced by individual factors regarding personality, car habits and motives, life experiences, habits, experience with car-sharing or the possession of a driver's license. However, other factors can also influence transportation choices and current transportation behavior: People experience different feelings while currently traveling with their current mode choice, which are also influenced by major changes for example in the form of deaths, childbirths, moves, or even new work situation. Consequently, changed life circumstances and mental state/experienced feelings can have an effect regarding the choice of means of transport.

The way people live, and commute thus has a lot to do with individual differences and environmental conditions. Changing environmental situations that influence mobility behavior, e.g., through policy instruments, employer incentives, or even personal circumstances, can have an impact on future mobility behavior.

The main purpose of the thesis is to study the impact of economic, social and psychological factors on the transport behavior of Polish citizens, using a conjoint analysis approach. Accordingly, the extent to which respondents' statements about a hypothetical situation correspond to actual behavior is investigated. The theoretical basis is the Engel-Blackwell-Miniard (EBM) model, a model for predicting consumer behavior (Engel et al., 1995).

The following main research question can be derived:

Do personal circumstances, emotions, drivers´ issues, gender and policy instruments have an effect on transport behavior?

The following sub questions can be derived as follows:

1.1 Do changes in life circumstances and job situation have an impact on transport behavior?

1.2 Do the mental state/experienced feelings have an impact on transport behavior?

1.3 Does the possession of a driver's license have an impact on transport behavior?

1.4 Does car-sharing experience have an impact on transport behavior?

1.5 Does gender have an impact on transport behavior?

1.6 Do policy instruments have an impact transport behavior?

1.7 Do employers incentives have an impact on actual transport behavior?

1.8 Does the non-availability of a car have an impact on actual transport behavior?

For this purpose, the following main hypotheses and sub hypotheses are generated:

H1 Changes in life circumstances and job situation within the previous 24 months have a significant effect on transportation behavior.

H 1a Changes in life circumstances and job situation within the previous 24 months have a significant effect on transport mode choice if employers offer incentives to switch to environmentally friendly transport modes.

H 1b Changes in life circumstances and job situation within the previous 24 months have a significant effect on transport mode choice if no car is available to get home.

H 2 Emotions such as mental states/experienced feelings while traveling with the current mode of transportation have a significant effect on transport behavior.

H 2a Emotions such as mental state/experienced feelings while traveling with the current mode of transportation have a significant effect on transport mode choice if employers offer incentives to switch to environmentally friendly transport modes.

H 2b Emotions such as mental state and experienced feelings while traveling with current mode of transportation have a significant effect on transport mode choice if no car is available to get home.

H 3 Drivers´ issues such as the possession of a driver's license and car sharing experience have a significant effect on transport behavior.
H 3a Having a driver's license has a significant effect on transport mode choice if employers offer incentives to switch to environmentally friendly transport modes.
H 3b Having a driver's license has a significant effect on transport mode choice if no car is available to get home.
H 3c Carsharing experience has a significant effect on transport mode choice if employers offer incentives to switch to environmentally friendly transport modes.
H 3d Carsharing experience has a significant effect on the transport mode choice if no car is available to get home.

H 4 Gender has a significant effect on transport behavior.
H 4a Gender has a significant effect on the choice of transport mode if employers offer incentives to switch to environmentally friendly transport modes.
H 4b Gender has a significant effect on transport mode choice if no car is available to get home.

H5 Transport policy instruments have a significant effect on transport behavior.
H 5a Transport policy instruments have a significant effect on transport behavior if employers offer incentives to switch to environmentally friendly transport modes.
H 5b Transport policy instruments in terms of punishment and incentives have a significant effect on transport behavior if no car is available to get home.

H6 Employers incentives have a significant effect on actual transport behavior.
H7 The non-availability of the car to get home has a significant effect on actual transport behavior.
H 8 Having a driver's license has a significant effect on actual travel behavior.

The first chapter deals with the problems of modern cities, such as the emergence of unsustainable mass mobility and its impact on people and health. How mass mobility has developed is reflected by current statistical figures. Another focus will be on what efforts have been made to increase road safety, this will also be explained in statistical figures. This is presented first based on European countries in the overview, in the special in the connection based on the EU- country Poland outlined. Due to the current pandemic situation prevailing during the writing of this thesis, the influence of COVID-19 and an outlook on possible changes related to unsustainable mass mobility will be given in this context. The remainder of chapter one traces the evolution of the concept of sustainability, it presents global approaches to sustainability and explains the characteristics, concepts, and models related to this topic. The last part of the first chapter deals with sustainable mobility options, such as active transportation sharing, service concepts, and reports results of various studies in this context. This is followed by a description of autonomous driving and the different levels of automation. In this context, several projects related to autonomous driving are presented.

The second chapter begins with a historical outline of the development of economics and distinguishes rational choice theory from the habitus concept. In the further course, the decision theories are distinguished from each other and outlined. Further, socio-cognitive models for the prediction of behavior are presented. Since behavior is influenced by habits and feelings, a historical and contemporary view of habits is first presented, followed by theories related to them. Subsequently, emphasis is placed on those theories that are shaped by norms and values, since behavior is influenced by personal and social norms (Triandis, 1977). A special focus in this chapter will be placed on the Engel-Blackwell Miniard model (Engel et al., 1995) as it serves as the theoretical basis for modeling behavior in this thesis. The acceptance of innovations plays an important role concerning future sustainable mobility, for this reason, behavioral theories in connection with the acceptance of innovations are outlined in the following. In the further course, a presentation of psychological perspectives that try to explain behavior will follow. Another focus is placed on motivation in human behavior, since motives can explain behavior (Brandstetter 2014, Heckhausen 2007). In this, a historical outline is given, starting with the year 1832. Different concepts of motivation follow. Personality traits, as well as emotions, influence behavior, which is expressed especially in driving and material possession. This is substantiated theoretically in this section, through the presentation of personality models and other concepts.

In the third chapter, the differences between the revealed preference method and the stated preference method are first explained, the latter being available under a variety of names such as "conjoint analysis" as used in this thesis. A brief introduction to the development of conjoint analysis and the objective of using this method is explained. In the following, different types of conjoint analysis are presented, and the advantages and disadvantages of each method are discussed. Then, an overview of the modeling and estimation techniques of this method, the logit modeling technique and the structural equation modeling techniques is given. In the remainder of the paper, the modeling techniques presented are discussed and the method chosen and the reasons for choosing the SEM modeling technique are presented. In the following sections, the questionnaire is described in detail. A detailed overview of the conjoint questions used is given. This is followed by the assignment of the individual parameters to the four stages of the EBM model, which are also based on and embedded in van Acker's Environmental Framework (van Acker 2010). In the further course, the different steps in the SEM modeling process are explained. The last part of this chapter deals with data collection and presents the instrument used for data collection.

The main findings of the research are summarized in the fourth chapter starting with the description of the population (age, marital status, household size, income, type of home and density area, education, employment, and car ownership) followed by plans to buy or sell the car and monthly estimated travel costs. In the following, the experiences of the respondents regarding sharing modes are presented as well as the reasons given why a mode of transport is not the preferred one. In the next step, the results are presented on the question under which policy instruments in the form of incentives and penalties the respondents would switch to other modes of transportation. This is followed by the results on the two conjoint analyses regarding the choice of transportation mode under the two hypothetical situations mentioned followed by a comparison and interpretation of these results with the responses regarding previous sharing experiences, driver's license ownership of the different genders and policy instruments. Subsequently, the correlations between the variables used are examined using a chi-square test. Moving forward, the ANOVA analyses are presented, which examines the effects of independent variables on dependent variables. The dependent variables are the psychological (individual) factors used in this survey, which are then subjected to factor analysis. Further on, the Part Least Square Structural Equation Modeling (PLS-SEM) developed based on the results is analyzed and interpreted.

The final chapter explains how the goal stated in the thesis was achieved. This is followed by a summary of the content of each chapter with a critical reflection and justification of the approach. The hypotheses presented in the Introduction are reflected and discussed. Referring to chapter two, it is explained why the EBM model was chosen as the theoretical framework for this thesis rather than other theoretical models. Furthermore, the connections between the presented theories and the contents of the questionnaire are explained and justified. In the following, the methodological procedure is reflected and discussed in the third chapter, especially the choice of the conjoint approach and its weaknesses are explained. The following are considerations for the choice of the modeling and estimation method and shows which strengths and weaknesses this approach has. In the further course, the use of the questionnaire is reflected, and conclusions are drawn about its scope. In the further course, the results in contrast with the main research objective are evaluated as described in “Introduction”. Further, the obtained results are critically reflected. A presentation of the most important results and recommendations on the possibilities of switching to environmentally friendly means of transport based on the results obtained is rounding off the dissertation.

CHAPTER 1
CHALLENGES OF MOBILITY

The transport of people, goods, as well as information has an impact on the development of countries and societies; without mobility and logistics, progress and prosperity are impossible (Deutscher Bundestag, 2017). The transport sector is a fundamentally important sector for any economy, providing, among other things, around 11 million jobs. Only through the transportation sector is it possible for people to be mobile in an international market (EC, 2019b; Eurostat, 2020). It has benefits in terms of trade and travel, however, the social costs of transport, such as accidents, the associated negative impacts on the environment, and the continued use of non-renewable resources are undeniable.

At the core of these problems lies human behavior. Despite the knowledge on the negative impact to society, health and the environment, the availability of suitable alternative technologies, and public policy suggestions, people continue to rely on unsustainable mobility systems. The non-sustainable mobility system will not change previous mobility behavior, in terms of choice of travel options or even choice of car (Holden et al., 2020). Mobility, in general, has an enormous impact on human health, climate change, and global resources; it is characterized by extreme inequality between rich and poor people, and people who possess a car or not (Perschon, 2012).

The fundamental question, however, is how to motivate people to use their private cars less and switch to shared or more environmentally friendly mobility. Insights from economics and applied psychology, such as understanding motivation, emotions, the development of habitual behavior, and personality, can help to understand and predict mobility behavior.

1.1. The Genesis and Consequences of Car-Based Mobility Systems

The way people live their lives is characterized by individuality. Mobility is an important prerequisite for self-fulfillment, fulfilling professional and private desires, and participating in social life and social progress. People do not want to do without individual mobility, so cars will still play an important role in 2040, as it guarantees temporal and spatial flexibility (Rauch, 2013).

The following subchapter describes the evolution of mass mobility and its consequences in the EU and specifically Poland. The following elements are presented:

- Automotive history
- Share of passenger transport by car
- Passenger car registrations
- Road and railway safety
- Air pollution
- Traffic noise
- Impact of the Covid-19 pandemic and outlook

The invention of the automobile in 1886 can be seen as the beginning of the age of mobility. Even before this breakthrough invention, there were many attempts and ideas to develop a vehicle that moved without the use of animal or muscle power. In 1769, the French inventor Nicolas-Joseph Cugnot developed a three-wheeled steam car based on the principle of James Watt's steam engine. The internal combustion engine then prevailed over steam propulsion with Lenoir's 1860 illuminated gas engine. German inventor Nikolaus Otto then invented, on the basis of the Lenoir engine, the Otto Engine in 1876. In 1885, Gottfried Daimler and Wilhelm Maybach designed the first motorcycle with a gasoline engine. A year later, in 1886, fellow German Carl Benz developed the first vehicle with a gas engine, and Daimler the first vehicle with a gasoline engine. In 1910, Zwickau-based Audi introduced the first branded car, the “Type A”. In the following 1920s, automobile manufacturing established itself as a new branch of industry; in 1929, 608,342 motorcycles and 422,612 cars were already counted in the German Reich. After the end of the World War 2, the automobile was well on its way to becoming a means of mass transport (Wenzlaff, 2011).

Today's "car-based, gridlocked societies" (Perschon, 2012, p. 2) are the result of the Athens Charter signed almost 80 years ago. It laid the foundation for the planning and design of cities. The separation of industrial areas from residential areas has led to a high volume of traffic, which is accompanied by a heavy dependence on road transport. Low transport costs, as well as the perceived unlimited availability of fossil fuels, caused road infrastructure to be highly prioritized and projects in this context were rapidly pushed forward with the aim of maximizing individual mobility (Perschon, 2012). The increase in individual mobility has an impact on the share of passenger transport by car: as of 2020, the share of passenger transport by passenger cars in the EU-27 is 82.9%, while the share of passenger transport by bus and train is 7.9% (Destatis, 2021). In Germany, passenger transport by car dominates with 85.1%, in Poland with 79.3%. The highest rate of motorization by car in the EU-27 is in Lithuania, at 90.4%. As for train and bus travel, the share is highest in Austria (12.9%), Germany (9.1%), and Poland (7.9%). The least amount of train and bus travel is in Greece (0.9%), followed by Lithuania with 1.1% (Destatis, 2021).

Increasing individual mobility leads to an increase in car registrations. Figure 1 shows new registrations of passenger cars in the EU in 2019 and 2020, revealing the consequences of the COVID-19 pandemic:

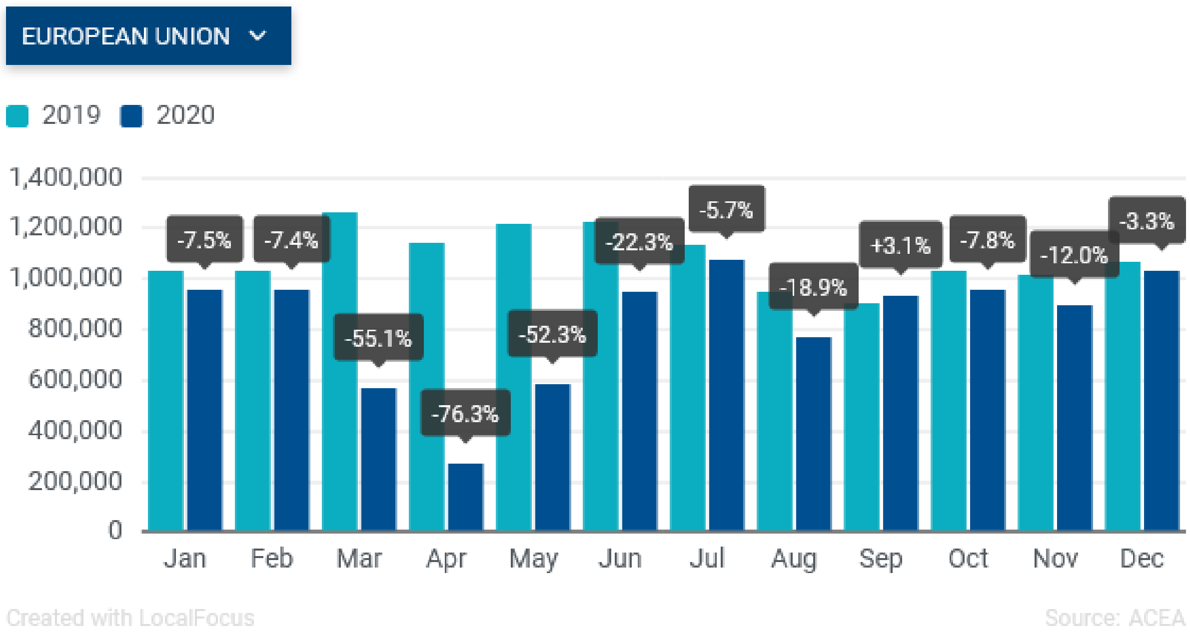

Figure 1 registration of new passenger car in the EU: 12-month tendency 2019 and 2020

Source: (ACEA, 2021a)

In 2020, the passenger car market in the EU declined by 23.7%. This is to be understood as a direct consequence of the COVID-19 pandemic, which was accompanied by full-scale lockdowns as well as other restrictions. The pandemic created an all-time consequences on car sales throughout the European Union (ACEA, 2021b).

The automotive market in Poland has changed tremendously after EU accession in 2004. During the first 15 years, as many as 12 million used cars were imported to Poland (Kołsut, 2020). More than half of the imported used cars are older than ten years, only one in ten is younger than five years (GTAI, 2019). Most used vehicles came from Germany and the average age of imported cars varied from 8.5 to 11 years, leading to the increased average age of cars (Kołsut, 2020). In connection with COVID-19, sharp declines were recorded in Poland at the beginning of April 2020 in terms of new vehicle registrations. The decline was particularly severe in the van segment, with a drop of almost 80 percent (Sas, 2020).

Table 1 provides an overview of the age structure of used cars registered in Poland between January and December 2020. It shows that vehicles older than 10 years account for the highest share of registrations, namely 54.5%, followed by vehicles between 4 and 10 years old with 34.3%, followed by younger models with a first registration of fewer than 4 years.

Age	Number of vehicles	Share %
≤ 4 years	103 292	11,1%
>4 years & ≤10 years	318 980	34,3%
>10 years	506 756	54,5%
Total	929 028	100%

Table 1 First Registration of Used Cars in Poland based on CEP
Source: adapted from (PZPM, 2021)

In Eastern Europe, new passenger car registrations growth began in 2014 and has continued since. On average, there are 495 passenger cars per 1,000 inhabitants in Eastern European countries, while in comparison, the passenger car density in the EU-15 countries is 543 vehicles per 1,000 inhabitants. Compared to other Eastern European countries, Poland was in the leading position with a plus of 17 percent (486,400 new registrations in 2017). In 2019, passenger car sales in the Eastern European EU-countries exceeded 1.5 million new vehicles for the first time. Poland, the largest single market among the Eastern European EU countries, recorded an increase of more than 4 percent, with 555,600 registrations (Kallweit et al., 2020).

Figure 2 presents an overview of the numbers of car registrations in Poland between October 2020 and September 2021. Passenger car registrations in January 2021 were very low in overall comparison. In March 2021, there was a high increase in registrations to 47,849 passenger cars. The peak of registrations in this period was recorded in December 2020 with

51,507 passenger car registrations. After June 2021, in which 43,711 passenger cars were registered, there was again a decline in registrations in the following month of July. Here, 38,349 passenger cars were registered. Significantly fewer cars were registered in August 2021 and September 2021 in particular: While registrations in June were still at 43,711 vehicles, in December it was done by 10,626 to only 33,085 registrations.

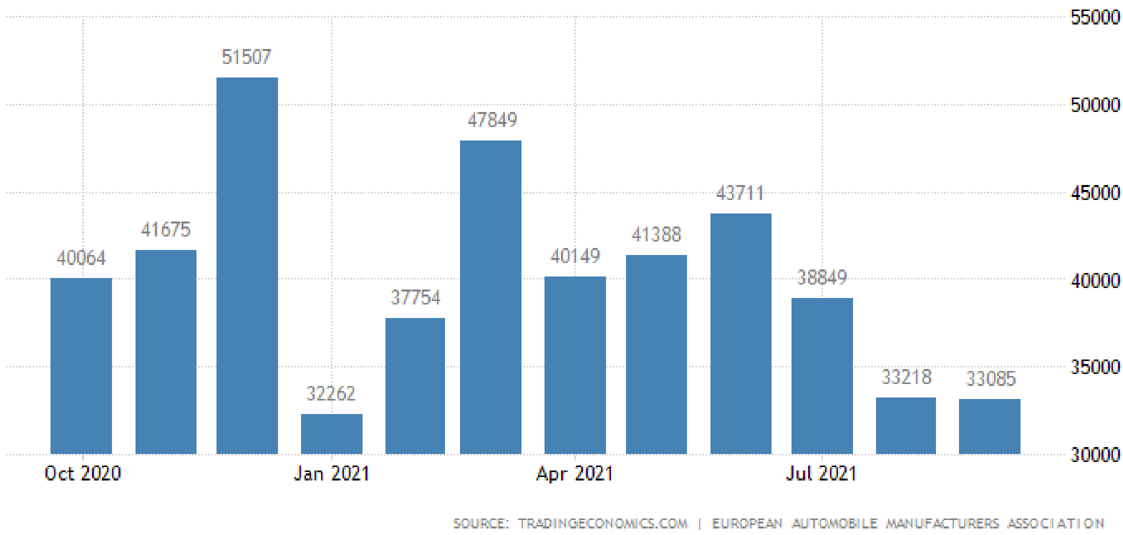

Figure 2 Car Registrations in Poland between October 2020 and September 2021

Source: (Tradingeconomics.com & European Automobile Manufacturers Association, 2021)

More and more manufacturers have introduced automobiles with alternative engine systems in recent years (Bauer, 2014). In the EU, more than half of the market share in 2019 is accounted for by vehicles with gasoline engines (58.9%), followed by diesel vehicles with 30.5%. The market share of vehicles equipped with environmentally friendly technology is only 10.6% (PZPM & ACEA, 2020, p. 6).

Table 2 provides an overview of vehicle registrations between 2014 and 2019 broken down by the type of engine in the EU countries. As shown, more than 36 million gasoline vehicles were registered between 2014 and 2018. The number of registrations for diesel vehicles decreased by approximately 1.95 million vehicles during the same period. There was a considerable increase in electrically charged vehicles by nearly 390 thousand vehicles. Hybrid vehicles also saw a massive increase between 2014 and 2019, with approximately 176,500 vehicles registered in 2014 compared to almost 900,000 vehicles in 2019. Fewer registrations were recorded for CNG-powered vehicles, although the total number of these vehicles (2019: 68,581 registered vehicles) is likely to play a smaller role in transportation than vehicles powered by gasoline (2019: 8,964,034 registrations).

	2014	2015	2016	2017	2018	2019
Gasoline	5,358,452	6,036,564	6,800,116	7,563,739	8,521,418	8,964,034
Diesel	6,599,462	7,039,611	7,175,630	6,617,051	5,402,079	4,650,558
Electric	69,958	148,027	155,634	218,083	300,258	458,915
Battery	37,517	59,165	63,479	97,667	147,428	284,812
Hybrid plug-in	32,441	88,862	92,155	120,416	152,830	174,103
Hybrid	176,525	218,755	278,729	426,769	598,462	896,785
Fuel cells	38	176	123	253	266	535
CNG	97,214	78,511	57,609	49,553	65,023	68,581
LPG + E85	141,452	140,321	118,430	156,710	164,270	187,378

Table 2: Trendy w latach 2014-2019 w krajach UE/Trends 2014-2019 in the EU countries (translation): Registrations data for PC (Passenger Cars) and LCV (Light Commercial vehicles) in 2021

Source: adapted from (PZPM & ACEA, 2020, p. 6)

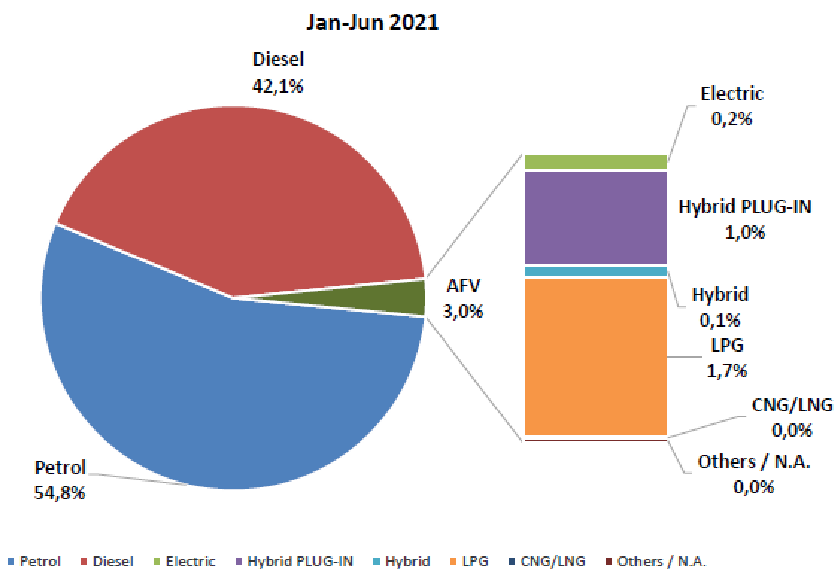

Figure 3 First Registration of Used Passenger Cars by Fuel Type, based on CEP

Source: (PZPM, 2021, p. 2)

Figure 3 shows how initial registrations of used alternative fuel vehicles (AFV) were performed in detail over the period from January to June 2021. Numbers are based on data from Centraina Ewidencja Pojazdow (CEP) (PZPM, 2021). The all-electric vehicles have a 0.2% share here. The share of vehicles with plug-in hybrid vehicles is 1.0%. The share of hybrid vehicles is just 0.1%. Most registrations were for liquefied gas vehicles (LPG) at 1.7% market share. Vehicles with compressed natural gas (CNG) and liquified natural gas (LNG) engines were not registered in this period.

The increase in individual mass mobility has resulted in more and more vehicles on the roads, which has also had an impact on road safety. The European Commission (EC) (EC, 2020a) reports, that almost 40% of traffic fatalities occur in city areas. Passengers in passenger cars (both drivers and co-drivers) represent 45% of all traffic fatalities, while cyclists represent 26% and walking pedestrians contribute to 21% of all traffic deaths. Although on the one hand, the number of fatalities among motorists decreased by 26% between 2010 and 2018, the number of cyclist fatalities decreased by only 5% over the same period. Looking only at the urban area between 2010 and 2018, the number of bicycle fatalities increased by 1%. Road fatalities mainly affect the elderly aged 65 and over (28% total fatalities in 2018 compared with 22% in 2010). Expressed in numbers, 22,800 road deaths were recorded in 27 EU countries, compared to 2010; this is a decrease of 23%, meaning almost 7,000 fewer deaths were recorded. (EC, 2020a). The numbers with the lowest death rates in the EU were recorded in both Sweden (22 deaths/million) and Ireland (29/million). In contrast, the highest death rates were recorded in Romania (96/million), Bulgaria (89/million), and Poland (77/million). The lowest road death rate so far in 2019 was registered by Croatia, Finland, France, Germany, Greece, Latvia, Luxembourg, and Sweden (EC, 2020a).

Figure 4 provides the number of traffic fatalities per million citizens by country between 2010 compared to 2019 (ACEA, 2020b). On average in the EU, 68 road deaths per million inhabitants were documented in 2010 compared to 51 road deaths per million in 2019. In Poland 103 road deaths per million were documented in 2010, compared to 77 road deaths per million in 2019. Poland has the third-highest rate in the EU, only Romania and Bulgaria are behind (ACEA, 2020b).

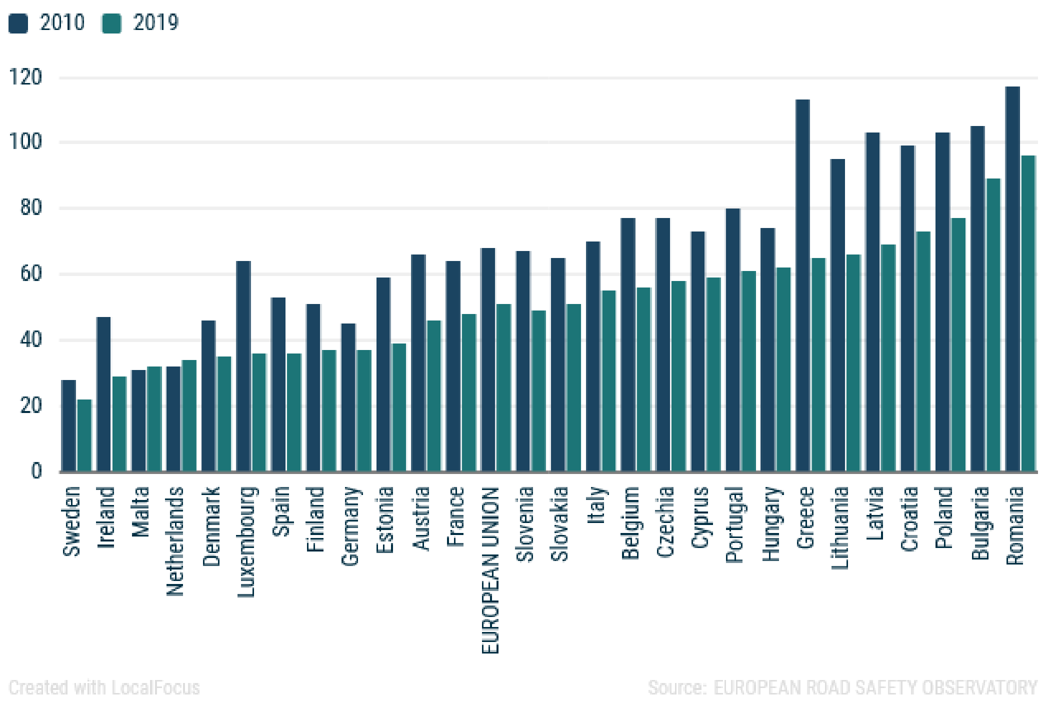

Figure 4 Road fatalities in the EU (2010 compared to 2019)

Source: (ACEA, 2020b)

In comparison, the European Union is reducing road traffic fatalities, thanks to efforts at the three levels, such as national, regional, and local. The number of road traffic deaths decreased by 43% between 2001 and 2010 and a further 21% between 2010 and 2018. Nevertheless, 25,100 people died in 2018, which, according to the European Commission's working paper, is unnecessary, unacceptable, and too high a social price to pay for mobility. Too few successes in terms of avoiding severe incidents have been reported so far (EC, 2019a).

Figure 5 illustrates the downward trend in road fatalities in the EU from 2001 to 2020. Despite the downward trend, a slight increase in fatalities was recorded around 2011. Poland's roads are among the most dangerous. Infrastructure has hardly been adapted since joining the EU in 2004, traffic has however sharply increased in the same time (Mitura, 2012).

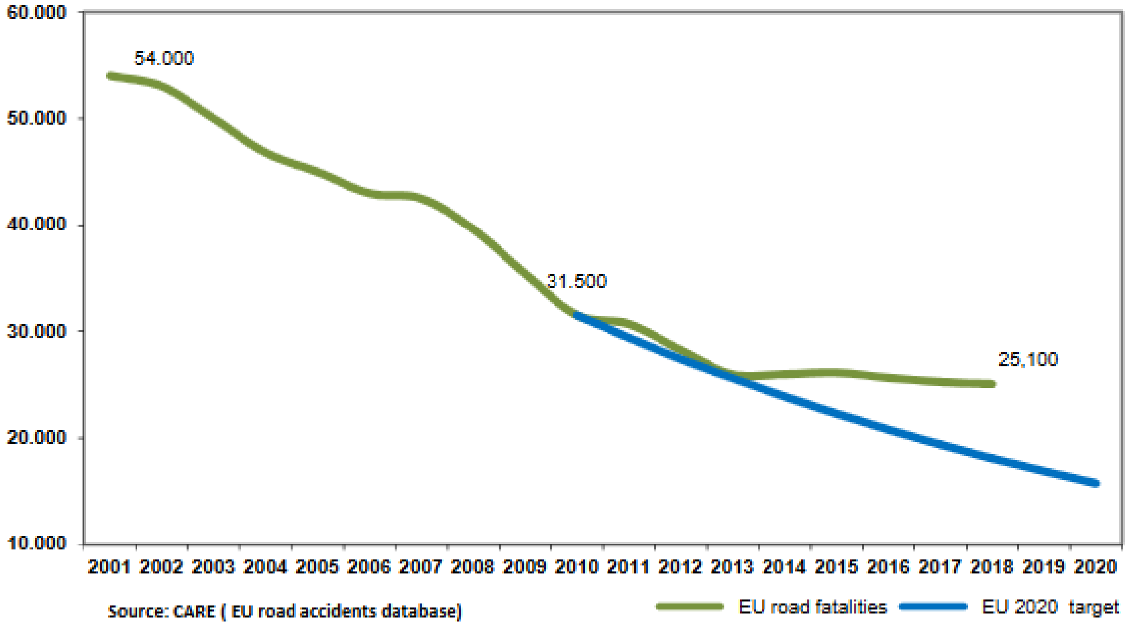

Figure 5 Tendency of the traffic fatality rate in the EU from 2001 to 2020

Source: (EC, 2019a, p. 2)

Figure 6 shows the development of road accidents, fatalities, and injuries in Poland between 2004 and 2018 (KGP & GUS, 2020, p. 3).

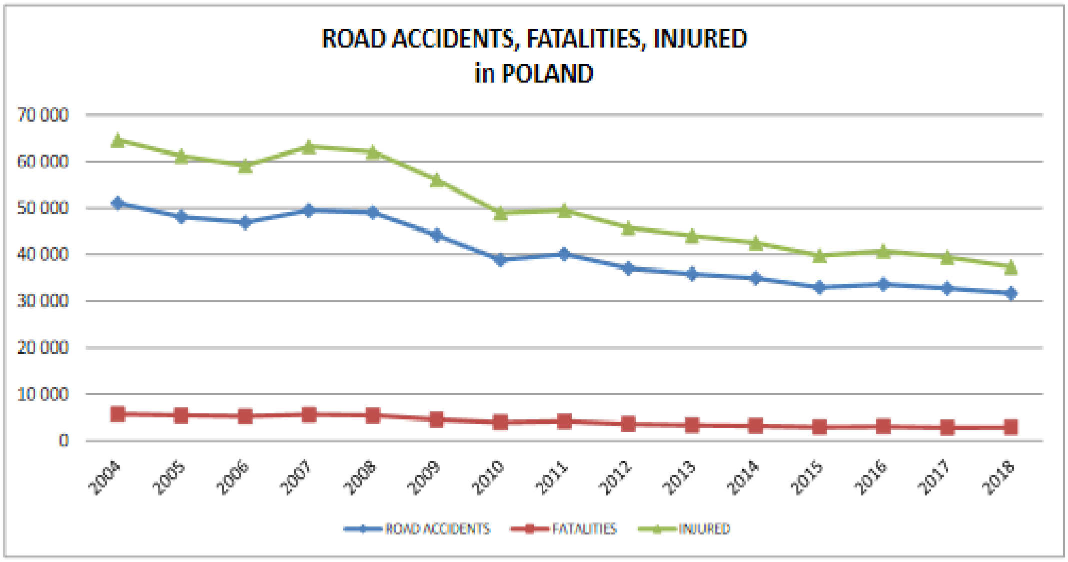

Figure 6 Road fatalities in Poland (2004-2018)

Source: (KGP & GUS, 2020, p. 3)

The green line shows the development of the number of injuries, followed by the blue line below the green line, which shows the development of traffic accidents. The red line below shows the development of fatalities. As seen, there was a slight increase in the number of injured and accidents between 2006 and 2007, but the numbers developed downwards again, especially between 2008 and 2010.

A project between Switzerland and Poland ("Road Safety") (Mitura, 2012), which was carried out between 2012 to 2017 contributed directly to improved road safety in Poland. Thus, through knowledge transfer and improvements of the traffic infrastructure in Poland, the number of traffic fatalities could be reduced. Switzerland implemented various approaches with its Polish partners, such as equipping local traffic police stations with unmarked police vehicles, special vehicles were provided that were equipped with radars for measuring speed, for example. Traffic calming measures were implemented in seven districts of the Małopolskie, Lubelskie, and Mazowieckie voivodeships (provinces), which increased traffic safety. Furthermore, 650 traffic police officers were trained, which led to a significant decrease in pedestrian accidents in the regions where measures were implemented. The project led to a revision of the Road Traffic Act in Poland. Higher fines for traffic offenses and harsher penalties for alcohol-involved road users were the result. Furthermore, victim compensation was introduced, based on the Swiss model (Victims Assistance Act): anyone who causes an accident while under the influence of alcohol is legally obliged to make a payment to the victim, the victim's family, or the Victim Compensation Fund (Mitura, 2012).

Public transport is very safe, especially railway travel as the safest motorized means of transport (Geißler, 2017). Across Europe, there has been a decrease in rail accidents between 2010 and 2018. Between 2010 and 2018, there were 563 fewer accidents overall, a reduction of 25.3% in accidents. Also, 31.5% fewer people were killed during this period (Eurostat, 2020). In Poland, the September 2020 report on the state of railway safety in Poland shows that 2019 was the safest year for rail transport since records began. Accidents decreased by 13%, compared to 2018 by as much as 13.5%. This means that it is even becoming increasingly safe for people to travel by rail (UTK, 2020).

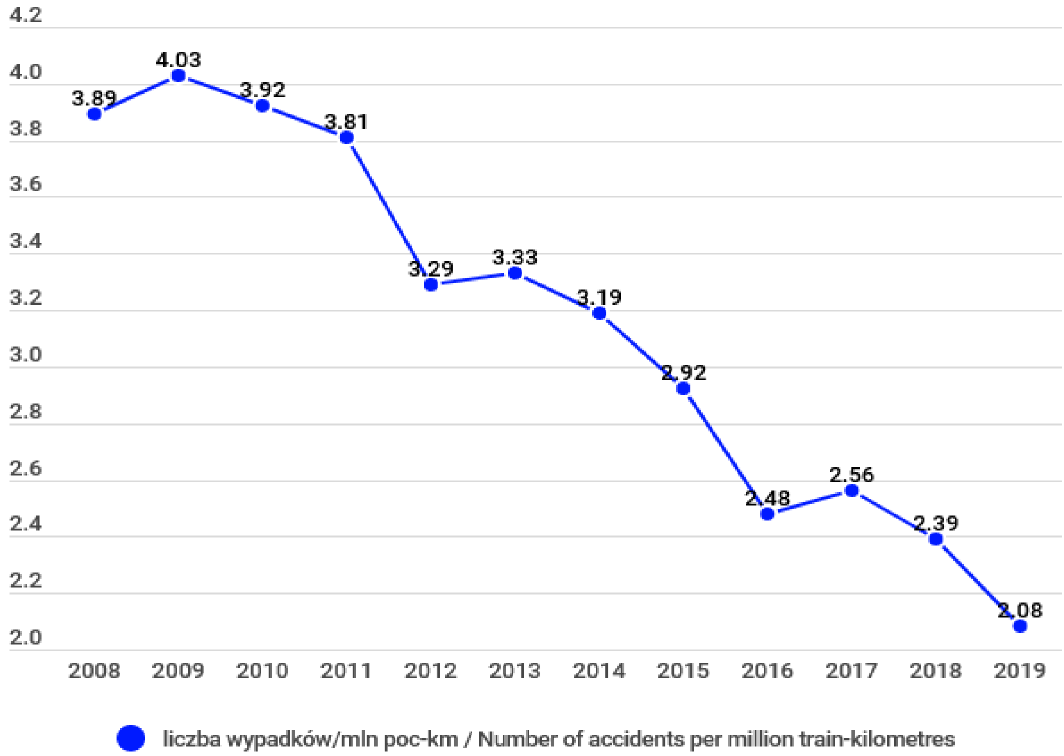

Figure 7 Number of accidents per million train-kilometers

Source: (UTK, 2020)

Figure 7 provides the development of accidents in the rail sector. As shown, rail transport in Poland is becoming safer, as demonstrated by the decreasing number of accidents. This may lead to optimism, but attention should be paid to train drivers in Poland, as they are responsible for 13 % of SPAD incidents (signal passed at danger) and the increasing number of suicides and suicide attempts (UTK, 2020).

The increasing number of car registrations and the problem of traffic safety are not the only problems associated with mass mobility: mass mobility is causing the air to become dirtier and dirtier. Air pollution is one of the biggest problems in modern cities. In 2017, around 886 million tons of carbon dioxide were emitted in the EU-wide road traffic. This means that CO_2 emissions were 24% higher than in 1990, with the majority of road traffic emissions being caused by cars and motorcycles. Ozone precursors (NMVOC, NOx, CO and CH4) are harmful to human tissues and are, therefore, considered a health risk, especially for people with breathing difficulties. The main contributors are the private households, which were the main contributors to the total ozone precursor emissions with 25.9% in 2017 followed by the transport sector with 24.4%; The formation of fine particles is due to the degradation of soils, water and forests, which subsequently contributes to respiratory diseases. The largest share of all industries in 2017 is agriculture, forestry and fishing with 43.6%, followed by transportation and storage with 22.1% or 3.7 million tons of SO2-eq; The major share of emissions in transportation originates from NOx (Eurostat, 2020).

The OECD (2016) has made a warning that “unless we clean up the air, by the middle of the century one person will die prematurely every 5 seconds from outdoor air pollution.” (OECD, 2016, p. 3). According to the European Commission (2018), air pollution exceeds recommended levels on a regular daily basis, especially in large cities. In fact, it reaches dangerous levels for several days a year. 65% of cities with a high income do not meet air quality guidelines according to the WHO. This is a problem as especially fine particulate in very low concentrations have a huge impact on health (EC, 2018).

Poland has problems in terms of dependence on fossil products: the country is dependent on oil and oil products (excluding biofuels) for 98.7% and on natural gas for 77.6%. Further, transport-related emissions and congestion in Poland are among the highest in the EU due to the high dependence on private vehicles, the low renewal rate of passenger and commercial vehicles on the roads, and the high share of road transport in freight transport (Eurostat, 2020). In cities, there are almost no alternative fuel vehicles. Moreover, the timely completion of all planned railroad investments by 2023 is at risk due to lack of capacity, institutional weaknesses, complex administrative and financial procedures, leading to delays and unnecessary bottlenecks (EC, 2019b). However, significant progress in the field of environmental protection has been noticeable, but problems remain. The State of Environment Report (SoE) reveals, that despite the continuous development of the Polish economy, no increase in emissions has been observed. Sulfur dioxide has been reduced in some cases. Despite the improvement in Polish air quality, significant exceedances of key target values such as ozone in summer and PM10, in winter, PM 2.5, and benzo(a)pyrene are still a serious environmental concern. Winter values are associated with emissions from household heating systems and unnecessary travel (Albiniak et al., 2014).

Figure 8 shows the “substances stated in the Treaty of Accession of the Republic of Poland to the EU, in the scope of the National Emissions Ceilings Directive 2001/81/EC” (EEA, 2015) The general and especially SO_2 reduction underpin the efforts that Poland has made concerning reducing air pollution.

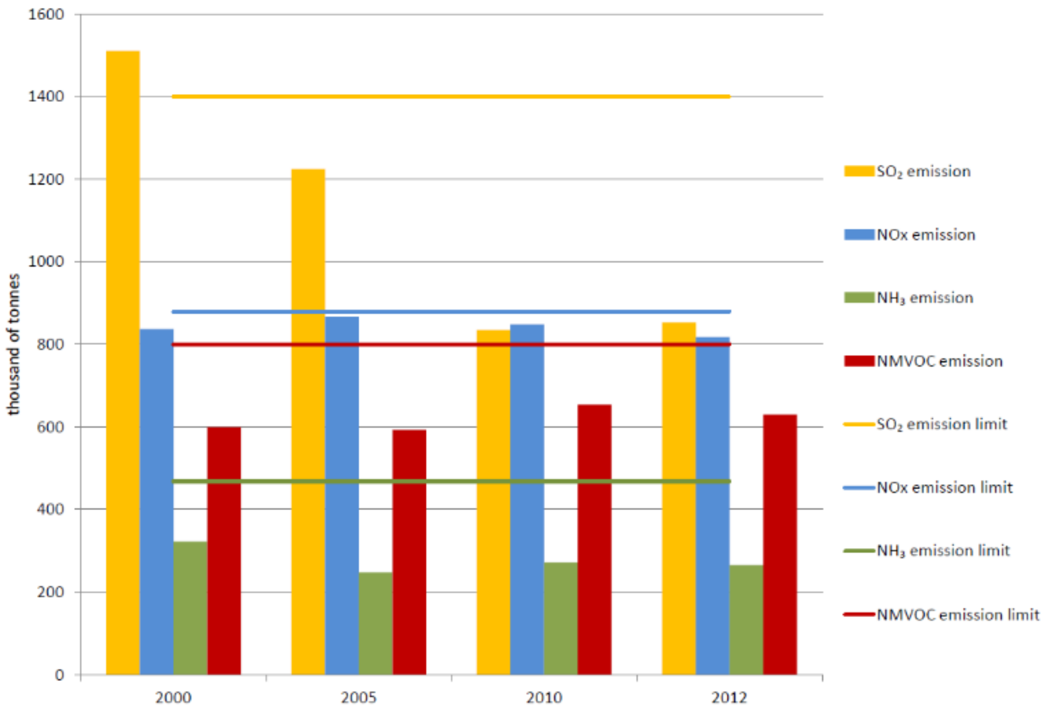

Figure 8 Emissions volumes compared with the national emission limits between 2000 and 2012

Source: (EEA, 2015)

Another challenge for modern cities is noise caused by traffic. According to the World Health Organization (WHO, 2020), traffic noise is recognized as the most serious threat to physical and mental health and well-being. Increased noise affects people's daily activities (WHO, 2020). The WHO Regional Office for Europe has created environmental noise guidelines that include advice on how to protect human health from environmental noise: "For average noise exposure, reducing noise levels produced by road traffic below 53 decibels (dB) Lden 2, as road traffic noise above this level is associated with adverse health effects. For night noise 2 Lden: Day-evening-night-weighted sound pressure level as defined in section 3.6.4 of ISO 1996-1:2016 21 exposure, reducing noise levels produced by road traffic during night time below 45 db Lnight 3, as night-time road traffic noise above this level is associated with adverse effects on sleep." (WHO, 2018). The European Environment Agency (EEA) reports, that more than three million people living in Europe are affected by noise limit that are exceeded during the day and night, at night alone, two million people are exposed to noise (EEA, 2019).

The 2018 Target Market Analysis in Poland concluded that over 70% of the citizens complain about noise pollution. Noise sources are mainly road, rail, air transport, as well as mass events. noise pollution from industry has improved, the situation has worsened significantly in traffic noise. Especially in urban areas, 41-55% of residents complain about noise exposure. The average noise level is 70dB around national roads, 69dB from the railway network, and 80-100 dB near airports. Comparing Poland with other European countries, there is a lot of catching up to do, and Poland also must comply with EU obligations regarding air quality and noise protection. To improve the situation, a new law on electromobility was introduced in Poland, which provides charging stations for electric cars, and alternative fuels, such as CNG and electric cars, were exempted from the excise tax (BMWi, 2018).

The EU Noise Directive 2002/49 (European Parliament, 2002) requires all EU Member States to draw up action plans to reduce harmful noise in agglomerations and around major railroads, roads, and airports. In February 2021, the European Commission announced its decision to refer Poland to the European Court of Justice for non-compliance with its commitments resulting from the Noise Directive (2002/49/EC). The goal of the European "Green Deal" (EC, 2021b) is to become climate neutral by 2050, which will benefit public health and environmental protection. Binding action plans are to be implemented to combat noise that is harmful to health. According to a Press Release of the European Commission on 18 February 2021 (EC, 2021c), the regulations in Polish national law are not sufficient to reach this this target. For example, action plans are missing for 20 of the most important railroad sections and 290 important road sections. According to Polish national law, the action plans do not have to include all the elements foreseen in the directive. For example, there are no regulations on protocols for public consultations, actions to protect quiet areas, and no long-term strategies. The public has the opportunity, through public consultations on the action plans, to comment on the extent to which the authorities take measures to reduce noise levels, where they may be harmful, or to prevent already existing noise levels from causing damage to health. It is not enough to adopt action plans: national law must specify which elements must be included in such plans. As Poland has so far failed to address the European Commission's concerns, the case was submitted to the Court of Justice of the European (EC, 2021c).

Many researchers have studied traffic noise and its consequences (e.g. Bull, 2003; Finke et al., 2020; Hoffer, 2015; Lera-López et al., 2012; Urbanek, 2021). Brown & van Kamp (2017) conducted a comprehensive systematic literature review concluding, that traffic noise causes severe adverse effects, such as an increase in sleep disturbance and cardiovascular disease. This systematic search focused on road, rail, and air transport publications (Brown & van Kamp, 2017). Harding et al. (2013) reported, that noise pollution is associated with hypertension, heart attacks, stroke, and dementia (Harding et al., 2013). Noise causes deterioration of cognitive abilities and causes tinnitus in children and is also a health risk for diabetes (Dzhambov, 2015). Summarized, the problems of modern cities can be traced back to mass mobility, which is associated with accidents, air pollution, and noise leading to severe health problems. Statistical figures indicate that there is a trend towards a cleaner environment. However, individual traffic is still very high, and no reversal is yet visible. The EU target to halve death rates by 2020 could not be met.

The COVID-19 pandemic has far-reaching and unprecedented impacts, not only on people but also on the transport sector worldwide (J. Zhang, 2020). In 2020, the pandemic led to a large decrease in public transport trips in different regions due to a decrease in the number of active travelers in 2020 (Jenelius & Cebecauer, 2020). The decrease in travel times for commuters by car and a reduction in congestion costs can be attributed to increased working from home (Hensher et al., 2021). Besides, the EU car market saw a -55.1% drop in new registrations in March 2020. The Association of European Automobile Manufacturers (ACEA), which represents the 16 leading car, truck, van and bus manufacturers in Europe, has defined four guiding principles for a successful recovery of the automotive industry in the context of the pandemic. In addition, ACEA has set itself the goal of making a significant contribution to the EU industrial strategy, the European Green Deal. For this purpose, a coordinated approach for a safe restart of vehicle production has been defined: thus, demand for all vehicle categories shall be stimulated with a focus on affordability using the latest (sustainable) vehicle technology (ACEA, 2020a). Furthermore, the authorities in the EU member states are to be urged to, among other things, accelerate vehicle registration and provide “an EU-wide network of charging and re-fueling infrastructure” (ACEA, 2020a, p. 2).

COVID-19 could help give sustainability a push in the right direction and further advance previous thinking and projects. How to define sustainability and sustainable mobility, what efforts have already been made, and what targets have been set and defined, can be found in the following section.

1.2. Sustainability and Sustainable Mobility

The term sustainability has gained attention due to its rapid use and spread in different disciplines: it can comprehensively describe current problems. Very often the term can be found in connection with economic issues. The trend to use the term has been further reinforced by environmental problems. In the meantime, the concept of sustainability has become firmly established in politics, business, and society (Spindler, 2011).

The evolution of the term “sustainability”, as well as concepts and developments in the field of mobility, are presented as follows:

- “Sustainability”: historical background and global approaches,
- Sustainability concepts,
- Characteristics of sustainable development, concepts, and models,
- Attempts of finding definitions for sustainability and sustainable mobility,
- The three generations of sustainable mobility between 1992 – 2005,
- Concepts and strategies at the European Level,
- Policy approaches and the “Four Elements” promoting sustainable mobility.

In the 18th century, sustainability was first formulated as a principle in German economics. Carlowitz (1645-1714) demanded a sustainable form of timber management, that only as much be cut down, as can grow back through reforestation. He recognized that the national economy could save the forest. With Rachel Carson's 1962 book “Silent Spring”), the issue of environmental protection gained further social awareness. In the United States, the National Environmental Policy Act (NEPA) became law in 1970. Global environmental policy was decisively influenced by the UN conferences on the environment, which have been held since 1972 (Spindler, 2011).

The UN World Commission on Environment and Development (WCED) issued in 1987 the report “Our Common Future”, also known as the Brundtland Report requesting “a new era of economic growth – growth that is forceful and at the same time socially and environmentally sustainable” (WCED, 1987, p. 7). In the report, "Sustainable Development” is defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p. 41). At the Earth Summit in Rio in

1992, world leaders tried to commit to promoting sustainability, however, “the second Earth Summit apparently produced little other than a statement that nobody in government really cares for the planet and its people” (A. Jordan & Voisey, 1998, p. 93). Further summits followed in 1997, 2002 and 2012 (Purvis et al., 2019, p. 684). In the year 2015, the United Nations member states approved the 2030 Agenda for Sustainable Development. In this agenda, member states set 17 Sustainable Development Goals (SDGs) for socially economic and environmentally sustainable development that have to be applied worldwide (BMZ, 2017). These 17 global goals include, in addition to fighting poverty and hunger, the fight against inequality, climate change, and the goal of making cities and settlements inclusive, safe, resilient, and sustainable (BMZ, 2017).

Sustainability concepts found “their way into academic literature and policy agendas around the globe” (Purvis et al., 2019, p. 685). Høyer (2000) tried to assign the characteristics of sustainable development to three different levels, for which he used terms from thermodynamics "extra prima”, “prima” and “secunda" (Høyer, 2000, as cited in Holden, E. 2014, p. 25).

Table 3, the “Extra-Prima” features are the key characteristics of sustainable development. The prima features were identified in the Brundtland Report and are intended to reinforce the extra-prima features; the extra-prima features take precedence over the prima features. Secunda are the characteristics that prevail in the debate on the implementation of sustainable development. Being “part of a sustainable development strategy” (Holden, 2007, p. 26) for a secunda feature, “it must relate to one or more of the extra prima characteristics.” (Holden, 2007, p. 26). Further, “aspirations for a better life should be subordinated to long-term ecological requirements” (Holden, 2007, p. 10).

Level	Characteristics
Extra Prima	Safeguarding long-term ecological sustainability Satisfying basic needs Promoting inter- and intra-generational equity
Prima	Preserving nature´s intrinsic value Promoting causal-oriented protection of the environment Promoting public participation Satisfying aspirations for an improved standard of living (or quality of life)

Level	Characteristics
Secunda (Examples: related to the first extra prima characteristics)	Reducing total energy consumption in the rich countries Reducing emissions of greenhouse gases, especially carbon dioxide Reducing consumption of non-renewable energy and material resources Polluting no more than ecosystems can tolerate Developing technology for efficient exploitation of natural resources

Table 3 “Extra Prima”, “Prima” and “Secunda” characteristics of sustainable development

Source: adapted from (Høyer, 2000 as cited in Holden, E.: 2014, p. 26)

During the last 20 years, there have been numerous models and conceptualizations that offer a variety of interpretations of the concept of sustainability. The original model is a concept of the "three-pillar conception of sustainability" with its three pillars called Social, Economic, and Environmental, a widely used concept (Purvis et al., 2019). Predominantly, it is interpreted to mean that all goals are equally desirable (Giddings et al., 2001, as cited in Purvis et al., 2019). Within the scientific and non-scientific literature, this "tripartite description" (Purvis et al., 2019, p.681) is also presented in terms of three intersecting circles of society, environment, and economy (Purvis et al., 2019).

However, the origin of this concept has not been fully clarified so far: the authors have tried to shed light on the roots of the concept of the three pillars of sustainability. Based on a broad literature review conducted, the authors were unable to identify a theoretical foundation, noting " The absence of such a theoretically solid conception frustrates approaches towards a theoretically rigorous operationalisation of ‘sustainability’” (Purvis et al., 2019 p. 681).

Other visual representations of “sustainability” can be retrieved from Figure 9, as three intersecting circles (left), concentric circles approach (above, right) and pillars (right below) (Purvis et al., 2019):

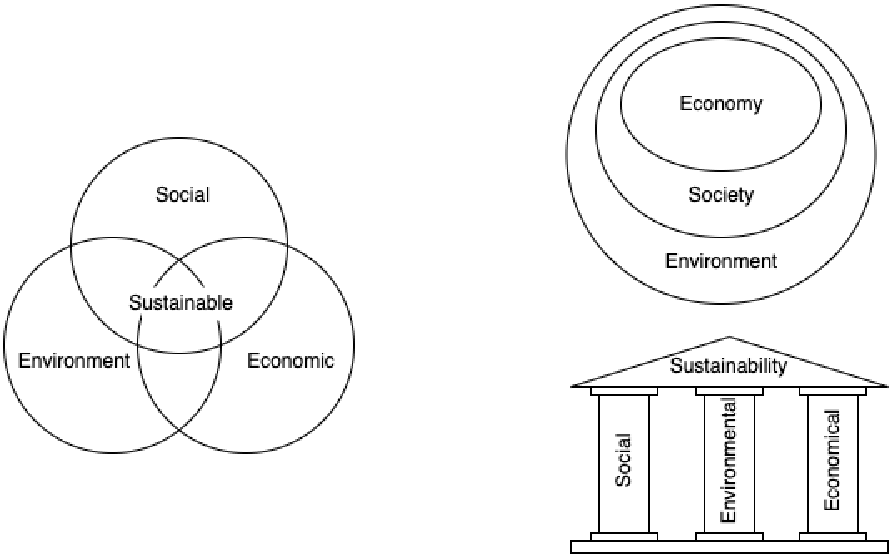

Figure 9 Three models of “sustainability”

Source: adapted from (Purvis et al., 2019, p. 682)

It is still not possible to speak of a sustainable mobility culture in 2021. Pure isolated solutions and isolated projects are not the right way to get to grips with global environmental problems. Therefore, a fundamental rethinking of individual transportation is required, which must be supported by the development of sustainability concepts. This demand does not only concern the automotive industry, but all industries involved in transportation, such as battery manufacturers and energy suppliers. Politicians are also called upon to drive sustainability forward through transport policy instruments and support measures (Bozem et al., 2013). Human-caused climate change, increasing urbanization, and digitalization are changing the requirements for today's mobility, which must be accompanied by investments in sustainable technologies (Ruess et al., 2020).

In the literature, there are several terms to be found, such as “sustainable mobility, sustainable transport, sustainable transportation and sustainable transport systems” (Holden, 2007, p. 7). Of these terms, the term "sustainable mobility" seems to be the preferred term in Europe (Black, as cited in Holden, 2007, p. 7) Perschon (2012) searched for a universally accepted definition of "sustainable mobility" and concluded, that there is no widely accepted definition of this specific term. For him, only an integrated approach, including the transport sector and areas of urban and spatial planning, architecture, and economic policy, supported by appropriate policies, is necessary that sustainable mobility can be developed (Perschon, 2012). To Holden (2007), sustainable mobility finds its expression in “the development of more efficient transport technology, the use of alternative fuels, the promotion of an efficient and affordable public transport system, the encouragement of environmental attitudes and awareness and the use of sustainable land-use planning" (Holden, 2007, p. 61). Sustainable mobility aims to reduce the negative impacts of travel without sacrificing travel on the same scale as before. It has to be ensured that everyone, regardless of age, has access to mobility (Holden, 2007).

Holden (2007) conducted a literature review on sustainable mobility and found, that the focus has changed significantly in this field over the past 15 years. To his view, the normal understanding of sustainable mobility and how it is interpreted can be divided into three generations: the first generation is referred to as the early years, which are indicated from 1992 - 1993. This is followed by the middle years from 1993 – 2000, followed by the late years 2000 – 2005 (Holden, 2007)

Dimension	First generation of sustainable mobility studies (1992-1993)	Second generation of sustainable mobility studies (1993-2000)	Third generation of sustainable mobility studies (2000-2005)
Transport´s impacts	Environmental impacts	+ societal impacts (quality of life)	+ economic, distributional impacts (equity)
EU policy focus	Reduction in transport volume (global consumption)	Transport intensity (local pollution)	+ congestion, quality of life, safety, accessibility, competitiveness
Travel categories	Production travel (work)	+ reproduction travel (non-work travel by car)	+ leisure-time travel (including long-distance travel by car and plane)
Scientific disciplines	Environmental engineering, transport geography, transport economy	+ sociology	+ psychology, social psychology, anthropology, political science, history (interdisciplinary)
Methodological approaches	Environmental impact assessment, quantitative modeling, regression analysis	+ scenario building, scenario analysis	+ case studies, in-depth interviews, qualitative modeling, institutional analysis, historical interpretive analysis
Types of research questions	"Is" transport sustainable?	"When" is transport sustainable?	+ "How" must we change to achieve sustainable mobility? Why do we fail to achieve sustainable mobility?

"+" indicates that the focus of the previous generation is broadened to include the marked item

Table 4 "Three generations of studies on sustainable mobility" (Holden, 2007, p. 59)

Source: adapted from (Holden, 2007, p. 59)

Table 4 shows, how the concept of sustainable mobility has evolved over time. As seen, the focus in the dimensions "transport impacts, EU policy focus, travel categories, scientific disciplines, methodological approaches and type of research questions" (Holden, 2007, p. 59) has changed in the three respective generations between 1992 and 2005. This is explained by the dimension "transport impact" as follows: the first generation (1992-1993) examined the environmental impacts caused by the influence of transport; the second generation (1993-2000) additionally examined the social impacts and the third generation (2000-2005) the economic and distributional impacts. The research questions (dimension “types of research questions) have also changed within the three generations from whether transportation is sustainable at all (first generation), to when it is (second generation) and finally to how sustainable transportation can be achieved and why it has not been achieved to date.

To Koska et al. (2020), sustainable mobility is characterized by barrier-free streets, clean air, short routes to school, public transport, and sharing offers that are well connected. A 30 km/h urban speed limit and wide bike lanes are also part of it, and cyclists and pedestrians need to have priority in road traffic so that they can travel safely and faster. Better interconnection, with guaranteed connections, enable comfortable movement by public transport, car-sharing, and rental bikes, as well as cargo bikes, contribute to sustainable mobility. Sustainable mobility ensures that the conventional private car no longer plays the main role in cities and that there is therefore more space for people to get around. As part of sustainable mobility, cars are electric, fuel-efficient, and emission-free. Many cities in Europe and around the world have been able to demonstrate that sustainable mobility has already been implemented. Stakeholder identification and early participation are strong requirements to a successful implementation of sustainable mobility concepts (Koska et al., 2020).

To support sustainable mobility, political instruments are necessary. These instruments are to be distinguished into three orientations: the first policy orientation aims at ensuring a voluntary change of behavior through information. The second orientation contributes to behavioral change through regulation, the third orientation assumes, that new technology will be developed and cause changes. Information-oriented policy results in people voluntarily giving up their previous individual transport behavior. This form of policy creates a greater awareness of the environment and, as a result, a switch to sustainable mobility. Sustainable behavior is not achieved through regulation. It is more helpful to improve the awareness of environmentally harmful behavior, educate people about the negative effects of transport, and provide them with guidance on how to reduce environmentally damaging behavior. The goal of this type of policy is to lead people towards a positive attitude to sustainable mobility. Regulatory policies use rules to change behavior. This form of politics assumes that people do not change their behavior voluntarily and that a behavior change can only be enforced through rules. Examples of such a policy include limiting the maximum speed on the one hand and offering an improved infrastructure at the same time. Technology-oriented policy needs a lot of financial support as the development of new technologies, which are important for sustainable mobility, is costly. Outdated technologies have a negative impact on the environment (Holden, 2007).

Approaches	Policy Orientations		
	Information	Regulation	Technology
Efficiency	Adapt to the use of more energy-efficient transport technology (e.g., buying smaller and less powerful cars	Regulate the use of more energy-efficient transport technology (e.g., national emissions standards for vehicles, inspection and maintenance programs, and the retirement of grossly polluting vehicles)	Develop more energy-efficient transport technology (e.g., public funding of R&D and large-scale demonstration programs)
Alteration	Adapt to the use of more energy-efficient modes of transport (e.g., increase the use of public transport and non-motorized travel	Regulate the use of more energy-efficient modes of transport (e.g., lowering fares for public transport and increasing frequency and punctuality	Develop new technology for more energy-efficient modes of transport
Reduction	Reduce travel demand through increasing positive environmental attitudes (e.g., information packages and awareness campaigns). Approaches (i)	Reduce travel demand through land-use planning (e.g., dense and concentrated housing development, and mixed land use).	Reduce travel demand through the development of information and communication technology (e.g., attractive forms of mobile conferences and telecommuting

Table 5 A typology for sustainable mobility

Source: adapted from (Holden, 2007, p. 72)

Holden (2007) developed a “typology for sustainable mobility” showing different combinations of approaches and policies to be seen in Table 5. To the author's literature review, four elements play an important role in achieving sustainable mobility: new technologies, public transportation, environmentally conscious behavior (“green attitudes”), and land use planning. It has to be noted, that all elements influence each other.
Figure 10 shows the four elements, (the role of technology, public transport, land use planning and green attitudes) in their relationship to sustainable behavior in everyday life. Solid arrows represent the main relationship: each element changes travel behavior. Dashed arrows indicate that changes in travel behavior influence the elements, for example, increased environmental awareness leads to a shift to public transportation. This then constitutes a reciprocal relationship. The path “technology” is divided into “new conventional (1a) and “alternative (1b)” technology.

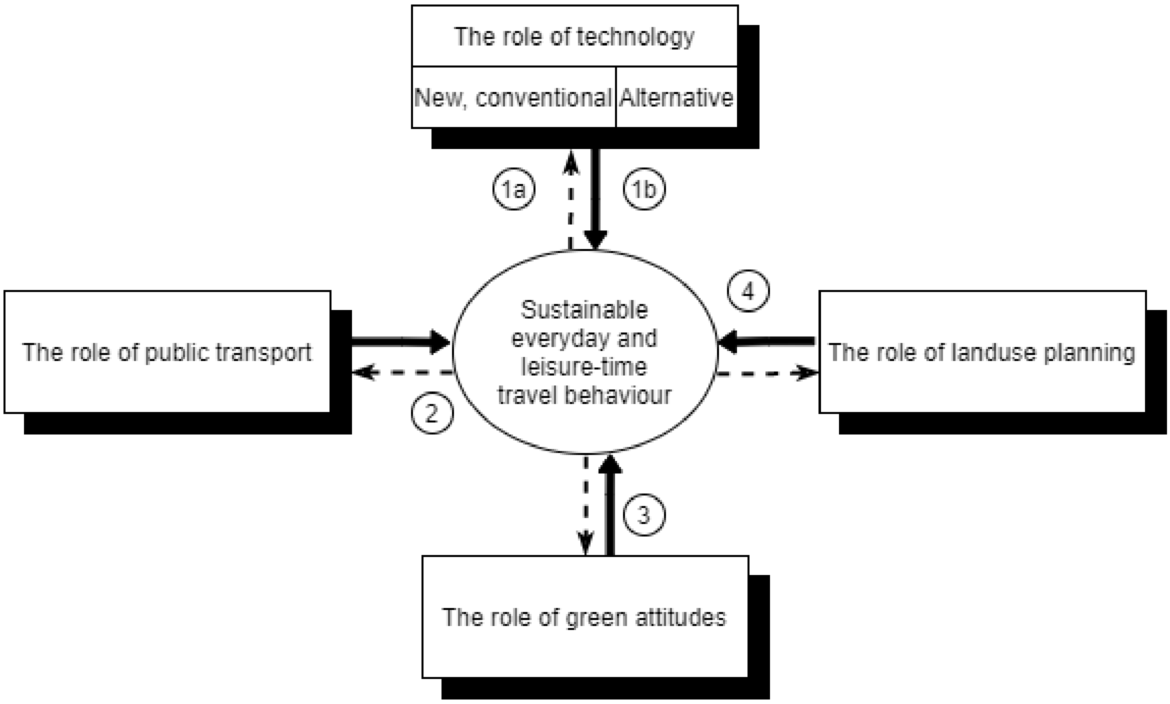

Figure 10: How to achieve sustainable mobility

Source: adapted from (Holden, 2007, p. 215)

As explained for 1a, cars should be less powerful, smaller, lighter, speed limits will also reduce energy consumption as higher speed needs more energy. For 1b, alternative technologies concern other energy sources, other fuels, and alternative powertrains for vehicles. However, the production of alternative ones again requires a lot of energy. Therefore, alternative energy chains must be developed which will reduce the total energy consumption. Self-produced natural gas or biomass increases national energy security and supports the agricultural labor market. The role of public transport (2) helps ensure that the basic need for mobility can be satisfied, including for those with low incomes. If energy prices rise, public transport could be more likely to be used. In addition, public transport helps to reduce congestion and improve air quality. Green attitudes (3) do not lead to changes in behavior, since habitual travel behavior is hardly changed. However, the views of environmentally conscious people play an indirect role by accepting or demanding more changes in the sense of sustainability in all four elements. Last but not least, appropriate city planning (land use planning 4), with improved public transport services, could make it easier or possible for all mobility groups to do without cars or planes (Holden, 2007).

At the level of the European Union, various concepts and strategies are discussed on how to improve sustainable mobility. Thus, the Commission of the European Communities presented in 1992 the “Green Paper on the Impact of Transport on the Environment - a Community strategy for sustainable mobility” (EC, 1992) highlighting the need “to focus on the causes of environmental problems in a different manner” (EC 1992, p. 1). The paper states, that transport consumes a lot of energy and material resources, vehicles require large amounts of material, contribute to air pollution, impact land fragmentation, affect biodiversity, and cause accidents (EC, 1992; Holden et al., 2020). In 2001, the European Commission presented its “White Paper – the European transport policy for 2010: time to decide” and 2011 the “White Paper on transport: Roadmap to a Single European Transport Area - towards a competitive and resource-efficient transport system” (EC, 2011). The White Paper 2011 is a roadmap for a Single European Transport Area aiming at an environmentally friendly and competitive transport system. In this roadmap, the EC has launched 40 initiatives for the next decade to increase mobility, removing barriers, and promoting growth and employment. Another goal is to reduce dependence on Europe's oil imports and cut carbon emissions from transport by 60% by 2050. The main targets by 2050 are to eliminate fueled cars in cities, 40% sustainable, low-carbon fuels in aviation, at least 40% fewer emissions in shipping, and shifting medium-distance passenger and freight traffic from road to rail and shipping by up to 50%. These measures would contribute to a 60% reduction in transport emissions by mid-century (EC, 2011).

As stated in the European Commission's strategy paper of 24.1.2013, Europe is highly dependent on oil for mobility and transport. In order to meet the long-term needs of all modes of transport, alternatives to fossil energy must be used and measures taken to accelerate the development of these fuels (EC, 2013; Sierpiński et al., 2016). However, “minimization of the negative environmental impact of transport cannot be pursued through mobility limiting, but only through efficient utilization of natural resources” (Sierpiński et al., 2016, p. 1745).

In 2020, the European Commission published its “Sustainable and Smart Mobility Strategy – putting European transport on track for the future“ (EC, 2020c) , with a plan of action on how to achieve the EU transport system's green and digital transformation and make it more resilient to future crises (EC, 2020c). To facilitate sustainable mobility, improving transport accessibility remains strategically important for the EU. The realization of the Single European Transport Area, as envisaged in the 2011 White Paper, is a central component of European transport policy (EC, 2020c).

The Trans-European Transport Network (TEN-T) policy is concerned with the implementation and development of an “EU-wide and multimodal network of rail, inland waterways, short sea shipping routes and roads which are linked to urban nodes, maritime and inland ports, airports and terminals across the EU” (EC, 2021d) to optimize infrastructure and reduce environmental pollution from transport. The goal is to connect the most important areas by 2030 and to cover all European regions by 2050 By combining different modes of transport for a single trip, emissions could be reduced by 90% by 2050, which is possible with the help of digital technologies. The goal is to have at least 30 million zero-emission cars and 8,000 zero-emission trucks on the road by 2030, and 100 European cities to be carbon neutral by then. Almost all vehicles such as cars, vans, and buses should be emission-free by then. To this end, the charging infrastructure and cycle paths should be expanded. (EC, 2020c). In addition, the European Commission has announced its intention to make drones a transport vehicle for sustainable mobility in the future. The intention is for drones to contribute to a range of sustainable transport services. Intelligent concepts could help support multimodality (EC, 2021a).

The importance of the involvement of stakeholders at the beginning of a “Sustainable Urban Mobility Planning” (SUMP) process has been promoted as well by the EC. Thus, “a sustainable Urban Mobility Plan (SUMP) considers the whole functional urban area, and foresees cooperation across different policy areas, across varying levels of government, and with residents and other principal stakeholders. It ensures a variety of sustainable transport options for the safe, healthy, and fluid passage of people and goods, with all due considerations for fellow residents and the urban environment" (EC, 2020b). SUMPs can improve the quality of life for residents such as "addressing challenges as congestion, air/noise pollution, climate change, road accidents, unsightly on-street parking, and the integration of new mobility services" (EC, 2020b) . Furthermore, the EU action plan includes the development of environmentally friendly fuels for transport, the integration of cycling into multimodal transport concepts, and the provision of a corresponding infrastructure. A modal shift to cycling reduces congestion, is space-efficient, and can also act as a last-mile solution to complement and improve the use of public transport (EC, 2020b).

Stakeholder participation has indirect effects on the performance of sustainable mobility (Yuen et al., 2020). However, different stakeholders also have different demands: for example, local authorities are more interested in reducing congestion and noise, while transport operators and retailers are more interested in controlling costs (Rześny-Cieplińska et al., 2021). The power of stakeholders has been studied by Hasselqvist and Hesselgren (2019). As a result of the study, the authors suggest practice-oriented design concepts focused on "new mobility practices, cycling infrastructure, child-friendly public transport, and transporting stuff" (Hasselqvist & Hesselgren, 2019, p. 1).

There are many reasons why sustainable mobility is necessary. However, when it comes to concrete projects, there is resistance from car owners who are afraid that parking space will become scarce; retailers are also concerned that earnings will decline and it is difficult for people to give up previous habits such as driving to the bakery (Koska et al., 2020).

In summary, economic development, social security, environmental protection, history, and culture as well as transport play a central role in sustainable transport planning. Sustainable transport means that future generations are not harmed by it, in environmental (conservation and development of alternative energy), social (equity and safety) and economic terms (balance between cost and efficiency, taking into account economic competitiveness) (Wey & Huang, 2018). Unnecessary traffic can be avoided through a multifunctional, compact city of short distances, integrated urban and rural transport systems, and an optimized settlement policy for the industry. In developing an urban strategy, people must be put at the center and urban spaces must once again be turned into meeting places for social exchange (Perschon, 2012).

Technological change and increasing digitalization can make mobility sustainable. New innovative concepts have already been developed and tested several times. The advancing developments in e-mobility and the associated improvement in air quality cannot be overlooked. The following chapters show, how sustainability can be increased in the future by using innovative technologies and concepts.

1.3. Sustainable Mobility of Today and the Future

One of the most significant achievements of the European Union is the freedom to study, live and work in other EU countries, but this freedom is not practical if there is no connectivity available. Much has already been done in the European Union to connect transport routes in Europe so that people and transport goods can travel more easily within and between countries. However, transport is a significant contributor to climate change (EC, 2019b). It is not only climate change that is driving changes in transport planning, but also changing societal values and norms, new technologies, digitalization, and ongoing urbanization. In addition, new technologies are driving a rethinking of previous mobility concepts (Ruess et al., 2020). However, innovations need acceptance and adoption, but acceptance does not automatically lead to adoption (B. Jordan et al., 2015). Privately owned cars are still the preferred mobility system, however, the population is generally open to alternative mobility (Kilian-Yasin et al., 2016).

Alternative non-motorized transportation modes and modes grouped into routes or networks (Ison & Ryley, 2007), as well as electric-powered vehicles, can help support sustainability. Therefore, the following mobility options are presented:

- Walking,
- Cycling (e-bikes and pedelecs),
- Sharing concepts (car-sharing and bike-sharing),
- Mobility as a Service (MaaS), e.g., on-demand taxis,
- Electrified vehicles (scooters and cars),
- Autonomous driving.

In our society, mobility plays an important role and represents a significant challenge, considering dwindling resources and the preservation and protection of the environment. Switching from fossil-fuel-based transportation to cycling or walking can be an excellent way to achieve this goal (Wachotsch et al., 2014). Especially in the field of cycling, e-bikes and pedelecs have become established in recent years. However, there is often a lack of differentiation between pedelecs and e-bikes. Pedelecs are electric bicycles; powered by muscle power and assisted up to a speed of 25 km/h by an electric motor with a maximum capacity of 250 watts. The handling of pedelecs hardly differs from that of conventional bicycles. E-bikes are bicycles with an auxiliary electric motor, which can also drive without pedaling. E-bikes can partially replace the passenger car as they offer more possible uses than a conventional bicycle. While riding an e-bike, hardly any emissions are generated, and comparatively very little energy is consumed. Almost noiseless, space-saving, health-promoting and inexpensive locomotion is thus possible. E-bikes bring a high degree of flexibility and expand the potential to replace car trips with e-bikes. Especially for distances between 5 and 20 km, they extend the radius of use compared to the bicycle (Wachotsch et al., 2014).

Sharing concepts, such as car-sharing or bike-sharing, can be one of many mobility solutions to tackle the problem of traffic congestion and make cities more livable again. This can only succeed if the number of cars on the roads is reduced and alternative means of transport such as public transport and bicycles offer users an attractive and reliable alternative. General advantages of sharing concepts cannot be foreseen: less demand of parking space (Lienkamp, 2012; Otto-Zimmermann, 2017), reduction of CO_2 emission, fuel consumption, traffic volume, and congestion (Baptista et al., 2014). A shared car can replace five to ten private cars (Lienkamp, 2012). “Sharing services can be an integral part of an intermodal mobility concept” (Severengiz et al., 2020, p. 81) having a “positive impact on the environment by linking services to public transport car or sharing in terms of location, payment, and tariffs” (Severengiz et al., 2020, p. 81), (BMVI, 2014; Severengiz et al., 2020).

A concept that improves sustainable mobility behavior and, at the same time, the efficiency of the transport network is Mobility as a Service (MaaS) (EPOMM, 2017). According to the definition of the MaaS Alliance (the European Mobility as A Service Alliance), Mobility as a Service (MaaS) is about putting people or goods at the center and offering mobility concepts tailored to individual needs (EPOMM, 2017). It combines different transport modes such as sharing modes, taxis, bicycles, as well as public transportation “to seamless trips over one interface (Utriainen & Pöllänen, 2018, p. 15). It attempts to overcome market segmentation by offering transport services tailored to individual mobility needs, and travelers can make an unbiased choice of modes for each trip (Becker et al., 2020). Within MaaS, it is possible to pay for the whole journey using different transport modes with one ticket and one single payment (Ho et al., 2018). A destination can be reached with comfort depending on the travel time and price. Integrated mobility systems gather information from different sources concerning timetables, real-time traffic data, car-sharing availabilities. However, if a customer needs to carry goods, transport of passengers and goods must be connected to the same transport mode (Giesecke et al., 2016; Utriainen & Pöllänen, 2018). A vital element of the MaaS model is Car-sharing, which is only possible in cities with a high density. Car-sharing and shared taxis result in less traffic and less congestion on the roads and, therefore, less pollution, as car-sharing companies usually offer smaller and newer cars (Giesecke et al., 2016). On-demand taxis can change the habit of people riding daily; to attract customers, service quality such as reliability, assurance, empathy, and responsiveness are significant measures (Banerjee et al., 2020)

The acceptance of MaaS has already been studied numerous times. MaaS studies have shown that as a result of MaaS, car-sharing and public transport is increasing, and the use of private cars is decreasing (Karlsson et al., 2016; Strömberg et al., 2016). Car ownership is no longer necessary, as MaaS is an efficient and flexible transportation system that eliminates the need to have a private car (Strömberg et al., 2016). MaaS increases the popularity of environmentally friendly means of transport and thus increases their use (Giesecke et al., 2016; Karlsson et al., 2016; Utriainen & Pöllänen, 2018). However, a switch to MaaS requires a period of at least six months (Strömberg et al., 2016). It can be assumed that the lifestyle will change due to the renunciation of the own car and the advantage of MaaS (Huwer, 2004; Utriainen & Pöllänen, 2018). People with multimodal weekly mobility patterns are more likely to adopt MaaS than unimodal car users. However, the ownership of a car and lack of interest in new technologies are the main barriers to the adoption of MaaS (Alonso-González et al., 2020). People are willing to buy a MaaS package if it covers all mobility needs. However, MaaS must be cost-competitive due to the low willingness to pay compared to current mobility costs. Pay-as-you-go could be a solution, one ticket for several mobility services in a package such as public transport, taxi services, and car-sharing (Liljamo et al., 2020). In Sydney (Australia), commuters “are willing to pay 6.40 for an hour of access to car-share services, with one-way car-share valued more than station-based car-share" (Ho et al., 2018, p. 302) . The estimated willingness to pay for public transportation is 5.90 per day, which is very low compared to the actual daily rate (Ho et al., 2018), the MaaS backbone is public transportation (Esztergár-Kiss & Kerényi, 2020). It can reduce transport-related energy consumption by 25 % when choice decisions are based on the total cost of private car travel. If shared modes are used instead of public transport in lower-density areas, the efficiency gains could be higher (Becker et al., 2020).

It doesn't always require a car to reach a destination. For short distances or as a last-mile solution, simple, small, and environmentally friendly means of transport are often sufficient. For example, e-scooters (electric two-wheel vehicles with a maximum speed of not more than 45 km/h, maximum power of no more than 4 kWh, can carry up to two persons) are a starting point to reduce emissions, contributing to cleaner air. The advantage of an e-scooter can be found in the smaller size, lower weight, and the consumption of much less energy than passenger cars. If scooters are shared, they have an additional positive environmental impact (Baptista et al., 2014; Lienkamp, 2012; Severengiz et al., 2020). Most daily trips can be performed with e-scooters. In a city like Munich, Germany, the charging infrastructure is sufficient. However, safety, weather conditions, and baggage capacities restrict attributes (Hardt & Bogenberger, 2019). E-scooters have grown in popularity, are in use worldwide, and began to attract public attention in 2017 (Baptista et al., 2014; Lienkamp, 2012; Severengiz et al., 2020). They can be used for travelling by using a mobile app, and left locked wherever possible within a permitted area. Since private ownership of E-scooter became popular, they became a higher presence in public resulting in the occupation of public space leading to conflicts between different transport mode users (Tuncer et al., 2020).

The key to climate-friendly mobility is not only public transport, Mobility as a Service (MaaS), or e-scooter, also electrified cars are possible. Electric vehicles (EVs) can be distinguished into battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs). BEVs are powered exclusively by batteries. They use an electric motor to drive the wheels and produce no emissions. PHEVs can drive between 20 and 30 miles with zero emissions and are powered by fossil fuel for longer trips. To maximize their zero-emissions capabilities, PHEVs must be plugged into a power supply (Sikora et al., 2020). Electric vehicles emit significantly less CO_2 when powered by renewable electricity. This shows that it is not only the automotive industry facing a major upheaval that can only be overcome through innovation. In Germany, there are currently 60 electric vehicle models from German manufacturers existing that can be charged with electricity at around 24,000 publicly accessible charging stations (CORDIS/EC, 2021). Since the batteries that power electric vehicles require large amounts of resources, these batteries must be manufactured sustainably. Sustainable sourcing of raw materials, a high proportion of renewable energies, and high energy efficiency in battery production are essential. Battery cells manufactured in Europe should differ from competitors on the market in terms of sustainability, environmental compatibility, and a better climate footprint. Disposal and recycling must also be included in the battery development and production process. A "green battery" can become a competitive advantage as production and logistics play a significant role. One of the goals is to reduce dependence on imported raw materials. Batteries from Europe are climate-friendly because renewable energies are already predominantly used in production (BMWI, 2019).

According to the “Community Research and Development Information Service” (CORDIS), intensified efforts have been taken in recent years that hydrogen-powered vehicles (fuel cell vehicles, FCV) are taking root. However, the mass introduction of electric vehicles with fuel cells will still take years (CORDIS/EC, 2021). Hydrogen-powered vehicles have the advantage that they are entirely emission-free and therefore keep the air clean since the exhausted air of a hydrogen-powered vehicle consists only of water vapor. Whether or not these vehicles are climate-friendly depends on the conditions under which the hydrogen is produced, as this requires electrical energy. The disadvantage of producing hydrogen is the losses during electrolysis, so the overall efficiency in the "electricity to vehicle drive" energy chain is only half that of a battery-powered vehicle. However, if there is a surplus of electricity from renewable energy sources, hydrogen can be produced from this electricity (BMW, 2019). However, the costs of purchasing a hydrogen vehicle for an individual user are very high, the infrastructure is insufficient. The solution for the implementation of hydrogen vehicles for transport may be hydrogen-taxi, hydrogen car-sharing systems, or hydrogen buses as it might be simpler for them to set up refueling stations. An example is the Hype beak Operator in Paris having a fleet of hydrogen-powered taxis, with today over 100 vehicles having a range of over 500 km and a charging time up to 5 minutes (Cacilo et al., 2015; Turoń, 2020). In Europe, around 150 fuel cell buses were put into service between 2012 and 2020, and there are plans to purchase more than 1,200 buses of this type. In addition, Barcelona has set itself the goal of replacing all pure diesel buses, except for mini-busses, with fuel cell buses by 2024 (BMVI, 2021).

Tomorrow's individual mobility requires economically and ecologically sustainable solutions. To this end, autonomous vehicles offer advantages and opportunities, as they strengthen local transport as a means of transportation for the last mile. The networking and communication of autonomous vehicles with the urban infrastructure can ensure efficiency and safety (Köllner, 2021). Autonomous driving is defined as automatic, goal-directed driving of a vehicle in real traffic with on-board sensors, add-on software, and map material stored in the vehicle for the detection of the vehicle environment (Bauberger, 2020; Geiler, 2015). There have been efforts and financial support from companies and the public sector to promote autonomous driving for some time now. As automation increases, questions of social acceptance, political design, and support also play an increasingly important role. The legal, national, and international framework must be adapted to developments (Schreurs & Steuwer, 2016).

Consequently, the 1968 Vienna Convention on Road Traffic should be adapted accordingly. In addition, (partially) autonomous driving also raises ethical questions, such as how a vehicle should behave in dilemmatic situations (BMVI, 2017). Finally, it can be assumed, that autonomous driving will significantly change mobility and transportation costs (Bauberger, 2020). The Society of Automotive Engineers (SAE) distinguishes between different levels of driving automation, as seen in Figure 11. As illustrated, at levels 0-3, the car driver still drives himself but must permanently monitor the support features. At levels 3-5, the car itself takes over the driving (Shuttleworth, 2019).

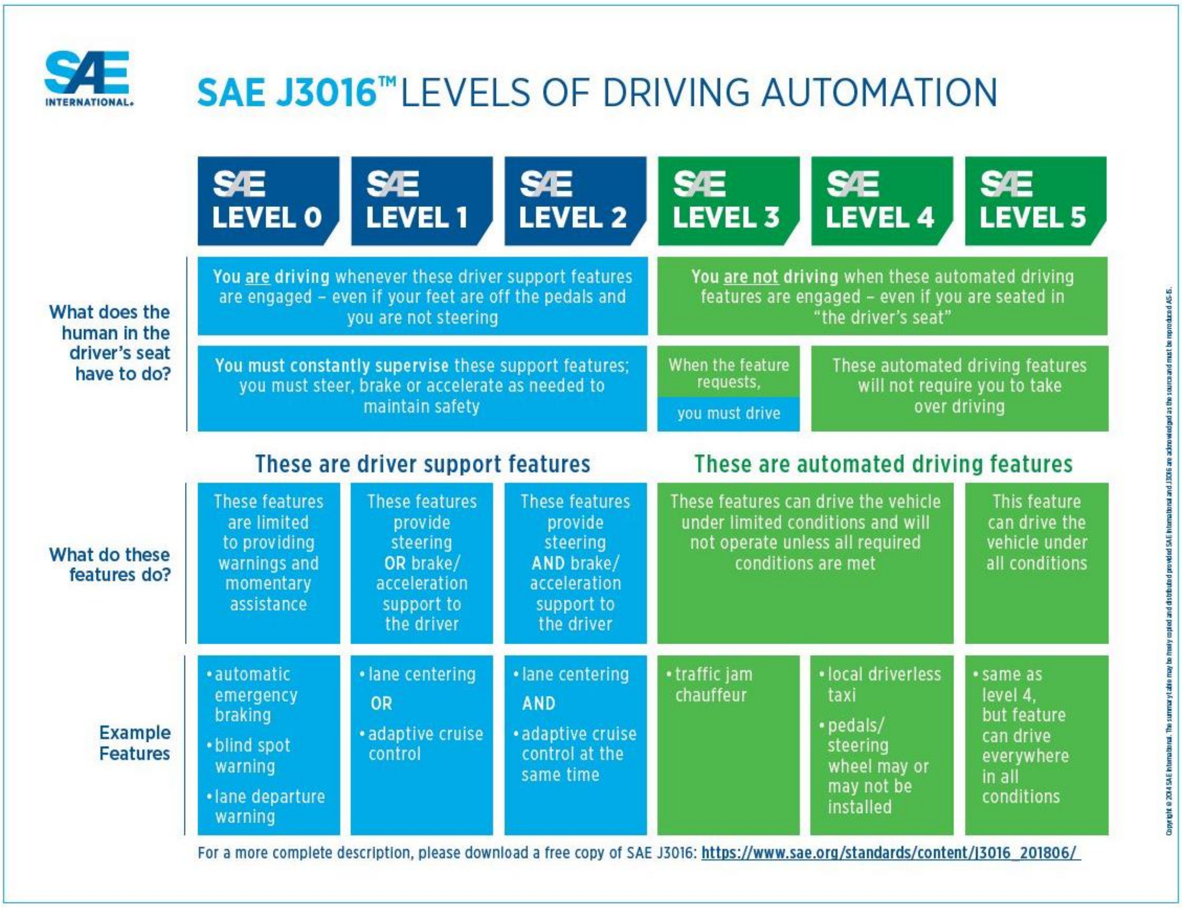

Figure 11: SAE automated-driving graphic

Source: (Shuttleworth, 2019)

It is forecasted that until 2040, many autonomous driving vehicles with a steering wheel will be private and are expected to reach 12,4 million units. Furthermore, autonomous taxis without a steering wheel will reach a maximum of 2.8 million units: this maximum depends on trust in technology and willingness to give up own car; vehicles miles travel will increase with the introduction of AT and has significant effects on congestion (Kaltenhäuser et al., 2020). Advantages of autonomous (shared) cabs (ATs) are less parking, since shared cabs drive most of the time, and increased traffic safety. They also cause less congestion, as autonomous cabs are known for their intelligent routing. Furthermore, they help to ensure the mobility of elderly people (Kaltenhäuser et al., 2020).

However, the research on the acceptance of autonomous driving is still very young. "Acceptance usually is conceptualized as the intention to use a new system" (Bernhard et al., 2020, p. 110). Many publications about the acceptance of autonomous driving and acceptance exist (Adnan et al., 2018; Bernhard et al., 2020; Herrenkind, Brendel, et al., 2019; Sciaccaluga & Delponte, 2020). The potential of autonomous driving is enormous, especially in terms of on-demand mobility and ride-sharing (Chan, 2017) and time savings for commuting trips (Kolarova et al., 2019). Autonomous driving could meet rising demands such as ride-sharing, leading to lower CO_2 emissions (Bernhard et al., 2020; Chan, 2017).

Various attempts have been made to convert public transport modes such as streetcars to autonomous operation in recent years. As early as 1984, the first automated streetcar was put into operation in Dortmund/Germany, followed by a people-mover system at Frankfurt Airport in Germany in 1994; Siemens presented an autonomous streetcar vehicle at InnoTrans 2018. However, all the known projects are not designed for passenger operation but rather for driverless autonomous shunting. The focus of the projects is to develop safe environment detection. To guarantee autonomous streetcar operation, it is necessary to clarify how passengers can safely change means of transport, how to deal with operational disruptions and how the technology should behave in the event of accidents. Costs also play an important role: the investment in automation and the labor costs of a vehicle driver must be weighed up. Finally, it must be clarified how to deal with obstacles that enter the light space from the side and how events can be evaluated in advance. However, it must be fundamentally questioned whether autonomously driving streetcars makes sense (Schmitz et al., 2019).

Autonomous driving has an impact on the costs of traffic and IT infrastructure. Higher acquisition costs are to be expected; however, if these cars are produced in large series, savings potential can be anticipated as well. It is likely that additional costs will arise for the vehicle equipment (software and hardware). The usage itself of automated or autonomous vehicles is associated with cost savings resulting primarily from efficiency increases due to an optimized and improved traffic flow. The deployment and use of automated vehicles require investments on the vehicle side and in infrastructure (including IT infrastructure). This results in costs for vehicle owners and infrastructure operators. This is offset by positive effects (benefits from cost savings) such as saving time and fuel in terms of hours spent in traffic jams and traffic flow and car ownership (Bauberger, 2020; *Hochautomatisiertes Fahren auf Autobahnen – Industriepolitische Schlussfolgerungen: Management Summary, Studie im Auftrag des Bundesministeriums für Wirtschaft und Energie*, 2015). Acceptance studies have shown that the main motivation for using such vehicles would be time savings and additional comfort. Autonomous driving can also lead to cost savings as the costs for maintenance and repair are lower but can rise again due to increased use. Also, it reduces fuel consumption and thus CO_2 emissions. It could also be proven that accidents can be avoided through highly automated driving, leading to savings in accident costs. It is assumed that 90% of accidents are due to human error (Bauberger, 2020; *Hochautomatisiertes Fahren auf Autobahnen – Industriepolitische Schlussfolgerungen: Management Summary, Studie im Auftrag des Bundesministeriums für Wirtschaft und Energie*, 2015). Grucza (2018) offers a critique of the assumption, "that autonomous vehicles must overcome hundreds of millions of kilometers so that they can be considered safe enough to allow them to move on public roads" (Grucza, 2018).

Self-driving public buses (SDPB) have the potential to make travel behavior more sustainable, but it needs widespread acceptance for market success. User acceptance is an essential factor for the economic growth of these services. Factors influencing SDPB acceptance are the price, ecological attitude, and the place of residents (Herrenkind, Nastjuk, et al., 2019). People's willingness to take automated buses for work, shopping and leisure, and family journeys has been investigated, showing that "frequency, perception of travel time, safety, and the informative are found significantly influencing people take the bus ride to commute" (Guo et al., 2016, p. 1). The Association of German Transport Companies (VDV) lists autonomous shuttle bus projects in Germany that are being implemented in cities such as Aachen, Berlin, Darmstadt, Düsseldorf, Frankfurt, and Hamburg, just to mention a few. The VDV is committed to mobility without owning a car, to the increase of autonomous driving and ride-pooling. Today, pooling offers, car-sharing, bike-sharing are already being set up and operated in Germany under the direction of local public transport (VDV, 2021). Some of these projects will be described as follows:

- **City Mobil and City Mobil 2.** The projects CityMobil and CityMobil 2 (Alessandrini et al., 2014) and other projects mostly involving small busses have been implemented, such as the CAST project (Christie et al., 2016) and a project ("User Acceptance of an Automated Shuttles in Berlin-Schöneberg") (Nordhoff et al., 2018). The results indicate that the most of the users prefer the minibuses and intend to us them. (Alessandrini et al., 2014; Krueger et al., 2016; Nordhoff et al., 2018). Eden et al. (2017) came to similar results (Eden et al., 2017). Disadvantages of autonomous minibuses reported are the slow velocity and data security (Bazilinskyy et al., 2015; Bernhard et al., 2020).

- **Robotaxis and Roboshuttles**. A study “Urbane Mobilität und autonomes Fahren im Jahr 2035” conducted by Deloitte (2019) shows that in 2035, every third trip could be made with autonomous vehicles. The autonomous shuttle ride would be 50% cheaper than public transport. A sales volume of 16.7 billion euros can be achieved for autonomous driving services, and an increase in traffic of 30% can also be expected. These model calculations assume that by 2035 new cars will be able to drive fully autonomously without the need for human intervention. Self-driving technology allows new mobility concepts, including autonomous cabs and shuttles, used in urban centers, and operated electrically. The scenario involves a free market in which providers can operate and develop without government restrictions. Private cars, as well as autonomous driving services, use the same road network. However, it must be assumed that increased traffic flow cannot be realized by 2035. The reason for this is the continued use of manually controlled passenger cars. In the future, fleet operators will offer 2 models: autonomous cab (individual ride for a single person) and autonomous RoboShuttle (shared ride with a maximum of 4 passengers). This would have a high advantage of convenience for the passengers, as there is door-to-door transportation, and it would also eliminate the need for a driver's license. The result of this broad study (conducted in 109 major cities in Germany showed that 32% of road users are willing to switch to an autonomous fleet vehicle if they must wait for a maximum of 10 minutes for its arrival. The autonomous taxi has greater acceptance than the RoboShuttle despite higher prices; conclusion: the kilometer with an autonomous taxi will be 25% cheaper than the trip with the own car, and fewer parking spaces will be needed. This freed-up capacity can be used for bicycle and pedestrian paths. The market potential is almost one-sixth of car sales in Germany (Deloitte, 2019).

- **2049: Zeitreise Mobilität (Time Travel Mobility).** The older and younger generations have their ideas about how to shape the mobility of the future. With innovative technologies such as virtual reality, people can develop visions of the day after tomorrow. On this basis, the project "2049: Zeitreise Mobilität" (Engl. Time Travel Mobility), was carried out in several cities in Germany and the USA. In this study, qualitative and quantitative survey methods were combined, including virtual reality scenarios as a stimulus being tested as part of the quantitative survey. The most important results were that mobility in 2049 should be emission-free in the first place (56.4%), followed by safety (44.8%), flexibility (42.1%), speed (27.5%), cost-free (24.3%), and user-friendliness (23.3%). This is followed by shared mobility (18%), individual (17.5%), convenient (14.9%) and functional (9.0%). The latter is stated as relaxing with 8.8%. Significant differences between the generations could be shown for example, generations Y and Z prefer fast and emission-free mobility; the other generations favor a comfortable and safe solution to get to their destination. It is clear from the results that climate-neutral mobility, followed by safety and flexibility, are the most important aspects of future mobility. The study results confirm that the demand for flexible offers will increase in the future (Ruess et al., 2020).

The preceding remarks show that shared mobility, combination of different means of transport, use of small flexible electric vehicles, and H2 technology will help get a grip on today's, and future traffic problems. Autonomous driving is assigned great importance in this context. Future projects involving the methods of virtual reality scenarios will help to gain knowledge about how sustainable traffic can be designed in the future.

CHAPTER 2
RATIONALITY AND IRRATIONALITY

“Although behavioural economics may well be seen as a new branch of the social science its roots go very deep in economic theory and history… behavioral economics is the modern form of much older traditions and the most recent manifestation of long-standing dissatisfaction with mainstream economic viewpoints” (Corr & Plagnol, 2019, Preface).

The following subchapter looks at the history of economics and the main aspects of rational choice theories, followed by the introduction of different utility theories. The criticism of utility theories is displayed. In response to the criticism, decision-making is explained on the “Architecture of Cognition” (Kahneman, 2003, p. 1450), followed by the (Cumulative) Prospect Theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992).

2.1. Behavioral Decision Making

The science of economics began with Adam Smith's (1776) "Working of the Invisible Hand", the interaction of many individual economic agents in a decentralized economy. However, the starting point of economic analysis is the assumption of the neoclassical theory of Homo Oeconomicus, who makes rational and logical decisions, is self-interested, and weighs costs and benefits in order to maximize utility (Corr & Plagnol, 2019).

The basic of rational choice theories is the "pursuit of self-interest". This aspect of self-interest was aptly formulated by Edgeworth (1888) who indicated that the “first principle of Economics is that every agent is actuated only by self-interest” (Edgeworth 1888, p. 16, as cited in Vriend, 1996, p. 265). According to later definitions, “an agent is characterized by the constraints in his choice and by his choice criterion” (Debreu, 1959, p. 37, as cited in Vriend, 1996 p. 265). Possibilities and preferences play a fundamental role, actors choose (one of) the most advantageous options given their preferences in their perceived opportunity set, where opportunities are perceived costs, benefits, considering information, decision, and transaction costs (Day, 1969 as cited in Vriend, 1996). For Diekmann (2014), rationality is understood as consistent decision-making (Diekmann, 2014). Rational choice theories model decisions between alternative choices based on defined preferences. The central point of rational choice theories is the assumption of preferences and a certain decision rule, whereby preferences must fulfill the requirements of completeness and transitivity. Theoretical variants of rational choice theory are utility theories and game theories. Utility theories distinguish between decisions under certainty and uncertainty. The latter is further subdivided into decisions under risk and uncertainty. In game theories, a distinction is made between cooperative and non-cooperative game theories (Braun & Gautschi, 2012).

In comparison to rational choice theory, the habitus concept (Sparrow & Hutchinson, as cited in Broda et al., 2018, p. 34) state that decisions are part of a social process, express lifestyles, and are shaped by past and present circumstances. In habitus theory, decisions are determined by personal, social, societal, and cultural contexts, they are intuitive and are influenced by personal and social factors (Broda et al., 2018).

Decision theories can be distinguished into normative theories and descriptive theories. Normative theories are intended to support rational decision-making, namely how one should behave. Descriptive theories are concerned with how decisions are made. Utility theories are considered normative theories. Utility is represented by a function to express a preference relationship. Behavioral decision theories include diverse theoretical descriptions, theories with a mathematical background, and theories expressed only through language decision making may take various forms and is “based on the characteristics of the knowledge of the decision-making environment i.e., how much the decision-makers knows about their surrounding environment” (Takemura, 2014, p. 6). The environment of decision making is divided into decision under certainty, decision under risk, and decision under uncertainty, the latter subclassified in decision under ambiguity and decision under ignorance (Takemura, 2014).

Decisions under certainty postulate that complete information about the respective environmental situation is available. Choices led to a certain outcome with certainty. The decision is based on utility maximization, i.e. the alternative that maximizes utility is chosen. (Braun & Gautschi, 2012). However, perfect certainty is out of reach because uncertainty affects all aspects of life and nothing can be predicted with certainty, not even the behavior of other people. For example, gambling is known to involve uncertainty. Thus, games of chance have been used as a basis in developing theories of decision-making under uncertainty because of their simplicity (Quiggin, 1993).

As seen from Figure 12, cases for decision making are roughly divided into three groups based on how much an individual knows about the environment (Takemura, 2014). The author illustrates the environment of decision making as follows (Takemura, 2014):

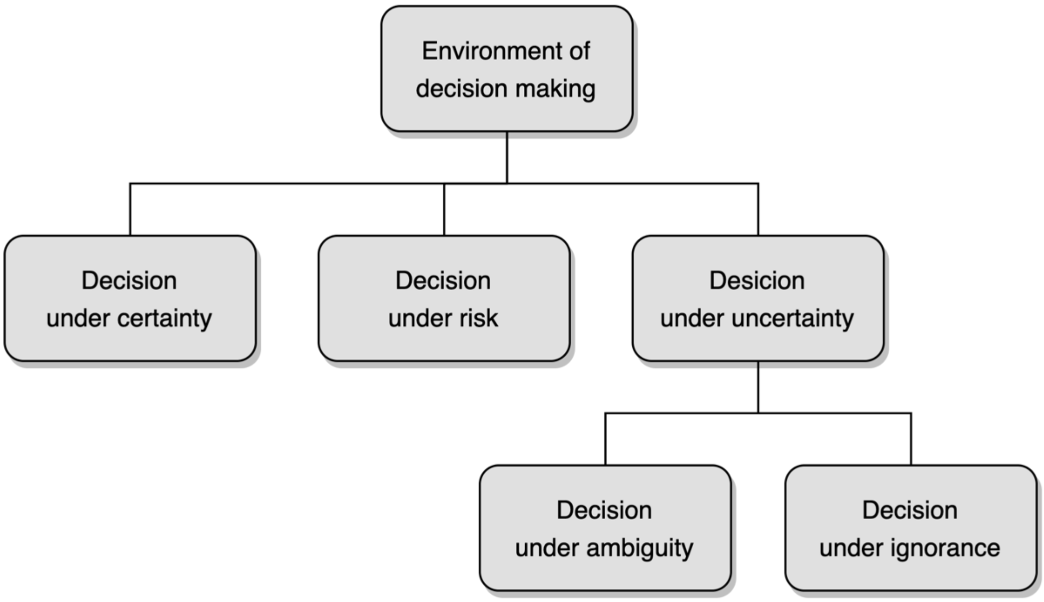

Figure 12 “Taxonomy of uncertainties as decision environment”

Source: adapted from (Takemura, 2014, p. 7)

Thus, economists are interested in how people make decisions under risk, uncertainty, and ambiguity, taking objective and subjective probabilities into account. When making decisions under risk, the outcome is not known, but the probability distribution that determines the outcome is known. In risky situations, chances are taken to be objective, for example, if there is a 50% chance of winning and a 50% of losing, it is a situation characterized by risk (K. De Groot & Thurik, 2018).

Decision-making under uncertainty can be sub-classified in decision-making under ambiguity and decision making under ignorance: Decision making under ambiguity refers to a state where conditions and outcomes that will occur are known, but the probabilities of the conditions and outcomes occurring are unknown. Decision making under ignorance occurs when the elements of the condition set or the elements of the outcome set are unknown (Takemura, 2014).

The normative theory and the descriptive (behavioral) theory can represent actual decision making, the descriptive theory also strives for a certain level of rationality in decision making, therefore both theories are not distinguished from each other. Decision-making can be roughly divided into decisions under certainty, under risk, and under uncertainty; the result of choosing an alternative is subjective desirability, which can be interpreted as utility. The concept of utility is here the basis of explaining the decision-making phenomena (Takemura, 2014).

The most discussed and applied theories of decision making under risk and uncertainty are:

- Expected Utility (EU) Theory,
- Subjective Expected Utility Theory (SEU),
- Random Utility Theory (RUT),
- Rank-Dependent Utility (RDU) Theory.

The Expected Utility (EU) theory is a theory for decision-making under risk, a type of decision–making in which the probability distribution of the results is known (Takemura, 2014). Bernoulli (1738) challenged the appropriateness of profit maximization as a basis for economic decisions under uncertainty and determined that a value of an item must be based on utility and not be based on price (Quiggin, 1993). Thus, he developed the EU Theory that states that based on individual preferences, people choose between risky situations in such a way that they maximize their expected utility (Bernoulli, 1738 & Sommer, 1954). This theory is an approach to rational decision-making and was further developed by Ramsey (Ramsey, 2016) and Savage (Savage, 1954) and expressed in a mathematical form by von Neumann and Morgenstern (von Neumann & Morgenstern, 1944, 1947), which provided the basis for the analysis of economic behavior under uncertainty. The main idea of expected utility is that the maximization of utility is to be assumed to be levels of wealth or income (Quiggin, 1993).

Four axioms define a rational decision-maker: completeness, transitivity, independency, and continuity. If all axioms are fulfilled, the individual acts rationally, and preferences can be represented by a linear utility function (von Neumann & Morgenstern, 1944, 1947 as cited in Quiggin, 1993). The central role plays the independent axiom, implicitly presented by von Neumann and Morgenstern (Quiggin, 1993). Allais (1953) revealed a violation of the axiom of independence and proposed the “Allais paradox” (Quiggin, 1993 Preface) to make choices inconsistent with this specific axiom. First, the criticism of Allais has not been taken seriously, but with the publication of a paper, representing models based on the idea of probability weighting (Kahneman & Tversky, 1979), the interest in this issue came up again. In the 1980s, a number of generalizations of the EU model explaining the Allais Paradox and other evidence inconsistent with EU have been proposed (Quiggin, 1993).

The problem of overweighting of low probability prompted theorists to propose a new theory that asserts that people choose among risky courses of action in ways that maximize what is called the Subjective Expected Utility (SEU) (Edwards, 1962). Subjective expected utility is a combination of utility function and probability function. The differences between the theories arise mainly from different structures to which the preference relations are applied, but this can also arise within the same structure, due to other axioms such as weak versus partial order. Theories of subjective expected utility have been developed by, for example, Leonard J. Savage (1954), Ramsey (1931), Anscombe and Aumann (1963), Pratt, Raiffa, and Schlaifer (1964, 1965), Fishburn (1967, 1969) and Luce and Kranz (1971) and Edwards (1954) (Fishburn, 1981). The Subjective Expected Utility (SEU) model of behavioral decision theory states, that when a person must make a behavioral decision, they will choose that alternative with the highest subjective expected utility (Edwards, 1954; Fishbein & Ajzen, 1975).

In summary, this model deals with beliefs about the consequences of performing a particular behavior and the evaluations associated with that different outcome. SEU can also be reinterpreted as a person´s attitude toward the behavior (Fishbein & Ajzen, 1975). Thus, the SEU theory is supposed to extend the expected utility theory with its axioms providing a foundation for the Regret theory. The formula of the SEU theory is as follows (Edwards, 1962):

$$SEU = \Psi_1 u_1 + \Psi_2 u_2 + \Psi_3 u_3 + \ldots + \Psi_n u_n \qquad (1)$$

Where n are possible outcomes of the course of action, the first utility $u1$ and subjective probability $\Psi 1$ and so on (Edwards, 1962).

Another utility theory is the Random Utility Theory (RUT), originating from McFadden (1973), who extended Thurstone´s (1927) theory of pairwise comparisons to multiple comparisons. The RUT proposes that the other choice alternative has a utility for a person that is not visible and, for this reason, is classified as "latent". The theory assumes that the utilities can be summarized by a systematic (explainable) component and a random (unexplainable) component. The formula of the Random Utility Model (RUM) is as follows (Elshiewy et al., 2017):

$$U_{nj} = V_{nj} + \varepsilon_{nj} \tag{2}$$

where V_{nj} is the deterministic (observable) component and ε_{nj} is the stochastic (unobservable) component (Elshiewy et al., 2017).

Systematic components include attributes that explain differences in choice alternatives and covariates that explain differences in individuals' choice decisions. Random components include all unidentified factors that influence choice. Since psychologists assume that individuals are imperfect measuring devices, random components may also include factors that reflect variability and differences in individuals' choices, and do not in themselves explain choice (Louviere et al., 2000). Travel demand analyses for transport planning based on RUM have been used worldwide thanks to its proven effectiveness (D. L. McFadden, 2001). The following theory for decision-making under risk and uncertainty is the Rank Dependent Utility (RDU) which was presented in 1982 under the name “Anticipated Utility” (AU) by Quiggin (Quiggin, 1982). It preserves the standard properties of continuity, transitivity, and first stochastic dominance. The RDU model incorporates notions such as probability weighting, it as an “Expected Utility with Rank-Dependent Preferences” (EURDP) (Quiggin, 1993 Preface), also known as “the dual theory of choice under uncertainty and simply as rank-dependent utility (RDU)” (Quiggin, 1993, Preface). In the Rank-Dependent Expected Utility (RDEU) model, attitudes to outcomes and attitudes to probabilities are distinguished. In the RDU model, risk aversion combines two different concepts: there is “outcome risk aversion, associated with the idea that marginal utility of wealth is declining. This is the standard notion of risk aversion from EU theory defined by the concavity of the utility function. Second, there are attitudes specific to probability preferences. An obvious ground for risk aversion in probability weighting arises for people characterized by pessimism, that is, those who adopt a set of decision weights that yields an expected value for a transformed risky prospect lower than the mathematical expectation. This yields a natural generalization of the basic definition of risk aversion to the RDU model" (Quiggin, 1993, p. 76). An alternative, more restrictive characterization of pessimism leads to a generalization of the definition of risk aversion in terms of second stochastic dominance. (Quiggin, 1993). The idea of rank-dependent weighting function in the RDU was combined with the reference point model of the Prospect Theory developed by Kahneman and Tversky (1979) into Prospect Theory (Quiggin, 2014). In the model, probability weighting is applied to the cumulative probability distribution rather than to individual probabilities. The formula for the discrete case is

$$V(p) = \sum_{n=1}^{N} w_n \ (p) U\ (z_n) \qquad (3)$$

where $x_1 \leq x_2 \ \ldots \ \leq x_N$, the ranking requirement of the results characterizes the model (Quiggin, 2014).

To develop the Cumulative Prospect Theory (CPT) (Tversky & Kahneman, 1992), this function was combined with the reference point model of Prospect Theory (Quiggin, 2014).

The analysis of decision-making under risk has been dominated by expected utility theory for a long time. However, people do not always behave in a utility-maximizing way, except in the case of simple problems. This has been criticized by Thaler (1980), who states "that the orthodox economic model does a poor job of predicting the behavior of the average consumer" (Thaler, 1980, p.58). He further adds that people apply rules of thumb in the real world, ignore sunk costs, underestimate opportunity costs, and sometimes fail to make a decision (Thaler, 1980, p.59). Moreover, people and organizations have implicit or explicit mental accounting systems that influence their decisions. Also, simple economic principles such as the principle of fungibility are often violated (Thaler, 1980, 1985). People make decisions with limited time and limited cognitive capacity. For them, satisficing is sufficient instead of optimizing (Koumakhov, 2009).

The idea of complete and unrestricted rationality requires boundless cognitive abilities (Munier et al., 1999). If the costs of obtaining information are higher than the benefits of the additional information, the actor must make a decision under uncertainty (H. A. Simon, 1959). Simon took this issue up with his theory of bounded rationality, by challenging the rationality concept of Homo Oeconomicus. He argued, that there are limits to reasoning ability, available information, and time and introduced the Theory of Bounded Rationality (H. A. Simon, 1955, 1957, 1959) which states that perceptual, reasoning limits the individual's abilities, and economic capacities. Therefore, cognitive heuristics are a key part of the decision process. Simon´s main heuristics can be summarized as follows (H. A. Simon, 1959):

⇒ Optimizing is replaced by satisficing,
⇒ Decisions "are discovered sequentially",
⇒ Individuals create and follow rules that "serve as alternatives of choice in recurrent situations",
⇒ Each rule "deals with a limited range of situations", and
⇒ Each rule is applicable with considerable independence from the others.

In consequence, "rules of thumb" are applied in decision-making situations and actors exhibit "satisficing" behavior (Koumakhov, 2009; H. A. Simon, 1957, 1959; Vriend, 1996). Satisficing is a merged word of "suffice" and "satisfying which means that people are satisfied with less than optimal utility (Corr & Plagnol, 2019). Thus, bounded rationality means that an actor constructs a simplified model of a real situation to cope with it and behave to this simplified model rationally. The role of simplified models is to focus attention on a few stimuli and mentally represent an overall situation. Simplified models have the function of a perceptual device: they filter information about the environment and the individual and direct attention to a few stimuli. They create a mental representation of the whole situation on this basis. Functioning as an interpretive device, pieces of information are categorized, and the result of both is a coherent knowledge system with a hierarchical structure and goal priorities. Simon's theory replaces the behaviorist stimulus-response (S-R) perspective with the M-S-R perspective (M = model of reality) and contributes to the idea of information processing (Koumakhov, 2009).

However, rules of thumb lead to cognitive biases occurring when heuristics are used, availability heuristics are applied, when people judge the likelihood of an event based by how easily a situation comes to their mind. In this case, real factors are ignored when making judgments (Tversky & Kahneman, 1974). Representativeness heuristics are used when judging the likelihood that an object or event A belongs to class B by looking at the degree to which A is similar to B. The likelihood that an object or event A belongs to class B is judged by looking at the degree to which B is similar to A. Information about the overall probability of occurrence of B is neglected (Kahneman & Tversky, 1972). Overconfidence is also a cognitive bias (Nickerson, 1998). Anchoring is a special form of the priming effect (information received earlier is remembered better than information received later (Atkinson & Shiffrin, 1968)) in which the first encounter with a number serves as a reference point and influences subsequent judgments. This process occurs unconsciously (Tversky & Kahneman, 1974).

Emotions influence decision-making and judgment, known as affect heuristics (Corr & Plagnol, 2019). Decision-making and judging are intuitive, rules that govern intuition are similar to the rules of perception (Kahneman & Frederick, 2002). Perceptual systems "are designed to enhance the accessibility of changes and differences. Perception is reference-dependent: the perceived attributes of a focal stimulus reflect the contrast between that stimulus and a context of prior and concurrent stimuli" (Kahneman, 2003, p. 1454). Further, "intuitive evaluations of outcomes are also reference dependent" (Kahneman, 2003, p. 1455).

Psychological research is often criticized as not being able to provide an alternative to the "rational-agent model" (Kahneman, 2003, p. 1449). Kahneman & Tversky (2003) offer a unified treatment of intuitive judgments and decisions that builds on studies of the relationship between preferences and attitudes by extending a model of judgment heuristics (Kahneman & Frederick, 2002). The guiding ideas for the development of the model are that a) most judgments and choices are made intuitively and b) rules governing intuition are generally similar to the rules governing perception (Kahneman, 2003). Figure 13 illustrates "The Architecture of Cognition" developed by Kahneman & Tversky (2003) distinguishing between two modes of thinking and deciding. As seen from Figure 13, two different systems in the brain process information in different ways: System 1 (intuition) is reflexive, fast, automatic, biased, intuitive, emotional, habitual, unconscious and effortless (Corr & Plagnol, 2019; Kahneman, 2011). System 1 is often emotionally charged, governed by habit, and, therefore, difficult to modify and to control (Kahneman, 2003). It is also referred to as an implicit, procedural system. System 2 (Reasoning) is reflective, slow, controlled, effortful, and potentially rule-governed. This one is also called the explicit/declarative system. System 2 operates when a decision must be made, and System 1 is unable to do so. The perception system and the operation of System 1 "generate impressions of the attributes of objects of perception and thought" (Kahneman, 2003, p. 1452) created not voluntarily and need not be verbally expressed. System 2 is involved in judgments, which are always explicit and intentional whether or not they are overtly expressed (Kahneman, 2003).

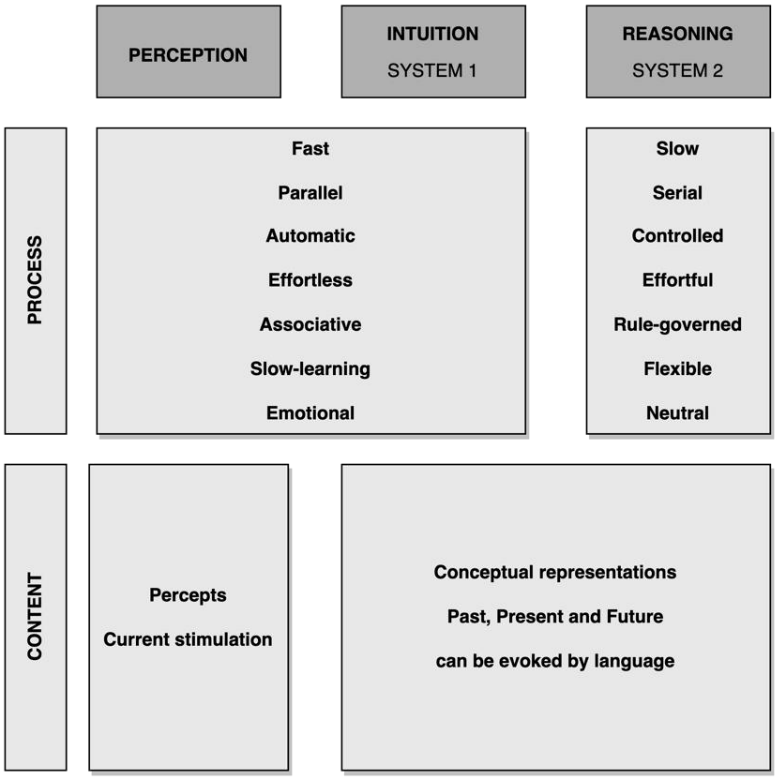

Figure 13: Cognitive Systems

Source: adapted from (Kahneman & Tversky, 2003, p. 1451)

However, System 2, is limited in its capacity, requires attention and deliberative processing, and is sensitive to fatigue. Behavioral economics focuses on system 1 because this is where biases and heuristics arise (Corr & Plagnol, 2019; Kahneman, 2011). Bias in decision making tend to value a product more if owned it which is called the endowment effect (Braun & Gautschi, 2012; Corr & Plagnol, 2019) (Kahneman & Tversky, 1979; Thaler, 1980; Tversky & Kahneman, 1974). This effect became known as the Allais Paradox as early as 1953, leading to risk aversion for certain gains and risk-seeking for certain losses (Kahneman & Tversky, 1979). Moreover, people generally reject components that are shared by all perspectives being considered. This tendency leads to inconsistent preferences when the same choice is presented in different forms. This motivated the authors to develop the Prospect Theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992).

The Prospect Theory is about how people behave and not about how they should behave, as outlined in the normative perspective of neoclassical economics. It describes decision-making under risk and assumes that decisions are made differently in different contexts. Risk-averse decisions are made in the gain frame, and risk-seeking decisions in the loss frame, meaning that behavior differs fundamentally in both frames (Dhami, 2017). The theory distinguishes between two phases in the decision process, as already described above. In the editing phase, a preliminary analysis of the offered prospects often yields a simpler representation of these prospects. The edited prospects are evaluated in the evaluation phase, and the prospect of the highest value is chosen. In the editing phase, the options are organized and reformulated to simplify subsequent evaluation and choice. In the evaluation phase, each of the edited prospects is evaluated, and the prospect with the highest value is chosen (Kahneman & Tversky, 1979). The theoretical model explains loss aversion, which can then be used for findings such as the endowment effect, it calls attention to reference points (a current status quo), meaning that the focus relies on relative changes around a reference point not looking at things in absolute terms. Changes can be influenced by framing the extent to which change is important to people costs (Corr & Plagnol, 2019).

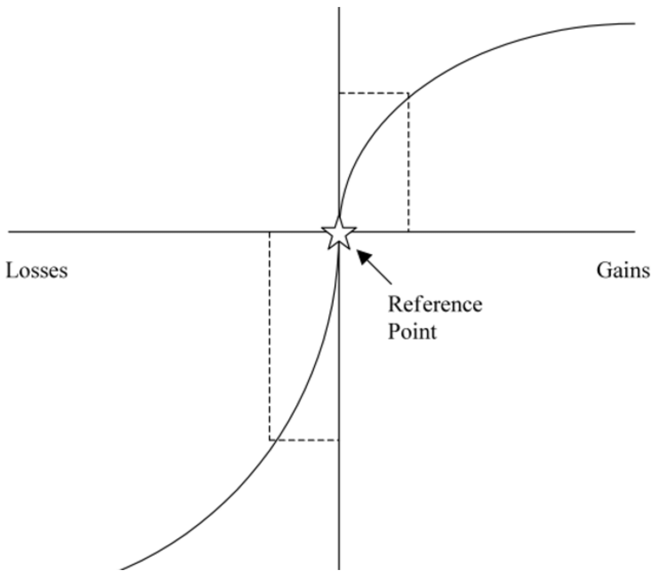

Figure 14 Prospect Theory value function

Source: from (Jayles, 2018, p.9)

As seen from Figure 14, the reference point is used to help understanding, how framing operates: it sets a point around which gains, and losses are evaluated. In the value function, the gain curve is concave while the loss curve is convex, which is steeper for losses than for gains; the current status quo is taken as the reference point, any deviations from this point are perceived as a loss, switching from the status means that losses are weighted more heavily than the gains from the switch. Thus, the switch to a different behavior is difficult as losses are more highly valued than gains (Tversky & Kahneman, 1992 as cited in Corr & Plagnol, 2019, p. 111).

In Prospect Theory, there is a problem with the weighting scheme, which is a monotonic transformation of the outcome probabilities. Thus the stochastic dominance is not satisfied (Tversky & Kahneman, 1992). "Stochastic dominance requires that a shift of probability mass from bad outcomes to better outcomes leads to an improved prospect" (Fennema & Wakker, 1997, p. 53). Moreover, the theory cannot be "extended to prospects with a large number of outcomes" (Tversky & Kahneman, 1992, p. 299). This was the reason for Tversky and Kahneman to extend the Prospect Theory (PT) to the Cumulative Prospect Theory (CPT) for decision making under risk and uncertainty. The CPT adopts the rank-dependent method for transforming probabilities introduced by Quiggin (1982) (Fennema & Wakker, 1997). The method leads to the overweighting of extreme events, which occur with small probability rather than an overweighting of small probability events helping to avoid first-order stochastic dominance (Tversky & Kahneman, 1992). Detailed, the CPT has the same value function with the same characteristics as in Prospect Theory. Concerning the determination of decision weights, the RDU model (Quiggin, 1993) was applied separately to gains and losses, then the sum of two resulting evaluations was taken, meaning that two separated weighting functions, one defined for probabilities associated with gain and the other defined for probabilities associated with loss allow different attitudes towards gains and losses (Fennema & Wakker, 1997).

Figure 15 shows a typical Cumulative Prospect Theory (CPT) weighting function, the S-inverse shape expresses overweighting of small probabilities (above the expected utility benchmark) and underweighting of high probabilities (below the expected utility benchmark), which also implies risk-seeking for prospects with small probabilities and risk aversion for prospects with large probabilities. The figure displays "diminishing sensitivity" (Fennema & Wakker, 1997, p. 56) to probability changes, i.e., the function is relatively "sensitive to changes in probability near the endpoints 0 and 1, but relatively insensitive to changes in probability in the middle region" (Fennema & Wakker, 1997, p. 56). In summary, the Cumulative Prospect Theory (CPT) is an "alternative descriptive theory" (Thaler, 1980, p. 39). It is an "alternative descriptive theory in which 1) the objects of choice prospects framed in terms of gains and losses, 2) the valuation rule is a two-part cumulative functional, and 3) the value function is S-shaped and the weighting functions are inverse S-shaped.” (Tversky & Kahneman, 1992, p. 316).

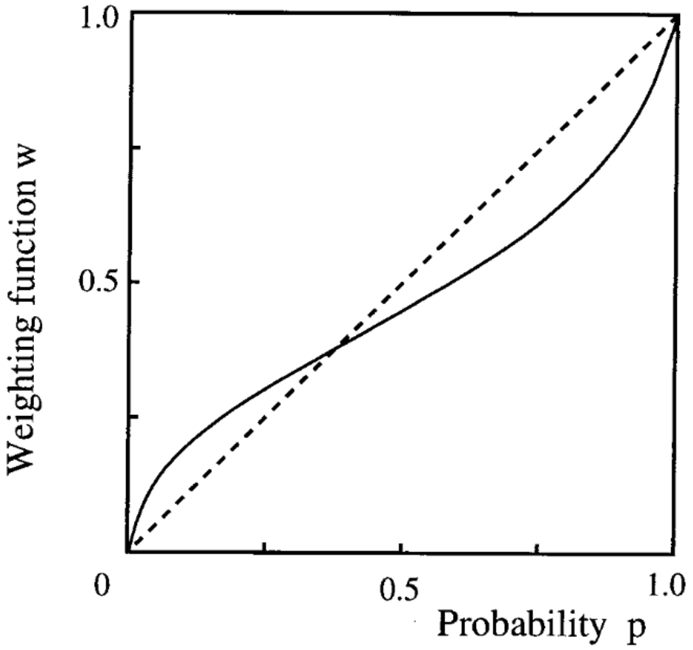

Figure 15 Cumulative Prospect Theory (CPT) weighting function

Source: from (Fennema, 1997, p. 56)

Fennema and Wakker (1997) discussed the differences between Prospect Theory (PT) and Cumulative Prospect Theory (CPT). The authors could show that the Cumulative Prospect Theory (CPT) is “not merely a formal correction of some theoretical problem in prospect theory, but it gives different predictions … it turns out that the mathematical form of cumulative prospect theory is well suited for modelling the psychological phenomena of diminishing sensitivity” (Fennema & Wakker, 1997, p. 53).

2.2. Socio-Cognitive Models

“The behavior people perform can have profound effects on their own health and well-being, on the health and well-being of other individuals, groups, and organizations to which they belong, and on society at large. There is growing awareness that human behavior can both cause and alleviate social problems in a variety of domains such as health, safety, the environment, racism, and intergroup relations, work motivation, and productivity” (Fischbein

& Ajzen, 2011, p. 1).

There are many efforts in different disciplinary directions that try to explain behavioral decision making. Using general dispositions to explain behavior in particular situations are, according to Ajzen, "poor predictors" (Ajzen, 1991, p. 180). There is also little empirical relationship between personality traits and behavior in particular situations. Attempts to relate generalized locus of control beliefs (Rotter 1954, 1966; Ajzen 1991) to behave in specific contexts also yielded disappointing results. Other approaches assume that behavior exhibited depends on preferences, which in turn are based on attitudes and perceptions, taking into account spatial, socio-psychological, and socio-economic characteristics (Allaman & Tardiff, 1982; Golledge & Stimson, 1997; Van Acker et al., 2010). Other authors postulate that travel behavior is the result of a hierarchical decision structure with a ranking from short-term to long-term decisions on lifestyle (Ben-Akiva, 1973; Salomon, 1981; Salomon & Ben-Akiva, 1983), where lifestyle is an individual's opinion, motivation, or orientation, internal and unobservable, but manifest themselves in observable patterns of behaviors (Munters, 1992). Conscious and unconsciously made decisions in travel behavior are to be addressed by linking theories of transport geography, microeconomics, and social psychology (Talvitie, 1997). To Engel et al. (1995), decision-making is formed by both individual differences and environmental factors, as a well as by psychological processes (Engel et al., 1995).

The following section is created to give an insight into the following theories and models as follows:

- Theory of Reasoned Action (TRA),
- Theory of Planned Behavior (TPB),
- Hierarchical model of perceived behavioral control,
- Engel-Blackwell-Miniard Model (EBM Model).

Already more than 30 years ago, Fishbein and Ajzen (1975) postulated that human behavior could be predicted by a small number of factors (Ajzen, 2011 p.39). The original formulation of the Theory of Reasoned Action (TRA) is based on and adapted from Dulany´s (Dulany, 1968) theory of propositional control (Fischbein & Ajzen, 2011). Fishbein (1967) proposed that a person´s intention to perform a given behavior is a function of two basic determinants: a person´s attitude performing a behavior and second, of a belief (i.e. subjective norm)

(Fishbein, 1967). The central factor in the Theory of Reasoned Action (TRA) and the Theory of Planned Behavior (TPB) is the actor´s intention to commit to a particular behavior Intention encompasses those motivational factors that drive behavior. The stronger the intent to engage in a behavior, the more likely it will be performed (Ajzen, 1991). Behavioral intentions provide evidence of the willingness and efforts made to perform a particular behavior. Intended willingness to act can include statements such as that a person will engage in and intends to engage in a behavior, and that the person expects and plans to engage in and will try to engage in a certain behavior (Fischbein & Ajzen, 2011, p. 39). The chances of engaging in behavior are related to the strength of intention, opportunities, and resources; furthermore, behavioral intention is expressed only through behavior under volitional control (Ajzen, 1991).

In this model, the attitude is a function of beliefs about the consequences of a performed behavior, the subjective norm (SN) is a function of normative beliefs and motivation to comply with expectations from other people (Fishbein & Ajzen, 1975). Attitude and subjective norm (SN) are the determinants of the intention to act, which explain the execution of an action (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975); behavioral intentions are the immediate precursor to behavior. If performing a behavior leads to a more positive outcome, attitude toward the behavior will be positive and vice versa (Fischbein & Ajzen, 2011 p.21), the more substantial the intention of an action, the higher the probability that the action will be carried out (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975).

Figure 16 provides the schematic outline of the Theory of Reasoned Action (TRA). The term subjective norm (SN) is defined as an “individual´s perception that most people who are important to her think she should (or should not) perform a particular behavior” (Ajzen, 2011 p. 131). Subjective norm (SN) is used in both TRA and TPB theories and refers to a specific behavioral prescription or specification attributed to a generalized social actor. It is a person's perception of what behavior is desired or expected. The subjective norm may or may not reflect what most important people believe to be correct (Ajzen 2011 p. 131). Two types of this norm can be distinguished, namely, injunctive, and descriptive norms. Injunctive norms refer to perceptions about what should be done in terms of performing a particular behavior; descriptive norms refer to perceptions that others do or do not perform the behavior in question (Fischbein & Ajzen, 2011, p. 131).

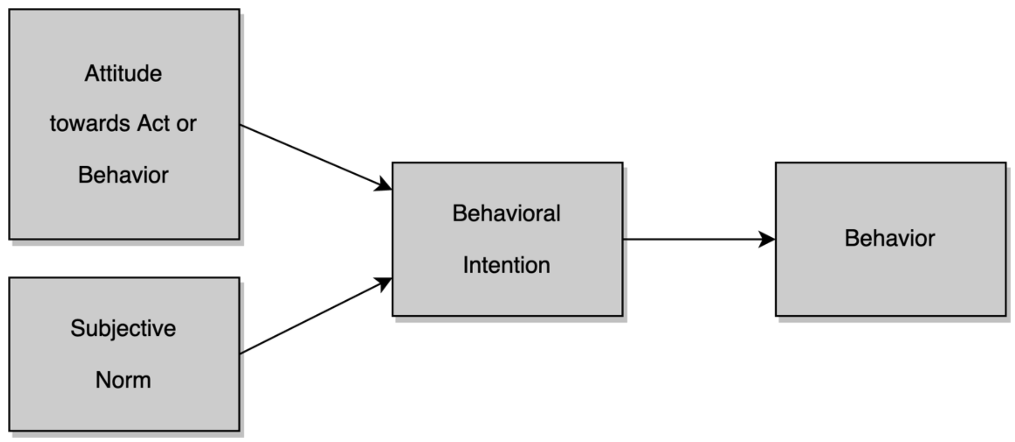

Figure 16 Theory of Reasoned Action (TRA)

Source: adapted from (Truong, 2015 p. 178)

Ajzen (1991) extended the basic model of the Theory of Reasoned Action (TRA) by the construct "Perceived Behavioral Control" (PBC) (Ajzen, 1991) referring to the perceived "ease or difficulty" (Ajzen, 1991) of performing a behavior and reflects past experiences and anticipated impediments and obstacles (Ajzen, 1991). His extension of the TRA is called the Theory of Planned Behavior (TPB) (Fischbein & Ajzen, 2011).

In this model (Figure 17), the concept of perceived behavioral control was added. The background is that people may not have complete volitional control over a corresponding behavior. In comparison, the Theory of Reasoned Action (TRA) posits that most human behaviors are under volitional control and that behavior can be predictable from intentions only. However, the lack of control may depend not only on the person him or herself but also on the actions of others. For this reason, the concept of Perceived Behavioral Control (PB) was introduced to account for the nonvolitional elements that are at least potentially present in all behaviors (Ajzen, 2002). Perceived behavioral control (PBC) is likely to affect intentions: High levels of perceived control strengthen a person's intention to perform the behavior and increase effort and persistence. In this case, PBC may influence behavior indirectly by affecting intention (ibid). Moreover, perceived behavioral control, if honest, provides valuable information about the actual control a person can exert in a given situation and is therefore useful as an additional direct predictor of behavior. The Perceived Behavioral Control (PBC) refers "generally to people´s expectations regarding the degree to which they are capable of performing a given behavior, the extent to which they have the requisite resources and believe they can overcome whatever obstacles- they may encounter" (Ajzen 2002, p. 677).

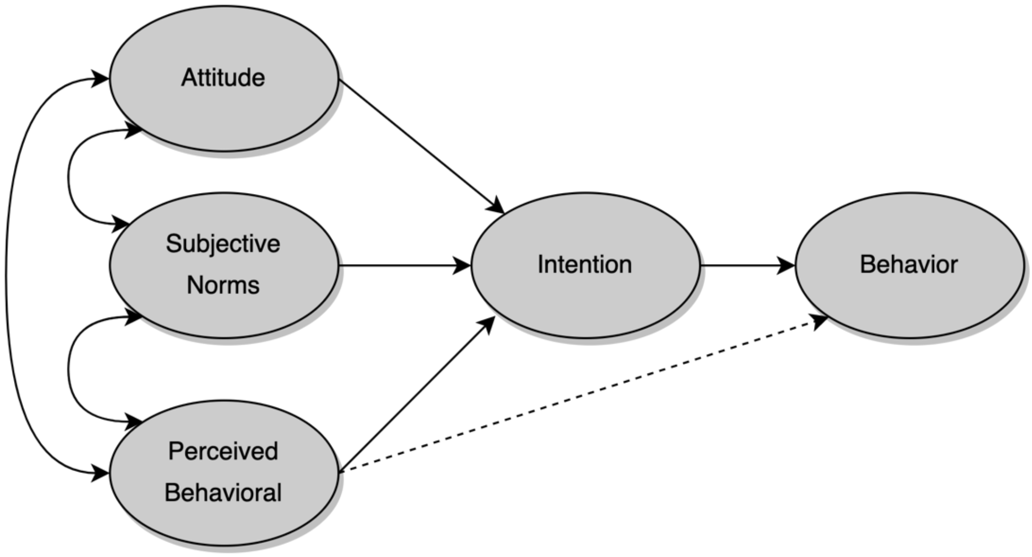

Figure 17 Theory of Planned Behavior (TPB)

Source: adapted from (Ajzen, 1991)

The concept of Perceived Behavioral Control (PBC) is based on the theory of self-efficacy proposed by Bandura referring to “people´s beliefs about their capabilities to exercise control over their own level of functioning and over events that affect their lives” (Ajzen, 2002, p. 667; Bandura, 1991, p. 257). The two concepts are similar in that both deal with the perceived ability to perform a behavior (Ajzen, 2002).

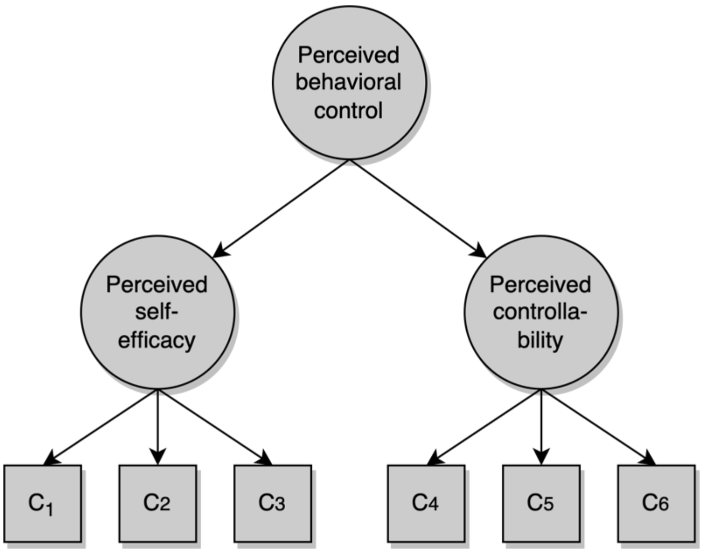

Figure 18 Hierarchical model of Perceived Behavioral Control (PBC)

Source: adapted from (Ajzen, 2002)

Figure 18 shows the hierarchical model of Perceived Behavioral Control (PBC), as to Ajzen (2002), “a hierarchical model may best describe the relations among perceived self-efficacy, perceived controllability and perceived behavioral control” (Ajzen, 2002, p. 678).As seen, the model comprises the two lower-level components self-efficacy (dealing largely with the ease or difficulty of performing a behavior) and controllability (the extent to which performance is up to the actor) (Ajzen, 2002, p. 680). Studies have shown that the behavior performed is influenced by the respective abilities (e.g., Bandura, Adams & Beyer, 1977, Bandura, Adams, Hardy and Howells, 1980). “Self-efficacy beliefs can influence choice of activities, preparation for an activity, effort expended during performance, as well as thought patterns and emotional reactions” (Bandura, 1982, 1991 as cited in Ajzen, 1991 p. 184). Many studies have confirmed the validity of this model (van Ryn & Vinokur, 1990; Schlegel et al. (1990), Ajzen & Madden 1986). However, Bamberg et al. (2002) criticized this theoretical approach postulating that people may develop an intention to act but might not take action. Bamberg et al. (2002) conducted competing behavior (Bamberg, 2002; Y. Zhang et al., 2020).

Figure 19 illustrates the Engel-Blackwell Miniard (EBM) Model, a model analyzing the factors that impact consumer decision making. It is a model for consumer decision falling into the category of comprehensive models (Engel et al., 1995): It identifies a number of different elements of consumer decision making and the interrelationships among these components. The model was first introduced in 1968 as the Engel/Kollat/Blackwell (EKB) model and has been continuously refined over time (Konstantina, 2015; Torres & Peganos, 2013).

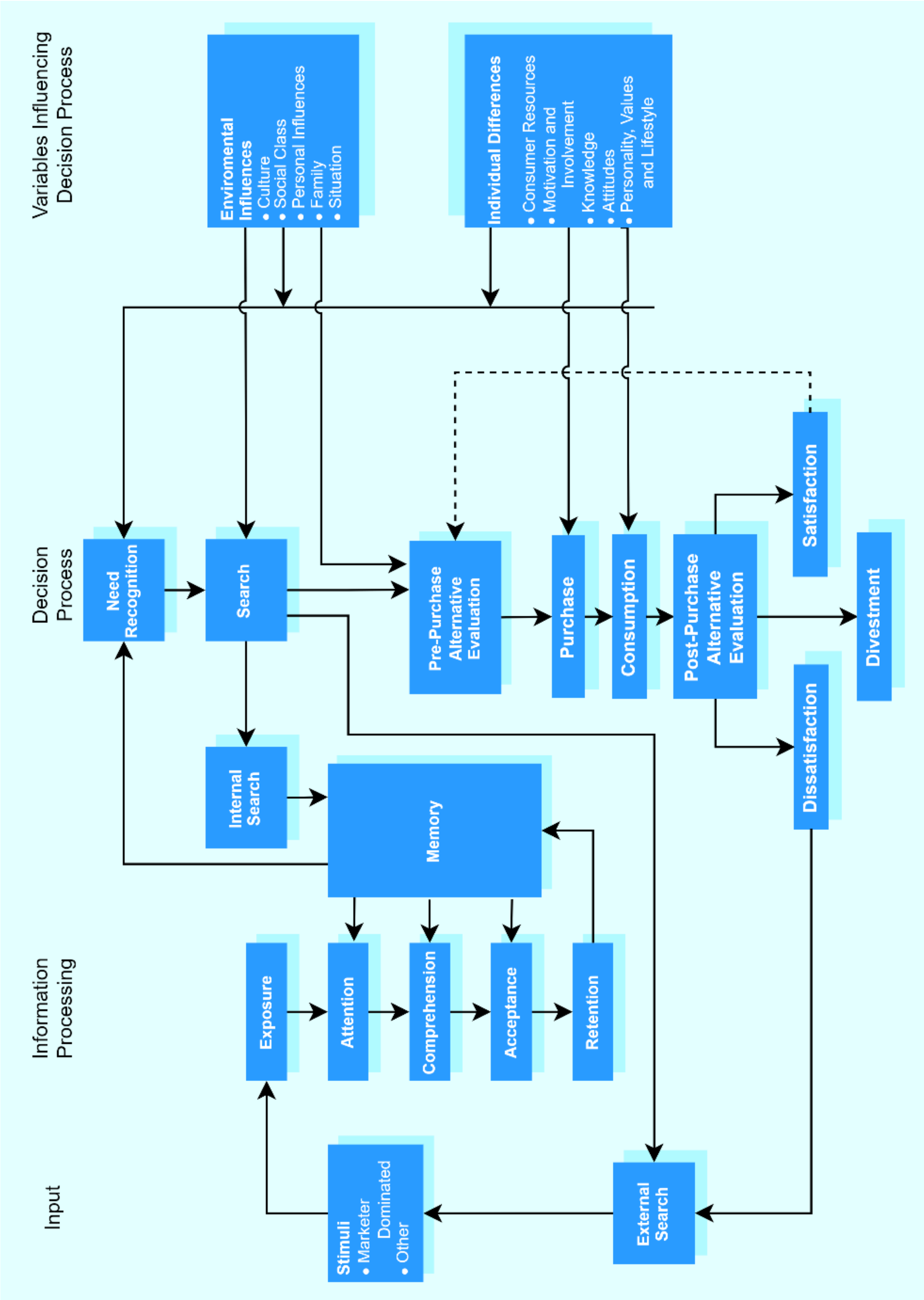

Figure 19 Engel-Blackwell-Miniard (EBM) Model

Source: adapted from (Engel et al., 1995, pp. 151, 154)

To the model, environmental influences can be distinguished between culture, situational influence, ethnic influence, family and household influence, personal influence, and social class and status (Engel et al., 1995, p. 606). “Culture is the complex of values, ideas, attitudes and other meaningful symbols that allow humans to communicate, interpret and evaluate members of society” (Engel et al., 1995, p. 637). Ethnic influences are based on nationality, religion, physical characteristics, or geographic location. “Ethnicity is a process that may be defined objectively, based on sociocultural characteristics, or subjectively, based on identification that a person makes for self or others” (Engel et al., 1995, p. 670). Social classes “are relatively permanent and homogenous groupings of people in society, permitting groups to be compared with one another” (Engel et al., 1995, p. 708), comprising, e.g., education, occupational status, and income (Engel et al., 1995, pp. 692–694). Personal influence “is expressed through reference groups and word-of-mouth communication. Reference groups influence beliefs, values, attitude and behavior and compliance with reference groups” (Engel et al., 1995, p. 735). It is essential to take the family situation into account in decision-making as “families or households are the unit of usage and purchase for many consumer products. Second, the family is a major influence on the attitudes and behavior of individuals” (Engel et al., 1995, p. 785). Family and household influences are, e.g., marital status, the number of family members, employment status, household income, marriages, remarriages, and divorce (Engel et al., p. 743). Situational influences include geographic location and climate, social environment such as the presence or absence of others in the situation, time (time of day, day of week, month, season), task, and preexisting states such as transient moods or states that are not based on monetary states (Belk, 1974 as cited in Engel, 1995, p. 795). Individual differences include consumer resources, motivation, commitment, and knowledge, attitudes, personality, values, and lifestyle (Engel et al., 1995, p. 149). Individual resources are distinguished between economic resources such as income, time, and cognitive capacities, with cognitive capacities playing an important role in decision making due to the limited capacity of consumer resources. If information exceeds the capacity of consumers, they become "overloaded" (Engel et al., 1995, p. 328). The information stored in memory, attitudes are the respective knowledge, which is shaped by beliefs and feelings. Need is the core motivational variable, which is a perceived difference between an ideal state and a present state and triggers behavior (Engel et al., p. 425). Personality, values, and lifestyle are a respondent's unique characteristics, "defined as consistent responses to environmental stimuli" (Engel et al., 1995, p. 461), personal values "explain differences among consumers" (Engel et al., 1995, p. 461) and lifestyles "are patterns in which people live and spend time and money.

Lifestyles are the result of the entire spectrum of economic, cultural, and social life forces that add to a person's human characteristics" (Engel et al., 1995, p. 461).

The process of decision-making behavior consists of five stages. The first stage is the "need recognition" stage, in which a decision-maker detects a difference between a desired state and an actual state. This state triggers a decision-making process based on the individual differences and environmental influences described above. This phase is followed by the "information search" phase, an internal search in memory, and when internal memory is insufficient, the consumer moves to an external search. This phase is based on individual differences and environmental influences. Stimuli can be divided into two categories: marketer-dominated, i.e., anything the supplier does intentionally, and "other," e.g., consumer reports. After the consumer is exposed to the stimuli, information processing follows. The Processing involves five steps. The first step is “exposure,” in which the information has reached the customer, in activating their senses and beginning preliminary processing, followed by “attention” occurring when the given information is deemed relevant. Step attention is followed by step comprehension in case attention is captured. Further analysis follows based on the categories of meaning stored in memory; acceptance: the step of this objective is to modify or change existing beliefs and attitudes. If the incoming message has not been discarded as unacceptable at this stage, it can be assumed that it has been accepted; Retention: The new information is stored in memory. After the consumer has gone through this information process, he evaluates the product characteristics by comparing them with his own standards and specifications, which are shaped by environmental influences and individual differences (stage “Pre-Purchase Alternative Evaluation”) (Engel et al., 1995 p. 151). In this stage, the evaluative criteria to judge the alternatives are determined (e.g., price, origin, salience, the given situation, the similarity of other options, the customers involvement and knowledge). This is then followed by the determination of the alternatives from which the choice is made. The determination of the alternatives is based on knowledge, memory, and if there is not enough information available, they turn to the environment for assistance to form the consideration set (= evoked set). The use of cutoffs or signals determines if a given alternative is acceptable or not. A signal can be, for example, a price. The fourth element in this stage, is the selection of a decision rule. Decision rules can be distinguished between simple and complex decision rules, compensatory and non-compensatory decision rules, where compensatory rules make it possible to compensate for product weaknesses with product strengths. A non-compensatory decision rule is the lexicographic approach, elimination by aspects and conjunctive, do not permit product strengths to offset product weaknesses. This stage is followed by the stages “purchase” and “consumption”, followed by the “post-purchase evaluation of alternatives”, where the customer evaluates the chosen product. If expectations match, the result is satisfaction; if not, the customer is dissatisfied and goes on an external search. A "post-decision regret" (Engel et al. 1995, p. 153) can lead to the evaluation of the alternative not chosen. The final stage is "divestment," in which the customer has the options of complete disposal, recycling, or sale on the second-hand market (Engel et al., 1995).

Based on the predecessor EKB model of consumer behavioral change, several authors conducted studies in vehicle purchase showing that choosing is a process over time and goes through different stages (for an overview of the studies, see Plananska, 2020 (Plananska, 2020). Other researchers ran a survey on the EBM model of 2003 to identify the consumers' profile (Torres & Peganos, 2013). Hsu, Lin & Ho (2012) designed and applied a recommendation system for tourist attractions and proved, that the combination of the EBM model and Bayesian network demonstrated “good prediction of tourist attractions” (Hsu et al., 2012, p. 3257).

Decision-making is driven by emotional aspects, depending on the situation and the importance of the decision to be made (Solomon, 2017), as well as habits. The following subchapter, therefore, presents models focusing on affective (emotional) and automated (habitual) behavior.

2.3. Models Focusing on Habits and Feelings

The extensive use of private vehicles leads to congestion on the roads. On the other hand, the ownership of a private vehicle has many advantages, for example, facilitating personal mobility and offering a sense of security and “heightened status” (Bull, 2003 p. 13). However, convincing people to switch from their private car to the bus is proving to be a complex process, as the habitual usage of car use has become a routine part of everyday life (I. Walker et al., 2015).

Thus, the following section deals with the theoretical consideration of habits and the following theories and hypotheses:

- Historical and contemporary views on habits,
- Theory of Interpersonal Behavior (TIB),
- Risk-as-feelings hypothesis,
- Habitual Model of Car Choice Behavior.

William James (1842-1910) already suspected that habitual change might not be as simple as willing one to behave differently might; in his lecture "on a certain blindness in human beings“ (1899), he suggested that habits change when the environment changes, not only geographically, but also when trying to see things from another's point of view. James distinguished between instincts (which help in forming habits made up of pre-established ways of doing things) and habits as new and repeated ways of doing things (B. P. Davis, 2019). Andrews (1903) described habit as “a more or less fixed way of thinking, ability or feeling acquired via repeated repetition of mental experience” (Andrews, 1903 p. 121 as cited in Kanishka Ariyasinghe & J.H.Arachchige, 2020). To the learning theory with its drive concept, a habit is a learned connection between stimulus and response (Hull, 1943, Zimbardo, 1992). Habits are induced by a cue and a stable, consistent context that triggers the same action or routine memory. For a behavior to become a habit, the behavior must be performed many times (repetition). A behavior is repeated when it is rewarded (motivation). The reward is responsible for a behavior taking hold and becoming a habit (Hollingworth & Barker, 2013). Simon (1950) describes habits so that people are not always aware of their behavior (H. Simon, 1950).

For Triandis (1977), habits are automated situation-specific processes or automatically becoming processes that occur without self-instruction. To predict behavior, a compromise must be made between attitudes and habits. If habits are strong in their characteristics, the attitude-behavior relationship is weak and vice versa. In 1989, repeated behavior (Ronis et al., 1989) was described in such a way that initial behavior depends more on reasoned influences, while unreasoned influences determine repeated behavior to a greater extent. The initial behavior remains the result of relevant attitudes and beliefs; if it is repeated, it becomes a habit. Decision-making is then no longer based on attitudes and other reasoned influences.

Repeated behavior is mainly influenced by habits rather than attitudes, unwarranted influences, resources, or enabling variables, and warranted influences directly affect behavior (Menard, 1997; Van Acker et al., 2010). Other authors consider that habit or a habitual choice is a performed behavior without deliberation (Van Acker et al., 2010). Based on the foundations of previous researchers, habits are "a learned sequence of acts that have become automatic responses to specific cues, and are functional in obtaining certain goals or end-states" (B. Verplanken & Aarts, 1999, p. 104. as cited in Verplanken, 2006, p. 104).

Habits are thus developed by repeatedly and automatically responding in a particular manner to a specific cue in a recurrent and stable context (Wood & Neal, 2007). A cue can be a particular time, place, object, person, physiological state, or activity. These types of associations are stored in memory, and a response is automatically triggered when the cue occurs. The advantage of habits is that they make everyday life more efficient. The disadvantage, however, is that alternatives are disregarded. Conscious intentions no longer drive incorporated habits, are no longer subject to willpower, and cannot be easily broken. To change habits, they must be analyzed in the habit context: the occurrence of key-cue responses has to be identified, new desired reactions have to be developed and should replace the negative key-cue responses. Furthermore, IF-THEN plans need to be created: IF specifies the condition, THEN the action (Verplanken & Orbell, 2019).

Triandis (1977) criticized, that neither the model of the Theory of Reasoned Action (TRA) nor the Theory of Planned Behavior (TPB) model considers habits and emotional aspects (Triandis, 1977). Another criticism came from Verplanken & Orbel (2003) stating that both the TRA and TPB models assume that intentions predict behavior, but both theories do not consider repeated behavior (Verplanken & Orbell, 2003). In responding to the absence of these factors, he developed the Theory of Interpersonal Behavior (TIB), which builds on the Theory of Reasoned Action (TRA) and the Theory of Planned Behavior (TPB) (Triandis, 1977). As the first main source of social influence, social norms increase the likelihood that individuals will behave accordingly per the given norms (Triandis, 1977). In TIB, new factors such as emotional factors, habits, and various sources of social influence have been added. The performance of a behavior is determined not only by intention but also by how habitual a behavior has become. Facilitating conditions, such as the absence of environmental or situational constraints, also play an essential role in this context. The TIB provides an explanation of how an individual's environment influences intentions and behaviors as it integrates the role of social influences through norms, roles, and self-concept. Norms lead individuals to act in ways that increase conformity within a social group and apply to all individuals in a group. Roles are the actions that are adequate for an individual to hold a position within a group. Self-concept is the individual goals and values of what behavior is appropriate (Moody & Siponen, 2013).

The concept refers to behavioral dispositions such as social attitude and personality attempt to predict and explain human behavior (e.g., Ajzen 1988, Campbell, 1963, Sherman & Fazio, 1983 as cited in Ajzen, 1991). Cognitive self-regulation plays an integral part in the theory of planned behavior (Ajzen, 1991), social norms similar to TRA and TPB are included (Moody & Siponen, 2013). Thus, the TIB is “more socially oriented than either the TRA or TPB, and it proposes several sources of social influence beyond those of social norms” (Bamberg & Schmidt, 2003 as cited in Moody & Siponen, 2013, p. 326).

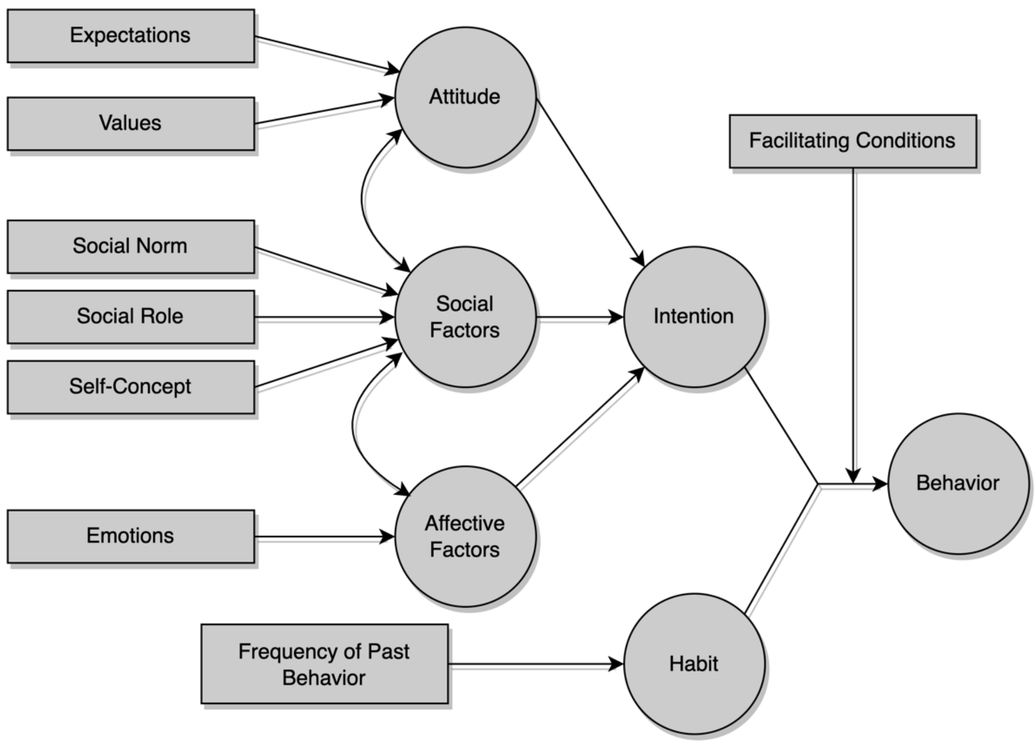

Figure 20 Theory of Interpersonal Behavior (TIB)

Source: adapted from (Galdames et al., 2011, p. 70)

The model (Figure 20) implies that attitude and behavior are positively correlated but have an indirect relationship. Attitude is explained by expectancy-value theory and depends on the expectations people have about the outcomes of their behavior and the importance they attach to the possible outcomes. Norm, social role, and self-concept describe the influence of social factors and personality traits on behavioral intentions. A social role is related to the expectations an individual has about their social position; social norm refers to the effect of others on an individual's behavior. Self-concept is related to an individual's self-esteem and view of self, affective factors are induced emotions, habitual behavior is related to repetitive behavior. It is difficult to change, facilitating conditions are exogenous factors that influence behavioral intention, e.g. attributes of alternatives and socioeconomic factors (Galdames et al., 2011).

Galdames et al. (2011) investigated the “role of psychological factors in mode choice models by a latent variables approach” (Galdames et al., 2011, p. 68) by using Triandis´ theory of interpersonal behavior (Triandis, 1977) as a theoretical framework (Galdames et al., 2011). Kang et al. (2019) developed a research model based on Triandis's (1977) theory to identify the predictors of drivers intention to switch from car-driving to PT and their behavioral readiness to use PT (Kang et al., 2019). To explain nonwork-related personal use of the internet at work, Moody and Siponen (2013) developed a new model based on Triandis´ theory. They demonstrated that their model predicted well the nonwork-related use of the Internet at work (Moody & Siponen, 2013).

Loewenstein et al. (2001) criticized decision-theoretical approaches for ignoring the role of emotions, particularly in decision-making under risk. In decision-making approaches, it is assumed implicitly or explicitly, that risky decision-making is essentially a cognitive activity. When people are confronted with the prospect of risk, there is a possibility that the risk will first be evaluated cognitively, followed by an emotional reaction. Furthermore, people experience fear reactions without knowing what they are afraid of (Loewenstein et al., 2001). The authors propose a distinction between anticipatory emotions and anticipated emotions. Anticipatory emotions are, for instance, fear, anxiety, dread to risks, and uncertainties. Fear as an emotional response experienced in risky situations depends on a variety of factors. For example, fear peaks shortly before experiencing a threat. Fear responses appear to be partly due to evolutionary predisposition and are often elicited by subliminal cues. Fear conditioning may be more durable than other types of learning. In contrast, anticipated emotions are expected to be experienced in the future (Dhami, 2017).

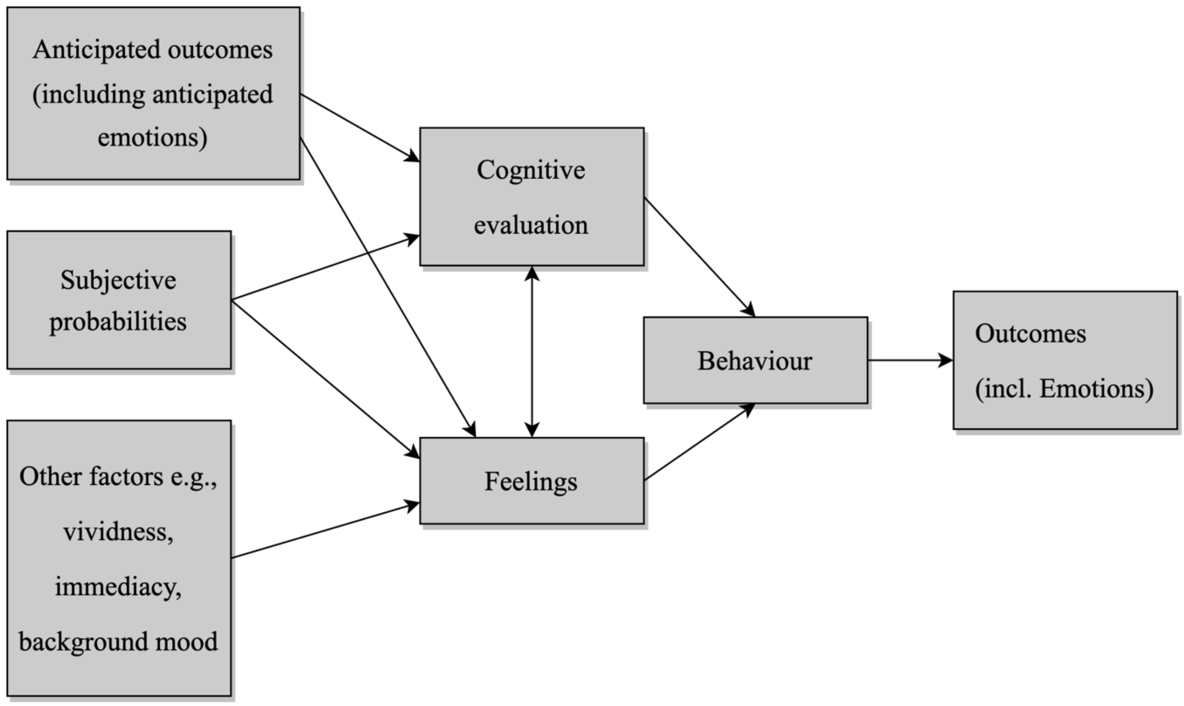

Figure 21 Risk-as-Feelings Perspective

Source: adapted from (Loewenstein et al., 2001, p. 270)

Loewenstein et al. (2001) provide a convincing argument for the inclusion of anticipatory emotions in economics, postulating that emotional decisions differ from cognitive decisions, because these decisions each address different pathways in the brain. The authors highlight the difference in these transmission channels as well as the differences in the respective outcomes in the risk as feelings theory. Summarized, decision-making under risk is a mixture of consequentialist and non-consequentialist reasoning (Dhami, 2017). As illustrated in Figure 21, behavior under risk manifests independently of associated probabilities and outcomes. According to this hypothesis, behavior occurs under a combination of outcomes and emotions (ignoring possibilities) or probabilities and emotions (ignoring outcomes). Each of these channels makes a prediction, which is impossible with traditional risk models of economics (Dhami, 2017).

Valor (2020) investigated the expected emotions of peer-to-peer (P2P) carsharing adoption in the context of sustainable mobility. She concluded that potential users develop feelings of stress, anxiety, and fear when participating in P2P-carsharing systems. The expected emotional burden of sharing deters potential users from this innovation (Valor, 2020). Other researchers examined the effects of incidental emotions (fearful, angry, happy) on the decision-making process. They found that risk preference was weaker in the fearful situation than in the angry and happy condition. However, the feelings regarding the outcome feedback were not determined by incidental emotions. The authors suggest that incidental fear unconsciously triggers risk-avoidant behavior (Q. Yang et al., 2020). Streicher et al. (2020) examined the evolution and interaction of cognitive and affective decision factors in the context of public megaproject approval using survey data from European countries and the United States. They concluded that affective feelings strongly influence support for public megaprojects and that although the influence of affective feelings on decisions is filtered through elaborate processing, the filtering mechanism is quite ineffective (Streicher et al., 2020).

The theories and models presented so far attempt to explain behavior from different perspectives. However, individual traffic and the resulting high volume of traffic cannot be explained by attitudes, motives, displayed behavior, and emotions alone; instead, habits play an important role in connection with driving. What is meant by habits is then explained with a focus on habitual car choice behavior.

The power of habits has been studied in many research programs on transportation choices (Aarts et al., 1997), showing that people with strong car use habits select less information concerning other transport modes than people with weak habits. Furthermore, strong habits come along with "tunnel vision, that is, a lack of attention or interest in information" (Verplanken & Orbell, 2019, p. 67). Verplanken et al. (1994) postulate that car choice behavior is based on habits and criticize, like Triandis (1977), the usage of the application of the Theory of Reasoned Action to predict car-choice behavior. Verplanken et al. (1994) postulate that in the domain of travel mode behavior the repetitive character of mode choice plays an important role as journeys are mostly made at the same time and under the same circumstances (Verplanken, Aarts, & Van Knippenberg, 1994).

As habits are patterns of behavior that are performed without thought, there is no doubt that car choice behavior results not only from attitudes toward other modes of transportation but also from a general car choice habit, decision involvement, and car availability. Car driving is integrated into many people's every life as a matter of course. Verplanken et al. (1994) proposed a conceptual model of car choice behavior postulating that car choice behavior is predicted “from the attitude toward choosing the car and the attitude toward choosing an alternative mode” (Verplanken, Aarts, Knippenberg, et al., 1994, p. 285) and from general car habit. According to the author´s model, habit is predicted by the decisional involvement “about travel mode choice for the journey and the degree of competition in a household with respect to car use” (Verplanken, Aarts, Knippenberg, et al., 1994, p. 285) The following
Figure 22 illustrates the author´s considerations (Verplanken, Aarts, & Van Knippenberg, 1994):

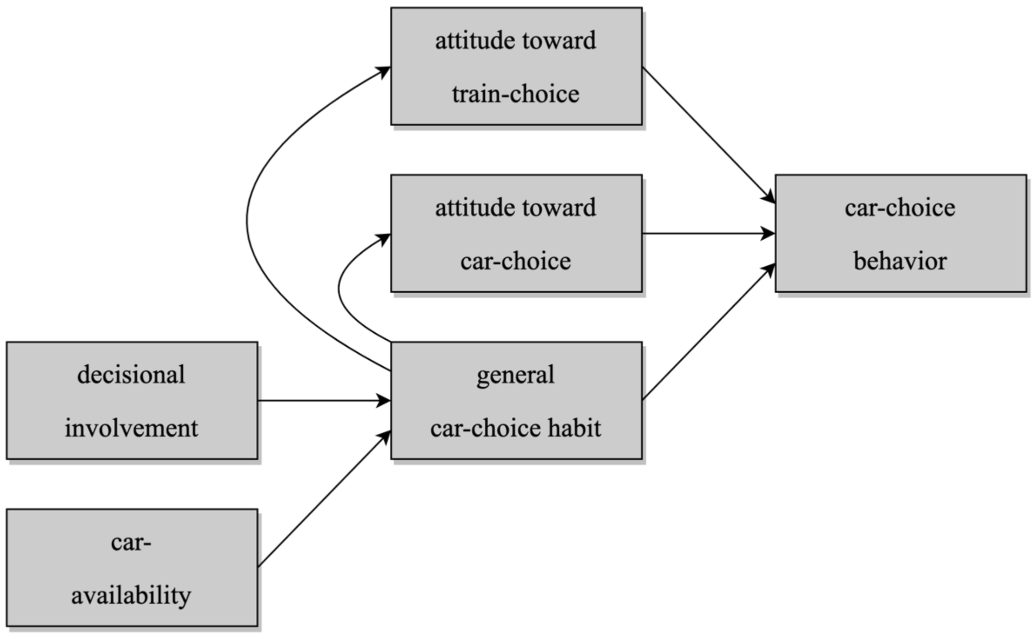

Figure 22 Antecedents of Car-Choice Behavior
Surce: adapted from (Verplanken, Aarts, Knippenberg, et al., 1994, p. 294)

Figure 22, shows that a habit can be predicted from the degree of involvement in the choice of model for the particular trip (decision involvement) and the degree of intra-household competition concerning the use of the car (Verplanken, Aarts, & Van Knippenberg, 1994). Verplanken et al. (1994) used a structured interview as a research method to test the described model. They demonstrated that habit is an important determinant of the decision to use a particular mode of transportation. Car choice behavior was well determined by attitudes toward choosing available options on the one hand and car choice habits on the other. Thus, it is evident that attitude alone is not sufficient to predict mode choice behavior (Verplanken, Aarts, & Van Knippenberg, 1994).

It is difficult to change behavior within the routine of daily behavior, as behavioral change requires implementation intentions. This requires a large portion of motivation to change, the search for the trigger of a habit, and perseverance. The easiest way to change habits is to change the individual context of a person. This is also postulated by the habit discontinuity hypothesis, which states that "behavioral change interventions are more effective if delivered when an individual´s performance contest changes, or the individual changes from one context to another" (Verplanken & Orbell, 2019, p. 71).

Neuroscientific research (see also section "biopsychological model in this chapter") began to investigate habits in the 1990s. Curiosity about a node of neurological tissue known as the basal ganglia led researchers to wonder if the basal ganglia might also play a role in habits. In animal experiments, they found that the basal ganglia activity decreased the more the behavior became automated (Duhigg, 2012). Habits develop and manifest themselves and are therefore difficult to break.

2.4. Norms and Prosocial Behavior

Behavior is influenced by personal and social norms (Triandis, 1977). Bamberg explored whether environmental behavior should be conceptualized in moral or utility-maximizing terms and concluded that moral values such as protection of the environment influence environmentally friendly behavior (Bamberg, 1999). The following section focuses on frameworks of prosocial behavior as follows:

- The Norm Activation Model (Schwartz 1977, 1981),
- Value-belief-norm theory (Stern et al., 1999, Stern 2000),
- Extension of the Norm Activation Model (Hunecke et al. 2001).

Schwartz's (1977, 1981) Norm Activation Model is a theoretical approach from social psychology, which attempts to explain environmentally appropriate behavior (Liebe, 2007). The model's basic assumption (Figure 23) is that prosocial behavior is determined by personal norms representing an individual´s perception about moral obligations to perform a specific behavior (H. Schwartz & Davis, 1981; S. H. Schwartz, 1977).

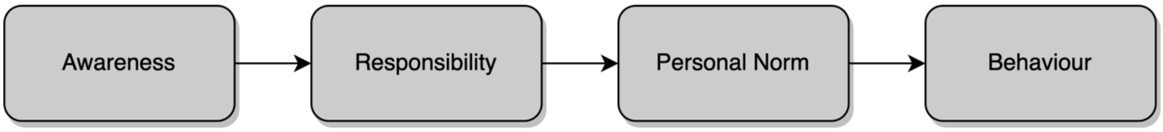

Figure 23: Basic model - Norm Activation Model (NAM)

Source: adapted from (Onwezen, Antonides, & Bartels, 2013, p. 142)

The core of the model (S. H. Schwartz, 1977) is the construct of personal norms. In contrast to social norms, personal norms are not expectations of others, but expectations that one has of oneself. Fulfillment of these expectations is associated with satisfaction, pride, and self-esteem, if the norms are broken, these results in feelings of guilt and self-contempt. Personal norms only become effective under several conditions. First, the distress of another person must be perceived as such. This is dependent on whether the distress has been explicitly communicated. The greater his willingness and ability to accept negative consequences for the help-seeker if his help is rejected, the more he will show a willingness to help. In addition, he must consider himself competent and responsible to be able to be helpful. The more he perceives an objective responsibility, he will feel more responsible due to his capabilities and competencies and the lack of other possibilities. If these activation steps are given, the potential helper constructs his personal norm for the action in question (commitment step). This personal norm is derived from his general value system and personal norms since the level of an action's subjective (social and moral) consequences are derived from these. However, from the perspective of costs, personality characteristics are responsible for whether a personal norm leads to a prosocial decision or not. If one's disposition to reject responsibility is well-developed, the more likely it is that a defensive reassessment of the decision-making situation will occur after the norm has been updated. The rejection of responsibility becomes effective the more arguments can be found to justify a decision against help, e.g., the more balanced the cost-benefit balance is. Individuals who have a strong tendency to reject responsibility will re-analyze and re-weight the costs and benefits and judge the state of distress to be less severe or their own competence or responsibility to be irrelevant. In this case, the previously constructed norm becomes obsolete. If norms are assessed as inappropriate, the defense mechanism becomes immediately effective (Schmitt et al., 1986).

Schmitt et al. (1986) critically examined the model by evaluating data from a study of adult daughters' prosocial performances on their mothers. Contrary to expectations suggested by Schwartz's theory (S. H. Schwartz, 1977), help costs do not diminish the influence of personal norms on performance but rather enhance it (Schmitt et al., 1986).

Liu et al. (2017) integrated the Norm Activation model (S. H. Schwartz, 1977) and the Theory of Planned Behavior (Ajzen, 1991) into one model to provide an understanding of transportation behavior. The authors showed a significant influence of perceived norm, attitude, and perceived behavioral control on the intention to limit car use. Personal norms act as a mediator between awareness of the consequences of car use, attribution of responsibility for car use, perceived subjective norm, and intention to reduce car use (Liu et al., 2017).

Mehdizadeh et al. (2019) tested the Norm Activation Model (NAM) by examining the effects of seasonal variation on the association between NAM theory and the use of green transportation modes. The results showed that the NAM theory was associated with green transportation use in summer, while the association was not confirmed in winter (Mehdizadeh et al., 2019).

Stern et al. 1999 (Stern et al., 1999) suggested the Value-Belief-Norm (VBN) Theory of movement support in relation to the environmental movement. The model (Figure 24) was derived from the norm-activation theory of altruism (S. H. Schwartz, 1977). According to the VBN model, altruistic, egoistic, traditional, and openness to change values are the New Ecological Paradigm (NEP), the knowledge that human actions have significant negative impacts on the environment (Dunlap et al., 2000; Dunlap & Van Liere, 1978; Dunlap & VanLiere, 1984). Different from the Schwartz Norm Activation Modell measuring problem-specific consequences, the NEP (New Ecological Paradigm) Scale (Dunlap et al., 2000) measures beliefs about the biosphere and the effects of human actions on it. From this, adverse consequences (AC) can be deduced. This model is associated with values, NEP, Awareness of Consequences (AC) beliefs and AR (Ascription of Responsibility) beliefs, and personal norms with pro-environmental actions. Beliefs related to the human-environment relationship, threats to valuable resources, responsibility for action, and, finally, activation of a sense of moral obligation that elicits a willingness to engage in pro-environmental behavior (Stern et al., 1999).

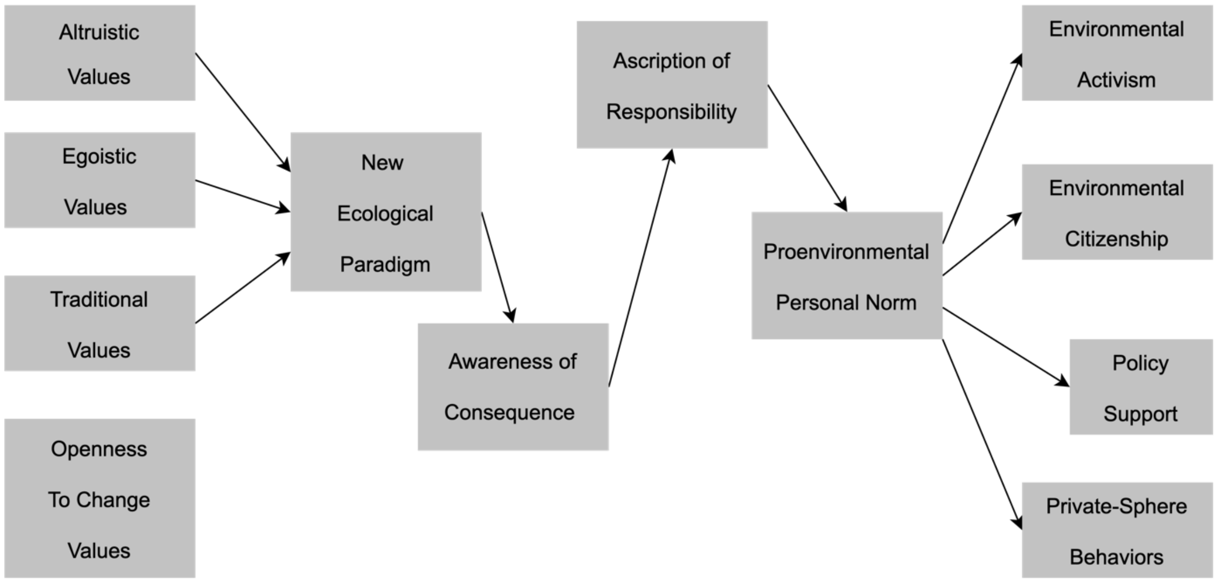

Figure 24 Value-Belief-Norm Theory (VBN)
Source: adapted from (Stern et al., 1999, p. 84)

Figure 24, shows that NEP affects Awareness of Consequences (AC), which subsequently has an impact on the Attribution of Responsibility (AR). The AR affects the pro-environmental personal norm leading to environmental activism, environmental citizenship, political support, and pro-environmental behavior (Stern et al., 1999).

Stern et al. (1999) examined the predictive value of their theory and compared it with six other models. As a result, the authors could demonstrate that the VBN theory “offers the best available account of support for the environmental movement” (Stern et al., 1999 p. 81). Other researchers (Hiratsuka et al., 2018) examined the VBN theory in Japan, finding that the more people think about the harmful consequences of car use, feel responsible for the problems caused by cars, and feel personally committed to reducing their car use, the more they endorse environmental values. Furthermore, they were able to demonstrate the mediation effect of pro-environmental beliefs and norms (Hiratsuka et al., 2018). In 2015, Lind et al. (2015) investigated whether the theory of values, beliefs, and norms could explain the mode switching reported in Norway. They demonstrated that values and beliefs explained 58 percent of the variance in personal norms, and personal norms and situational factors appeared to be significant predictors of modal choice (Lind et al., 2015).

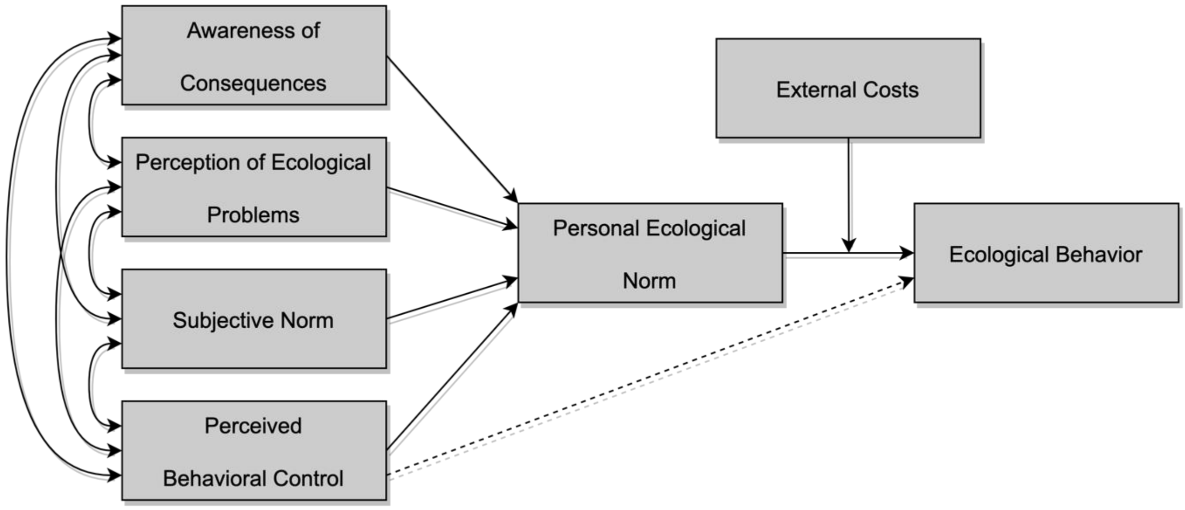

Figure 25 Modified model - Norm Activation Model (NAM)

Source: adapted from (Hunecke et al., 2001, p. 832)

Hunecke et al. (2001) advanced the Norm Activation Model (NAM) and presented their comprehensive framework for environmentally friendly behavior. As illustrated in Figure 25, external costs are integrated into the model as a moderator variable that integrates the low-cost hypothesis.

The basic idea of the low-cost hypothesis of environmental behavior is that environmental attitudes most likely and preferably influence environmental behavior in situations that are associated with low costs or behavioral requirements. The lower the cost pressure in a situation, the easier it is for the actors to translate their environmental attitudes into corresponding behavior. Conversely, the importance of attitudes decreases when a situation entails greater behavioral demands (Preisendörfer, 1999 p. 79) (Hunecke et al., 2001; Scheidler, 2010). The awareness of consequences originates from the Schwartz model and is a predictor of the personal norm. It is a significant cognitive component and is intended to capture the understanding of the effect of one's own actions. The subjective norm is derived from Ajzen (Ajzen, 2002) and directly activates the personal norm, and is seen as an important determinant of ecological behavior (Scheidler, 2010). The primary motivation of acting pro-socially is that this behavior results in benefits for other or themselves (Steg & de Groot, 2010), most of the time pro-social behavior is linked to morality (Batson and Powell, 2003, as cited in Udo et al., 2016, p. 519).

Hunecke et al. (2001) investigated the extent to which external costs influence the relationship between personal ecological norms and environmental behavior. They applied the modified model in the context of transportation by distributing free tickets for a subway ride to 50% of the participants in the field experiment. The results showed that both personal norm and external cost influence the choice of transportation mode (Hunecke et al., 2001) Other authors (Wittenberg et al., 2018) extended the model to investigate how environmental motivations, psychological, and monetary aspects influence photovoltaic (PV) households' energy-saving behavior. The findings revealed that personal norms were predicted by problem awareness and awareness of consequences, subjective norms were contributory to personal norms, and perceived behavioral control was not relevant (Wittenberg et al., 2018).

User acceptance towards innovations is a central challenge for scientists and transport planners and is closely related to a successful introduction of new innovative and sustainable transport concepts. It is defined as “the demonstrable willingness within a user group to employ information technology for the tasks it is designed to support” (Dillon & Morris, 1996, p.7 as cited in Bernhard et al., 2020, p. 110). The following subchapter presents the most relevant theoretical acceptance models in economic research.

2.5. Behavior and the Acceptance of Innovations

The success or failure of innovation depends essentially on its acceptance and thus on people's decision to use it. The concept of acceptance is a non-observable psychological construct - its roots are located in Rogers' diffusion research of the 1960s. Acceptance research is characterized by cognitive approaches such as the Theory of Reasoned Action (TRA) and the Theory of Planned Behavior (TPB) (Rüggeberg, 2009). However, the Theory of Reasoned Action (TRA) presented has been criticized as not being specific enough to explain certain behaviors, such as those related to the adaptation of innovations. In response, Davis introduced his Innovation Diffusion Theory, a model, which was developed to explain information technology adoption (Roostika, 2012). Other scientists deal with the topic of acceptance of innovations and behavioral change who view behavioral change as a multistage process being divided into different phases.

The following theories and models illustrated seek to link and explain behavioral change and acceptance of innovations or new technological achievements as follows:

- Innovation Diffusion Theory (IDT),
- Technology Acceptance Model (TAM),
- Unified Theory of Acceptance and Use of Technology (UTAUT),
- Value-Added Model (VAM).

The Innovation Diffusion Theory (IDT) developed by Rogers (2003) explains “the process by which an innovation is communicated through certain channels over time among the members of a social system” (Rogers 1995, as cited in Dibra, 2015, p. 1457). The main idea in this theory, that behavioral change is a process over time (Prochaska, J., Redding, C., Evers, 2008). The core constructs of the theory are: “*Relative Advantage* (“the degree to which an innovation is perceived as better than its precursor” (Moore & Benbasat, 1991, p. 195), *Ease of Use* (“the degree to which an innovation is perceived as being difficult to use” (Moore & Benbasat, 1991, p. 195), *Image* (“the degree to which use of an innovation is perceived to enhance one´s image or status in one´s social system” (Moore & Benbasat, 1991, p. 195), *Visibility* (“degree to which one can see others using the system in the organization”) (Venkatesh (2003), (Moore & Benbasat, 1991, p. 195)), *Compatibility* (“the degree to which an innovation is perceived as consistent with the existing values, needs, and past experiences of potential adopters” (Moore & Benbasat, 1991, p. 195), *Results Demonstrability* (“the tangibility of the results of using the innovation, including their observability and communicability” (Moore & Benbasat, 1991, p. 203) and *Voluntariness of Use* (“The degree to which use of the innovation is perceived as being voluntary or of free will” (Moore & Benbasat, 1991, p. 195), (V. Venkatesh et al., 2003).

Rogers' theory has been used primarily in transport research and sustainability studies (Dibra, 2015; Nehme et al., 2016). Moreover, it is a widely used theory that can be employed to provide a general understanding of technology adoption (Ball et al., 2020; Brancheau & Wetherbe, 1990; Karahanna et al., 1999; Wu et al., 2016). However, the model also has its weaknesses. For example, Greenhalgh et al. (2005) found that only one-fifth of the studies that used the IDT had an explicit theoretical foundation; further, the principles and mechanisms of the research would be fragmented, as most studies applied their own conceptualizations instead of a discrete model (Greenhalgh et al., 2005; Meyers, 1999; Wu et al., 2016).

Competing models try to explain the user acceptance of innovative technologies (Venkatesh et al., 2003). As an adaption of the Theory of Reasoned Action (TRA) Davis (1989) introduced the Technology Acceptance Model (TAM). He developed and validated new scales for two specific variables: perceived usefulness and perceived ease of use. He defined "perceived usefulness as "the degree to which a person beliefs that using a particular system would enhance his or her job performance", useful is capable of being used advantageously; perceived ease of use "the degree to which a person believes that using a particular system would be free of effort" (F. D. Davis, 1989, p. 320). "Perceived ease of use is supported by Bandura´s (1982) research on self-efficacy" (F. D. Davis, 1989, p. 321) , which is very similar to perceived ease of use. To Davis (1989), perceived ease of use and perceived usefulness function are the fundamental factors of user behavior (F. D. Davis, 1989).

The Technology of Acceptance Model (TAM), like the TRA, belongs to the models and theories of individual acceptance and was developed to predict the acceptance and use of information technologies. It bases on the TRA, but in TAM, the attitude construct was excluded in order to be able to better explain the intention in parsimonious terms (Venkatesh et al., 2003; Venkatesh & Davis, 2000). Its straightforward and robust structure explains an individual's key considerations for accepting information systems (Wu et al., 2016). TAM has been applied to information systems at the organizational or individual level, often in conjunction with other conceptualizations (Morris & Venkatesh, 2000). The model is illustrated in Figure 26.

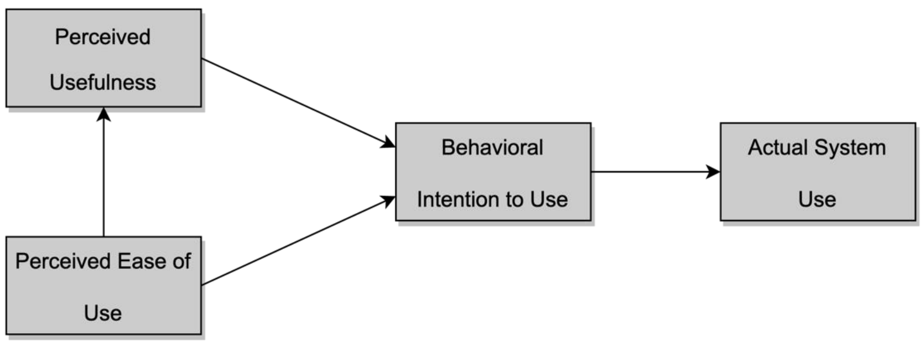

Figure 26 Technology of Acceptance Model (TAM)

Source: adapted from (Sohn & Kwon, 2020, p. 3)

In 2018, a survey was undertaken to study the acceptance of autonomous vehicles (AVs) through an extended TAM construct revealing, that the constructs “perceived usefulness“, „perceived ease of use” and “perceived trust ”and“ social influence are beneficial predictors of behavioral intention to accept AVs (Panagiotopoulos & Dimitrakopoulos, 2018). Chen (2019) studied the factors that influence the decision to use autonomous shuttle services and extended the TAM with additional variables in this regard. The results suggest that perceived ease of use and perceived usefulness are positively correlated with attitude, trust is positively related to attitude, but not to intention to use these services. Perceived enjoyment is positively related to attitude and intention to use (C.-F. Chen, 2019). Zhang et al. (2019) extended the TAM to include initial trust and perceived security risk and perceived privacy risk to examine the factors influencing user adoption of automated vehicles. They found that trust is the most important factor contributing to positive attitudes toward AVs and, along with perceived usefulness, drives users' intention to use AVs (T. Zhang et al., 2019).

The TAM omits relevant information such as social influence. Furthermore, it was criticized for lacking explanatory and predictive capabilities for technology use (Chuttur, 2009; Legris et al., 2003; Wu et al., 2016).

To address the problems with the TAM model, Venkatesh et al. (2003) developed the Unified Theory of User Acceptance (UTAUT) by redefining and integrating existing technology acceptance theories (Bernhard et al., 2020; Sohn & Kwon, 2020). The researchers developed a model (see Figure 27) with four constructs such as “performance expectancy, effort expectancy, social influence and facilitating conditions” (Venkatesh et al., 2003, p. 447), and four key moderators “gender, age, experience, and voluntariness of use” (Venkatesh et al., 2003, p. 447).

Performance expectancy is the extent to which it is believed that using the system will help improve performance. It is the strongest predictor of intention, which is moderated by gender and age. Effort expectancy is the degree of ease associated with using the system, moderated by gender, age, and experience. Social influence is the extent to which a person perceives that significant others think he or she should use the system, moderated by gender, age, experience, and voluntariness of use. Facilitating conditions are the extent to which an individual believes that an organizational and technical infrastructure is in place to support the system, moderated by age and experience. As can be seen, facilitating conditions have a direct influence on usage behavior and performance expectancy. Effort expectancy and social influence affect intention to perform a behavior that has a positive impact on technology use (Udo et al., 2016; Venkatesh et al., 2003).

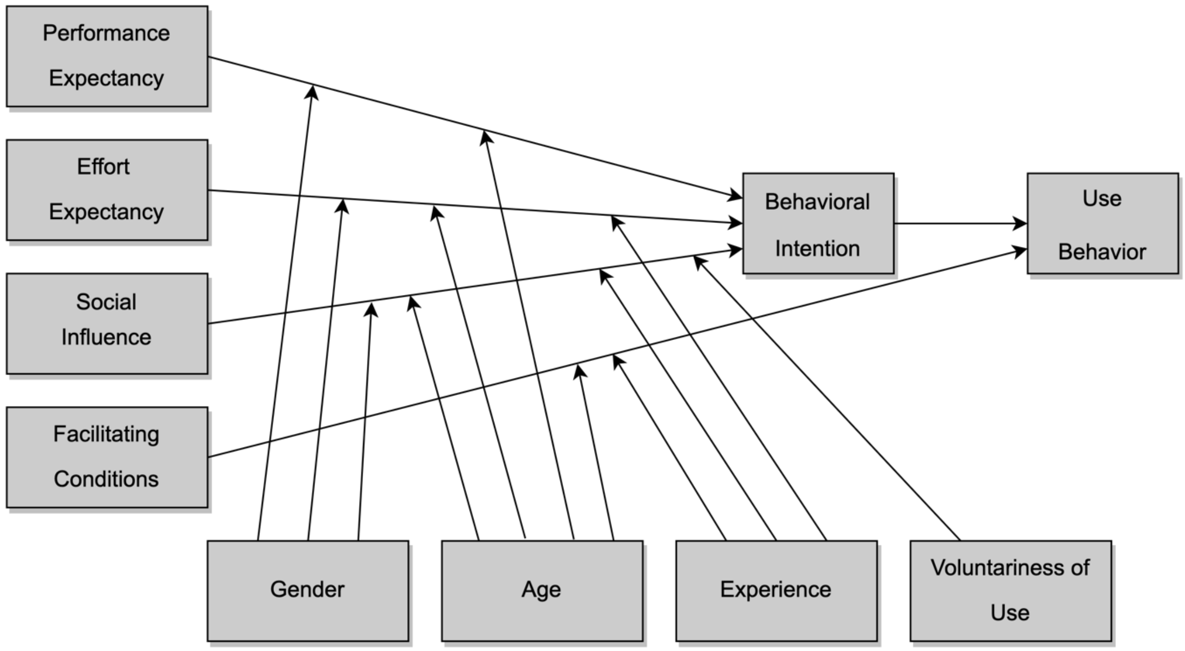

Figure 27 Unified Theory of Acceptance and Use of Technology (UTAUT)

Source: adapted from (Venkatesh et al., 2003, p. 447)

Wu et al. (2016) explored the acceptance of smartwatches and combined the Innovation Diffusion Theory (IDT) the TAM-Model and the UTAUT as well as perceived enjoyment in one model. The results revealed that attitude, ease of use, and gender have no significant effect on acceptance. Participants aged 35-54 were found to have a significant demand for enjoyment (Wu et al., 2016). Udo et al. (2016) examined the factors having an impact on digital piracy (DP). The authors used the UTAUT and the NAM as a theoretical framework. They demonstrated that personal norm, along with other factors, impacts engagement in digital piracy (DP) (Udo et al., 2016). Since inconsistent outcomes in several studies were discovered investigating the predictors of mobile banking adoption using the UTAUT, Jadil et al. (2021) conducted a meta-analysis that focused on the UTAUT theory. The researchers noted that all the UTAUT relationships showed significant results. Performance expectancy is the strongest antecedent of usage intention, and usage intention is the most important predictor of usage behavior (Jadil et al., 2021).

The UTAUT model has been criticized as it leaves out several important variables that make the framework less compatible with new predictors (Bagozzi, 2007). Furthermore, it discusses only extrinsic motivations and perceived enjoyment: intrinsic motivation was identified being an important factor for adopting new technologies. Park et al. (2012) found out that perceived enjoyment could help to increase consumers' willingness to use innovation (Park et al., 2012; Wu et al., 2016).

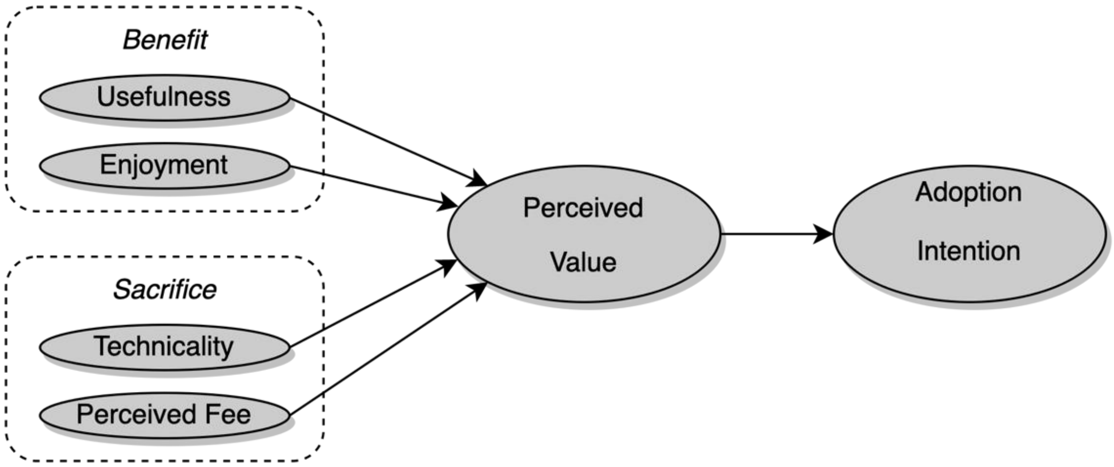

Figure 28: Value-Based Adoption Model (VAM)

Source: adapted from (Kim et al., 2007, p. 115)

The Value-Based Adoption Model (VAM) was developed to overcome the weaknesses of the TAM model (Kim et al., 2007). As seen from Figure 28, the VAM builds on two basic constructs to represent perceived values namely benefits and sacrifices. The benefit components of the perceived value are "usefulness" (extrinsic and cognitive benefit) and "enjoyment" (intrinsic and affective benefit). The sacrifice component of the perceived value (monetary in price and non-momentary aspects such as time, effort, and other unsatisfactory spending for purchase and consumption) covers "technicality" and "perceived fee" (Kim et al., 2007).

Explained, technicality is how something is perceived as being technically accurate, efficient, conveys the intended meaning, and effective on the receiver (DeLone & McLean, 1992; C. E. Shannon & Weaver, 1949). Davis (1989) defines technicality as "the extent to which an individual believes that using a particular system is free of physical and mental effort" (F. D. Davis, 1989 as cited in Kim et al., 2007 p. 116). Perceived price symbolizes the encoding or internalization of the objective selling price of a product or a service (Jacoby & Olson, 1977; Kim et al., 2007). Probably the most widely accepted definition of perceived value comes from Zeithaml (Zeithaml, 1988), to which the consumer's perception of what he receives and what he gets determines the overall evaluation of a product's usefulness (Kim et al., 2007; Zeithaml, 1988). Kim et al. (2007) show that perceived value dominates adoption intention. Moreover, the higher perceived value indicates more willingness to adopt the technology; perceived costs influence the evaluation of the value more than the benefits to be gained (Kim et al., 2007). Usefulness is an extrinsic and cognitive benefit of a perceived value. If a technology is perceived as useful, it is more likely to be adopted (Pedersen et al., 2002). Intrinsic motivation such as enjoyment has a direct influence on use (F. D. Davis et al., 1992).

Roostika (2012) investigated the mobile internet acceptance among university students using the Value-based adoption model (VAM). The results revealed that usefulness and enjoyment had a positive influence on perceived value, the perceived value had a positive effect on adoption intentions (Roostika, 2012). Within a study on behavioral intention regarding the use of artificial intelligence (AI) technologies, Sohn & Kwon (2020) compared the TAM, TPB, UTAUT, and VAM models. Results confirmed that the VAM is the best model for predicting behavioral intention. Pleasure was the determining factor in the model, why the VAM performed better than others did. It could be shown that in terms of adoption of smart products or services, pleasure is more important than usefulness. The approach of users bases on curiosity for new technologies and not on usefulness. When products have minimal practical value but are highly innovative, adoption is driven by pleasure and subjective norms rather than utility (Sohn & Kwon, 2020).

As shown, many combinations of several models exist. To understand the behavior of inexperienced potential users of an IT system, Taylor and Todd (1995) combined the predictors of the TPB model with the predictors of the TAM model in one framework (Taylor & Todd, 1995a). The IDT, TAM, UTAUT, and perceived pleasure has been combined in one model confirming that enjoyment is an important determinant explaining behavior and behavioral change (Wu et al., 2016).

Enjoyment is an emotion. Emotions affect perception and the storage of information in short-and long-term memory. It is assumed that emotions play a role in the development of personality (Bliesener et al., 2001). Not only attitudes, perceived behavioral control, values, and norms, but also habits and emotions influence the behavior of individuals (Triandis, 1977). Emotional factors contribute to the acceptance, adoption, or rejection of innovations. Thus, the following subsection deals with the roles of emotions in the decision-making process.

2.6. Five Psychological Perspectives Explaining Behavior

Behavior is usually active, well-organized, and target-oriented, but social circumstances can bias it, implicit primes and underlying motives, or biological drivers (Ryan, 2012). In its long history, psychology has experienced a variety of changing views and controversies about models and methods that attempt to explain behavior. For Wilhelm Wundt (1902), a person's feelings were the central object in his research, and introspection was one of the most important methods. In the last century, psychology in the USA and later in Germany was dominated by behaviorists. After the decline of classical behaviorism, cognitivism took its place (Zimbardo, 1992). A new field is the human approach is the Positive Psychology introduced by Martin E.P. Seligman, but already noted by A. Maslow in earlier works focusing on human strengths, satisfaction, and well-being (Asendorpf et al., 2020).

There are five psychological perspectives trying to explain behavior:

- The bio-psychological model,
- The psychodynamic model,
- The behaviorist model,
- The cognitive models,
- The humanistic approaches.

To the bio-psychological model, biological structures and processes can explain the psychological functional level of behavior. The origin of behavior is found in genetic programs, the brain, the nervous system, and the endocrine systems of the human organism. Four basic assumptions thus characterize the bio-psychological approach: psychological phenomena can be understood in terms of physical and biochemical processes, the general principle of reductionism can be applied (complex phenomena can be adequately explained by reduction to smaller phenomena, behavior is determined by physical structures and inherited processes, underlying structures and processes can be modified by experience). Behavior is molecularly analyzed, Biopsychology belongs to the field of neuroscience (Zimbardo, 1992).

In the psychodynamic model, behavior is controlled by drives, inner conflicts, and motivations, which can be both conscious and unconscious. Early childhood experiences influence behavior throughout life, often unconsciously. Human actions arise from inherited, egoistic, sexual, and destructively determined drives. The most important contribution to the psychodynamic model comes from Sigmund Freud (Zimbardo, 1992). Freud (1856-1939) developed a structural model of the psychic apparatus and a model of personality development. The structural model developed in 1923 distinguishes between the id, ego, and superego. The id comprises everything inherited, brought along from birth, the drives originating from the bodily organs; the ego mediates between the id and the outside world; the superego are norms and standards of the parents, the authorities, and the respective culture. Behavior and experience are a function of the dynamics of these three instances. According to Freud, the personality develops in stages: the phase of primary narcissism and orality, the anal phase (learning to say no, dissociation), then coping with the Oedipus Complex and latency period in late childhood, last, development into a mature adult. According to Adler, personality is formed in the tension between egoism and a sense of community and in overcoming feelings of inferiority (Bliesener et al., 2001).

The behaviorist model assumes that stimuli from the individual's environment determine behavioral responses. What is being studied here can be described with the "ABC of psychology": A = antecedent conditions that precede the behavior, B = behavioral response, C = consequences that follow. Behaviorist approaches thus focus on the observation of behavior rather than on the inner processes. Data are collected in controlled laboratory experiments in which stimuli are presented and responses recorded. The methodological ideal is quantifiability. For behaviorists, general principles of behavior transcend species. Therefore, animal experiments are the key to explaining human behavior. John B. Watson was significantly involved in the emergence of behaviorism. He drew on the learning concept of the Russian physiologist Pavlov, who discovered that a physiological reaction that was originally triggered only by food could be triggered after some time by another stimulus. Watson, however, was more interested in the learned association itself, while Pavlov focused on the physiology of the learned association (Zimbardo, 1992).

In contrast to behaviorists, cognitivism deals with the "black box", i.e., the inner processes in an individual cognitive approach encompass the processes of perceiving, reasoning, remembering, thinking, problem-solving and decision making, the structures of memory, concepts, and attitudes, summarized around the processes of information processing. According to the model, information from the environment is taken in before a reaction takes place; the active process of cognition is interposed. People react to their own subjective representation of reality and not as it exists as an objectively describable material world. In this model, thoughts are both outcomes and causes of overtly observable actions. Feelings such as regret are an example of cognition occurring because of an action. Learning models belong to the cognitive approaches explaining, how concrete actions and attitudes are related to personality. According to Bandura's approach, (Bandura & Health, 1986), people learn by observing other people and imitate people they like and whose behavior has proven successful. He developed the concept of self-efficacy, self-efficacy is the belief that one can achieve or make a difference in a particular situation (Bliesener et al., 2001; De Vos et al., 2013). In social cognitive behavior theory (Bandura & Health, 1986) behavior consists of a reciprocal relationship between personal characteristics and the environment and acts as interacting determinants (Van Acker et al., 2010).

Probably the dominant model is the cognitive model, but variants of humanistic models have become increasingly important. To this cognitive model, people strive to realize their potential, seek change, and plan their lives, giving them a structure to achieve optimal self-actualization. Behavior is examined based on life stories. Representatives include Car Rogers, Rollo May, and Abraham Maslow. Humanistic psychology focuses on how inner processes deliver new insights and value orientations (Zimbardo, 1992).

The humanistic and cognitive models are similar in that people experience their world subjectively as opposed to the behaviorist model, which focuses on observable behavior. The major difference between the cognitive and humanistic models is that in the cognitive model, the internal processes of information processing are divided into steps and linked to observable aspects of behavior, and in the humanistic model, it is about how internal processes lead to new insights and value orientations (Zimbardo, 1992).

2.7. Human Motivation Directing Behavior

“People’s motivation is explicit and conscious; at other times behavior is clearly energized and directed by nonconscious, implicit aims and attitudes. Finally, whether motives are implicit or explicit, the behavior organized by them will be variously successful” (Ryan, 2012, p. 3).

The history of motivation research can be distinguished into four lines. There are approaches to will phenomena, as externally caused or internally driven (Wilhelm Wundt 1832-1920). Another approach is the experimental will psychological research with Narcissus Ach (1910), instinct theoretical motivation research with the characterization of instinct. In contrast, motivation is captured with behavioral ethological concepts (McDougall, 1908), personality theoretical approaches (Freud 1900-1915) and associative research composed of learning psychology (James, 1890 and Thorndike, 1898) and activation psychology approaches (Pavlov, 1927). Finally, systematic and experimental learning research emerged with Thorndike (1874-1949 and James (1842-1910). James already coined the explanatory term "habit", which became central for learning research. However, the starting point of motivation research was Darwin (1859) with his thesis of natural selection and "survival of the fittest”. Galton (1822-1911) and Binet (1857-1911) are the founders of the personality test development, which was later incorporated into the personality theory line of motivation research by Allport (1937), Murray (1938), and Cattell (1950) (H. Heckhausen, 2010).

The key question of motivation is whether actions are influenced by the past, embedded in the present, or oriented towards future goals as well as whether they are determined by the situation (extrinsic motivation) or by the person him/herself (intrinsic motivation) (Bliersbach et al., 2002). In self-determination theory (SDT), developed by Deci and Ryan (Deci, 1971; Deci & Ryan, 1985) it is assumed that people are naturally active and therefore show proactive behavior towards their environment. The basis for exhibiting this behavior is intrinsic motivation. Humans have an evolutionary tendency to integrate and organize psychological resources. This process involves internalizing different types of information from the environment (values, attitudes, circumstances, and knowledge) and integrating the regulation of internal needs (e.g., drives and emotions). Autonomous motivation is intrinsic motivation and internalized extrinsic motivation based on the natural integrative tendency. “Nonintrinsic, socially transmitted motivations and regulations can become fully internalized and form the basis for autonomous or self-determined extrinsically motivated behavior" (Ryan & Deci, 2003 as cited in Ryan, 2012, p. 88).

Motives play a role in what behavior is performed, especially in the context of mobility behavior. Motives are reasons for action (movere, Latin: to move). The goal of action is the satisfaction of motives. Motives refer to individual motives for action; motivation is the totality of motives that are effective in a current situation. Motives and motivation are hypothetical constructs that are not directly observable but can only be derived from behavior (Bliersbach et al., 2002). Motivation sets human action in motion, is comparable to learning, helps to explain observed changes in behavior (Zimbardo, 1992), it is based on the "need" or "drive" for self-preservation. Cognitive/goal theories look at individuals' evolved and psychological needs and motives replacing the "old drive theory" (Ryan, 2012, p. 4) of Hull and Freud with a different set of drivers (Ryan, 2012).

One of the best-known motivational theories is Maslow´s hierarchy of five needs (see Figure 29) postulating that actions are driven to satisfy specified desires. The "hierarchy of needs" (Taormina & Gao, 2013) was introduced in 1943, suggesting that basic needs must be fulfilled before an individual can move on to more advanced needs.

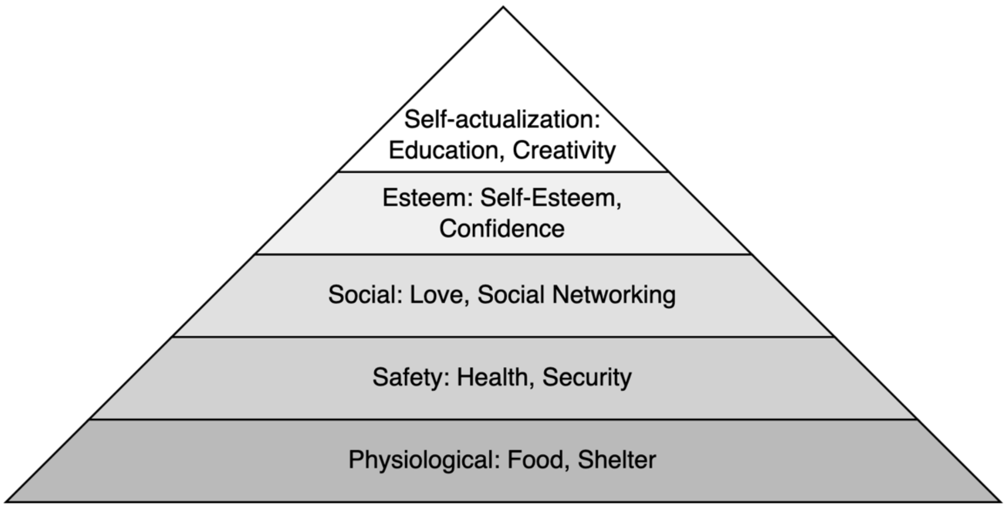

Figure 29 Maslow´s (1908 – 1970) Hierarchy of Needs

Source: adapted from (Gebhardt & Fateri, 2014, p. 2)

Maslow sees physiological needs as the basic level of his five-level hierarchy of needs. Once these needs are met, saftety needs follow. The next category is social needs, as people desire social recognition and social relationships. After that, the individual tries to satisfy his own needs in the form of success, freedom, independence, reputation, esteem or even prestige. The highest need is the need for self-actualization, which according to Maslow is the realization of one's own potential (Taormina & Gao, 2013).

In summary, human beings have a need or a drive for self-preservation, and motivation is based on such a need. Maslow´s hierarchy assumes that survival takes precedence over all considerations; survival must be assured before another need becomes active. Maslow (1971) described experiences similar to flow as ‘‘loss of ego,’’ ‘‘self-forget-fulness,’’ ‘‘loss of self-consciousness,’’ and even ‘‘transcendence of individuality’’ and ‘‘fusion with the world’’ (Maslow 1971, pp. 65–70 as cited in Csikszentmihalyi, 2014, p. 141).

A flow experience occurs if a person is actively engaged physically, emotionally, or intellectually, with the environment. People are motivated by doing pleasant activities and having optimal experiences and getting into the flow. Only flow activities result in flow experience (Csikszentmihalyi, 2014). Thus, Csikszentmihalyi developed the flow theory (Csikszentmihalyi, 2014), which should help to explain when an activity is experienced as enjoyable. There are complementary lines of explanation: Behavior is personally rewarded when trial and error learning turn out to be an effective strategy to achieve goals. Overcoming challenges and salience is therefore adaptive and increases the chances of success. Second, it is an internalized drive that serves the purpose of either the id or the superego; in this and the previous case, the behavior is a manifestation of other drives pursuing their own goals. Third, a person may choose to engage in such behavior because of innate or learned psychological needs like competence and autonomy: The pleasure experienced in intrinsically motivated behavior mainly results from satisfying these basic psychological needs. Fourth, it is the "phenomenological account" (Csikszentmihalyi, 2014, p. 229), what people experience while engaged in activities that involve mastery, control, and autonomous behavior (Csikszentmihalyi, 1977, p. 49), without presupposing the causes why such experiences occur. It is believed that the human organism is a system in its own right, not reduceable to dearly held levels of complexity such as stimulus-response pathways, unconscious processes, or neurological structures. All four of these types of explanations are compatible, support each other and move the organism in the same direction. It often happens that genetically programmed instructions conflict with learned instructions or that the unconscious pushes in a direction that contradicts what phenomenological reality proposes. Number four focuses on events that take place in the individual's consciousness, which is the field of study of the flow experience: people seem to act for the sake of activity, which is called autotelic activities, people perform activities but without any detectable extrinsic rewards. Flow is thus perceived as a pleasant subjective experience that needs to be repeated. It is accordingly a subjective state: a person is completely involved in something so that they forget about time, fatigue, and everything else except the activity itself. Flow is responsible for other subjective qualities, such as the merging of action and consciousness. During flow, people experience the loss of self-control, the “me” disappears, and the “I” takes control. People experience an absence of fear of losing control. Worrying about whether what one is doing can succeed is one of the primary sources of psychic entropy in everyday life. Reducing it during flow is one of the reasons why such an experience is pleasant and thus perceived as rewarding. People have an altered sense of time because during flow, attention is fully invested in the moment-to-moment activity and time quickly passes. Time passes faster (Conti, 2001 as cited in Csikszentmihalyi, 2014).

For the flow experience, an activity must have goals, as goals help to give direction and purpose to the behavior. Flow is a balance between perceived challenge and perceived ability. When perceived challenge and skills match, attention is fully absorbed. When challenges begin to exceed abilities, one becomes anxious; when abilities begin to exceed challenges, one becomes bored. Experiencing flow depends on whether there is clear and immediate feedback. It is vital to ensure that the person is informed about how well they are making progress in the activity and whether the present course of action needs to be adapted or kept. In summary, flow is characterized by a clear set of goals, optimal challenges, and explicit and immediate feedback. If these points are followed, the intrinsically rewarding engagement is achieved (Csikszentmihalyi, 2014).

Figure 30 is representing the original model, if options for action are considered too demanding, the resulting stress is experienced as anxiety. Anxiety arises when the challenges are still demanding but the capabilities are still high. If the opportunities for action are in balance with the challenges, flow occurs. If the capabilities are greater than the opportunities to use them, boredom arises, which then turns into anxiety when the gap becomes too large (Csikszentmihalyi, 1977).

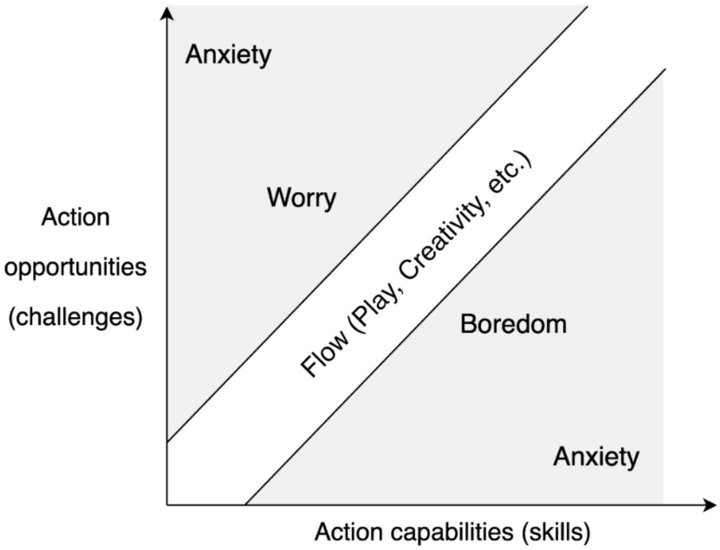

Figure 30 The original model of Flow

Source: adapted from (Csikszentmihalyi, 1977, p. 49)

Csikszentmihalyi (1977) studied the differences between happier and less happier individuals using the concept of the “eight channels of experience” (Csikszentmihalyi, 2014, p. 75). As illustrated in Figure 31, the current model of flow comprises the mental states “anxiety, arousal, flow, control, relaxation, boredom, apathy, worry, anxiety” (Csikszentmihalyi, 2014, p. 248).

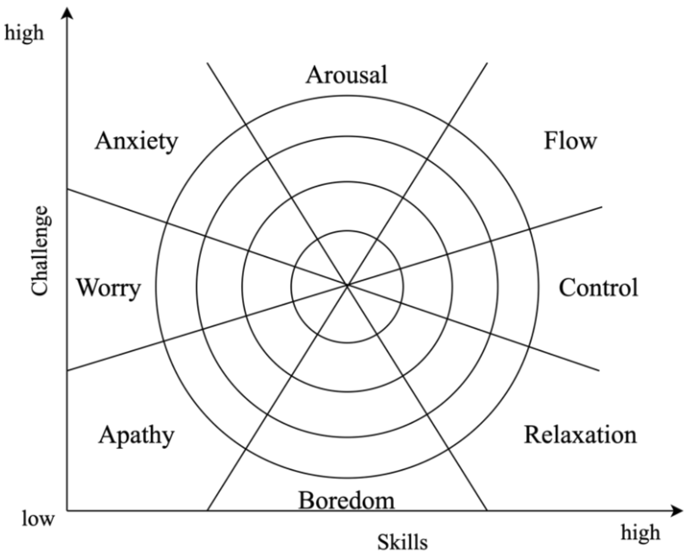

Figure 31 The current model of the flow state

Source: adapted from (Csikszentmihalyi 1977, as cited in Csikszentmihalyi, 2014 p. 248)

A flow feeling occurs when the challenges and abilities perceived by an individual are over the average level; if they are below, the actor experiences apathy. As the concentric rings show, the intensity of the experience increases with distance from the average level of the actor's challenges and abilities (Csikszentmihalyi, 2014, p. 248).

Commuting and flow are reported to have little in common, as commuting is often reported as one of the least, enjoyable daily activities (Te Brömmelstroet et al., 2021). To Schiefelbusch (2010), travel experience is "the sensual and perceptual impressions acquired through all the sense while traveling" (Schiefelbusch as cited in Te Brömmelstroet et al., 2021, p. 5). Flow theory consequently helps to provide important insights into how daily mobility contributes to greater satisfaction and sustainability (Te Brömmelstroet et al., 2021). The problem is that many people enjoy car driving and tend to exert themselves while driving, which goes hand in hand with a subjective feeling of dominance. Claims of power and dominance are asserted through driving skills and a powerful vehicle. For many, pushing a high-performance vehicle to the limit is associated with enjoyment and well-being (Bliersbach et al., 2002).

However, if driving is done under time pressure and it is difficult to reach the destination due to heavy traffic, impatience and stress arise (Bowen et al., 2020; De Vos et al., 2013; Paschalidis et al., 2019; Rendon-Velez et al., 2016; Zhao et al., 2020). Travelers experience satisfaction and well-being when there is no time pressure or when looking at a beautiful peaceful landscape. Well-being can also increase through active participation in travel. People who are not active due to mobility limitations have less well-being (De Vos et al., 2013; Ferdman, 2021; Kou et al., 2018; Pantelaki et al., 2021; Shliselberg et al., 2020; Vella-Brodrick & Stanley, 2013). Gaining the ability to actively participate in transport and developing competencies increases feelings of satisfaction. In this case, people develop a higher confidence in themselves to be able to achieve certain goals. From a mainstream perspective, well-being is an individual-subjective phenomenon (De Vos et al., 2013). Kwarciński & Ulman (2018) distinguish between four kinds of well-being theories, the human flourishing well-being theory based on Kraut (2007) and Seligman (2011), referring "to Aristotelian eudemonism" (Kwarciński & Ulman, 2018, p. 30), "hedonistic theories, desire-fulfilment theories and objective list theories" (Kwarciński & Ulman, 2018, p. 31). To the authors, the hedonistic view is "what would be best for someone is what would make his life happiest. On Desire-Fulfilment Theories, what would be best for someone is what, throughout his life, would best fulfill his desires. On Objective List Theories, certain things are good or bad for us, whether or we want to have the good things, or to avoid the bad things" (Parfit, 1984, p. 493 as cited in Kwarciński & Ulman, 2018, p. 31). Kwarciński & Ulman (2018) developed a hybrid wellbeing index (HWB) based on a theoretical philosophical analysis and operationalized using econometric techniques. By proposing a HWB index, the authors bridge the gap between philosophy and economic measures. The eudaimonic understanding of well-being is to live in a way that reflects "one's daimon of true self, which becomes possible by identifying one's potential strengths and limitations and choosing those goals that provide personal meaning and purpose in life" (Waterman et al., 2010, p. 42 as cited in Vos et. al. 2013). To De Vos et al. (2013) travel affects both hedonic and eudaimonic aspects of well-being (De Vos et al., 2013).

Following Maslow´s hierarchical pyramid for needs, Csikszentmihalyi´s flow concept, a short description of well-being theories and the briefly outlined HWB index (Kwarciński & Ulman, 2018), a further model, Heckhausen´s "Rubicon model of action phases" is presented in Figure 32. The model provides a structure that attempts to explain how human motivation can be transformed into action and goal achievement. Not only the role of motivation, but also the role of volition is the focus of consideration and provides a further explanation for motivation or goal-oriented action (H. Heckhausen et al., 1987).

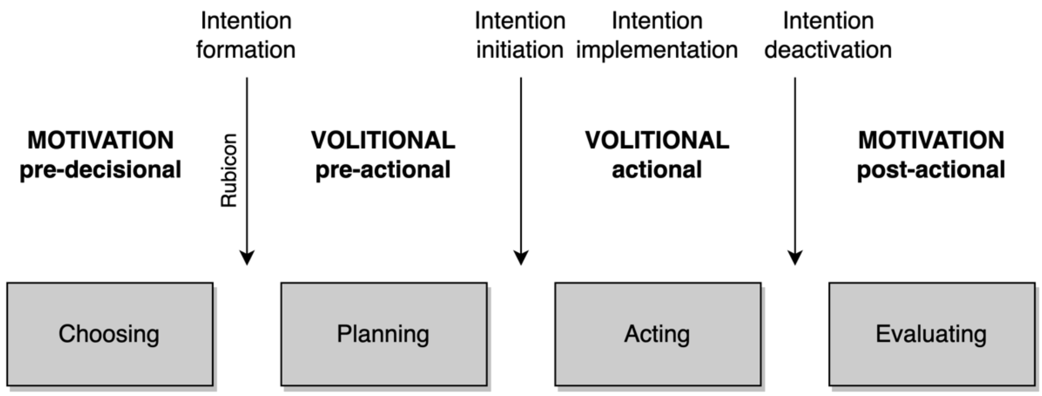

Figure 32 Rubicon model

Source: adapted from (Heckhausen & Gollwitzer, 1987 as cited in Heckhausen, 2007, p. 167)

As seen from Figure 32, these two basic problems, namely the choice of goals for action and its realization were integrated into a framework model (H. Heckhausen et al., 1987). The framework model goes from desiring to choosing (goal selection) and from choosing to wanting in the acting goal pursuit. The model attempts to provide answers to how an agent selects his goals, plans their realization, carries out the plans, and evaluates his efforts to achieve his action goal (Achtziger & Gollwitzer, 2009). As illustrated, the course of action distinguishes the four phases (choosing, planning, acting, evaluating) that follow one another. Each phase involves a different task, each of which must be successfully completed before moving on to the next phase. Phase 1 (Choosing) is the weighing phase (pre-decisional motivational action phase), in which the desirability and feasibility of the various desires and concerns are weighed against each other. The transformation from a desire to a goal is called "crossing the Rubicon" and is "the goal formation intention". In this phase, one is committed to oneself to put the goal into action. Phase 2 (Planning) is the pre-actional volitional phase. In this phase, the goal is willed, and consideration is given to the strategies to be used to realize the goal that was set in the first phase. In this phase, resolutions and plans are developed that are conducive to achieving the desired goal, and consideration is given to how problems can be solved. The third phase (Acting) is the phase of action (actional, volitional phase), in which the planned actions from the previous phase are implemented to achieve the goal. Here, the implementation of the action is determined by the degree of self-commitment, volitional strength. This is only possible if one does not get discouraged in case of setbacks, but rather when interrupted, restarts the work in order to achieve the set goal, e.g., by increasing the effort. The last, fourth phase (Evaluating) is accompanied by an assessment (post-actional motivation phase), in which the result of the project is evaluated: how well was the goal achieved, if it was not achieved, it is reflected on whether the goal could have been achieved by other methods (Achtziger & Gollwitzer, 2009). The main assumption of the Rubicon model is that each phase is associated with a specific cognitive orientation that should support solving the task at hand (deliberating, planning, acting, evaluating) (Brandstätter et al., 2013).

"Traits are not the same as motives: instead, traits channel or direct the ways in which motives are expressed in particular actions —sometimes channeling them in strange directions" (Winter, 2005 p. 569). Thus, the following subchapter deals with personality traits in the context of travel behavior.

2.8. Personality and Emotions Directing Behavior

Since ancient times, it was considered useful to distinguish between two types of person characteristics, namely states and traits. (Chaplin et al., 1988). Thus, the following subchapter starts with aspects of personality and emotions focusing on the irrationality of car driving as follows:

- Aspects of Personality,
- Historical and contemporary views on personality and character,
- Personality models,
- Historical background of irrationality and emotions,
- Definition and function of emotions,
- The Irrationality of Car Driving,
- “To have is to be?” A theoretical model of material possession.

In the discipline of psychology, the concept of personality is used in different ways; however, consensus can be observed in the followings aspects (Otto, 2000):

⇒ Personality is an organized set (a system) of characteristics of a person (system character).

⇒ The traits of a person are more or less stable over time (time stability)

⇒ Temporally fluctuating conditions are known as "states".

⇒ Stability over time is only relative, as personality traits can change throughout a person's life span.

⇒ The individual traits differ from other persons, are therefore typical for the given person (individuality).

The human journey to grasp the personality began with Galen, who lived in the second century AD. He advocated the doctrine of the four temperaments: the melancholic, the choleric, the sanguine, and the phlegmatic. Immanuel Kant, in his book on "Anthropology," brought the doctrine of the four temperaments up to date and made it popular and acceptable to science. W. Wundt (1874) was the first to translate the categorical types into continuous dimensions (Figure 33), pointing out that choleric and sanguine have the property of changing, while phlegmatic and melancholic are unchanging (Eysenck et al., 1981).

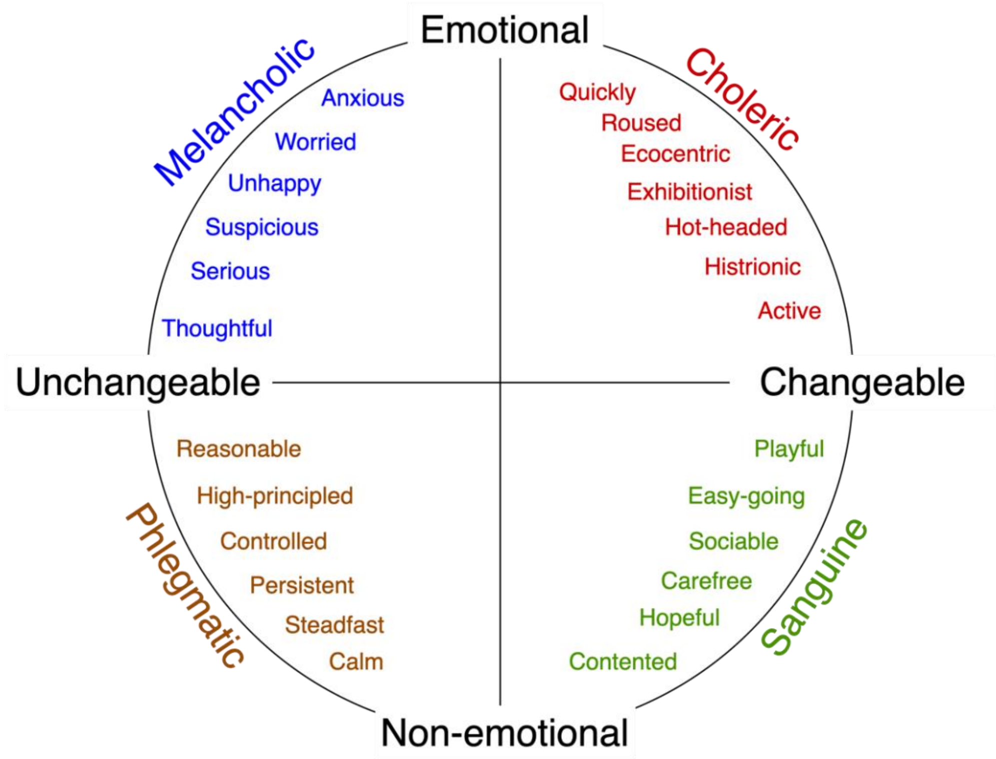

Figure 33 Traits traditionally associated with the "four temperaments" of Galen, arranged along two major dimensions of personality (according to Wundt, 1874)

Source: adapted from (H.J. Eysenck et al., 1981 p. 8)

Ernst Kretschmer (1940) assigned different forms of temperament, character, and behavior to the respective physique and tendency to illness; he distinguished between leptosomes, pycnics, and athletes as physique types. (Bliesener et al., 2001). Allport and Odbert (1936) made a classification of almost 18,0000 terms provided in Webster´s Unabridged Dictionary. Norman (1967) updated the first classifications as follows: temporary state, temporary activity, social role, or relationship, or one of four exclusion categories. The classification of each term used was based on the assessment of stability over time. Allport and Odbert (1936) categorized the terms referring to consistent and stable forms of adaptation of an individual to his environment as traits (p. 26), states were defined as present, transient mental states (Allport & Odbert (1936, p. 26 as cited in Chaplin et al., 1988 p. 542), Norman (1967) (Norman, 1967 as cited in Chaplin et al., 1988 p. 542) distinguished traits from two types of transient traits - states and activities (Chaplin et al., 1988). Cattell (1943) undertook a reduction of the extracted personality terms from Allport and Odbert (1936) to 35 clusters of 6 to 12 terms (Cattell, 1943, 1946b, 1946a, 2009). These term clusters were narrowed down to

5 factors by Tupes & Christal (1958, 1992) and interpreted as extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience (Rammstedt, 2007). Eysenck et al. (1981) developed a personality system in which a person's personality can be described as the result of the expression of the dimensions introversion vs. extraversion and neuroticism vs. stability (neuroticism). His theory is not a personality typology, but a factor theory based on personality dimensions (Eysenck et al., 1981). Later, he added the dimension “Psychoticism vs. Socialization” (1993). This dimension is supposed to determine the likelihood of a person easily losing their temper, rebel against the system, or act regardless. Eysenck suspected that traits are genetic by postulating that through different levels of brain arousal, either extroversion or introversion is formed. Canli et al. (2000) confirmed this by showing that the amygdala, an important emotion center in the brain, is enlarged on the left side in extroverts.

Another model describing personality is the Five-factor model which has been applied to describe the overall personality (Bliesener et al., 2001). It is based on the lexical approach (Eysenck, 1970), which assumes that all-important inter-individual differences of a language are represented by corresponding terms (De Raad et al., 1988; John et al., 2010). The five dimensions of the model are described as follows (Rammstedt et al., 2013):

- ⇒ Extraversion: sociability, activity, talkativeness, and assertiveness; inversion pole: quiet, taciturn, withdrawn.
- ⇒ Agreeableness: description of interpersonal behavior, if high expression: altruistic behavior, a tendency to interpersonal trust, cooperative, yielding, if low expression: cool, critical, distrustful
- ⇒ Conscientiousness: purposeful, persistent, disciplined, and reliable; inversion pole: careless, indifferent, inconstant
- ⇒ Neuroticism: emotional lability. High expression: Prone to insecurity, tend to react nervously, anxiously, depressed.
- ⇒ Openness to experience: Interest in new experiences, adventures, and impressions, high expression: inquisitive, imaginative, intellectually, and artistically interested, low expression: Tendency to have fixed views, little interest in new things, and rather conservative.

The best known and most comprehensive questionnaire is the “Neuroticism-Extraversion-Openness Personality Inventory (NEO-PI-R)” (Costa & McCrae, 1992) with 240 items, the short version of the NEO-PI-R is the “NEO-FFI (Neuroticism-Extraversion-Openness Five Factor Inventory)” (Costa & McCrae, 1989) which includes each of the five factors with 12 items. The “Big Five Inventory” (BFI) (John et al., 1991, 2010) is known as an economic instrument because it has 44 items. Since these instruments are too long in research, the BFI-10 (Rammstedt, 2007; Rammstedt & John, 2007) was developed. The BFI-10 includes 10 items and based on the BFI of John, Donahue & Kentle, 1991 (John et al., 1991). Objectivity is considered to be given due to the standardization of the evaluation and the assignment of a numerical measurement value describing the respondent's expression in the 5 dimensions of personality. Rammstedt and John (2007) report sufficient to good reliability coefficients for the subscales of the BFI-10 at a six-week retest interval; content validity and factorial validity were confirmed (Rammstedt & John, 2007).

There is a rich body of research where the Big Five Inventory (BFI) has been used. For example, authors examined the relationship between the “Big Five personality traits and daily spatial behavior” (Ai et al., 2019, p. 285). The results revealed that “extraversion positively related to daily spatial behavior, especially to the number of different places visited, the total distance traveled, and the entropy of movement. Agreeableness positively related to the range of movement. Conscientiousness negatively related to the number of different places visited. There was no evidence that neuroticism and openness relate to daily spatial behavior” (Ai et al., 2019, p. 285). Riendeau et al. (2018) were able to show in a study that personality factors are related to driving safety. Linkov et al. (2019) studied the driving behavior of truck drivers and correlated the behavior with the Big Five personality traits, sensation seeking, and present-moment perspective. It was found that truck drivers who had high scores on Sensation Seeking drove faster than those who had higher scores on the Conscientiousness trait. This has already been confirmed in previous studies (Linkov et al., 2019).

Other authors investigated the influence of Big Five personality traits in combination with various socio-demographic factors and accident involvement experiences on deviant driving behavior. This study found that respondents who had experienced accidents in the past had a higher Agreeableness score, female drivers who had a high Conscientiousness score were less likely to commit orderly violations. Neuroticism was positively correlated with aggressive violations (Hussain et al., 2020). Milfton & Sibley (2012) investigated the question of whether personality influences environmental engagement. They investigated correlations between the Big Five personality traits and environmental engagement. It was shown that Agreeableness, Conscientiousness, and Openness to Experience are the traits most strongly associated with environmental commitment (Milfont & Sibley, 2012) Another study examined the relationship between personality traits and environment. It was shown that greater environmental commitment is related to higher scores on Agreeableness and Openness, with smaller positive correlations occurring with Neuroticism and Conscientiousness (Hirsh, 2010). Critics of the trait models argue that these models cannot explain how a particular behavior arises in a particular situation or how personality develops (Bliesener et al., 2001).

Personality traits are associated with many dysfunctional behaviors, such as risky behavior, which can be seen, e.g., from car drivers (Lucidi et al., 2014) e.g., sensation seeking is generally understood as an individual need for novel, intense and complex stimuli and situations (Roth & Hammelstein, 2003). Zuckerman (1994) defines sensation seeking as a behavioral disposition based on genetics and biochemistry. People have a need for varied, new, and complex impressions with a willingness to accept social and physical risks. The concept goes back to sensory deprivation studies, Freud's drive theory, and the model of optimal mood and arousal. Zuckerman distinguishes between thrill and adventure-seeking (tendency to engage in risky activities), experience-seeking (tendency to seek new experiences such as travel and drugs), disinhibition (e.g., loss of self-control) (Gössling, 2017), and boredom susceptibility (tendency to avoid boring and repetitive people and situations) (Asendorpf et al., 2020). For example, Zuckerman and Neeb (1980) found out that individuals who exceed speed limits score high on the Sensation Seeking Scale (Gössling, 2017; Zuckerman, 1994).

Road violence is positively correlated with sensation seeking (Linkov et al., 2019; J. Yang et al., 2013), racing and driving at high speeds lead to a sensation of acute danger, behavior such as speeding or avoidance of public transport can be related to both personality traits and emotions (Gössling, 2017). Speeding stimulates the central nervous system (CNS) and can have a narcotic effect like the effect of a drug (Diekstra & Kroon, 2004). Speeding leads to hormonal "kicks" due to the increased stress situation, stress and the perception of increased danger to fight-or-flight reactions. Conditions like these result in the release of hormones to better cope with the situation in question. The hormones released epinephrine (adrenaline) and norepinephrine as well as cortisol influence body functions such as blood pressure or heart rate and increase blood glucose levels, leading to a state of arousal. The two main stress systems relevant to stress, emotions and behavior are the sympathetic nervous system (SNS) and the hypothalamic-pituitary-adrenal (HPA) axis (Gössling, 2017; Wirth, 2011). The periaqueductal grey (PAG) is connected to many areas of the brain. It is a part of the limbic system, which is relevant for emotional behavior. It may also have a role in modulating perception to salient internal-external stimuli related to survival, emotion, and memory. Neuroimaging data of the "human brain behind the wheel" (Navarro et al., 2018, p. 464) confirms that driving is an activity that relies on many regions of the brain (Navarro et al., 2018).

For many, car identity is synonymous with personal identity. However, the extent to which this is true depends on the situation, developed through childhood experiences, social environment, and comparison with others (Giddens, 2008; Phillips & Daniluk, 2004). Through cars, humans extend their capabilities, which gives the car its identity. This identity makes the car a close-knit trusting partner (Gössling, 2017). Generally speaking, "material possessions are psychologically important because they intimately bound up with our sense of identity" (Dittmar, 2008 p. 25). In other words, they extend the self because they exceed the boundaries of the human physical body. The tie between possessions and the self is strong because they give people a sense of control and express personal and social identity (Dittmar, 2008).

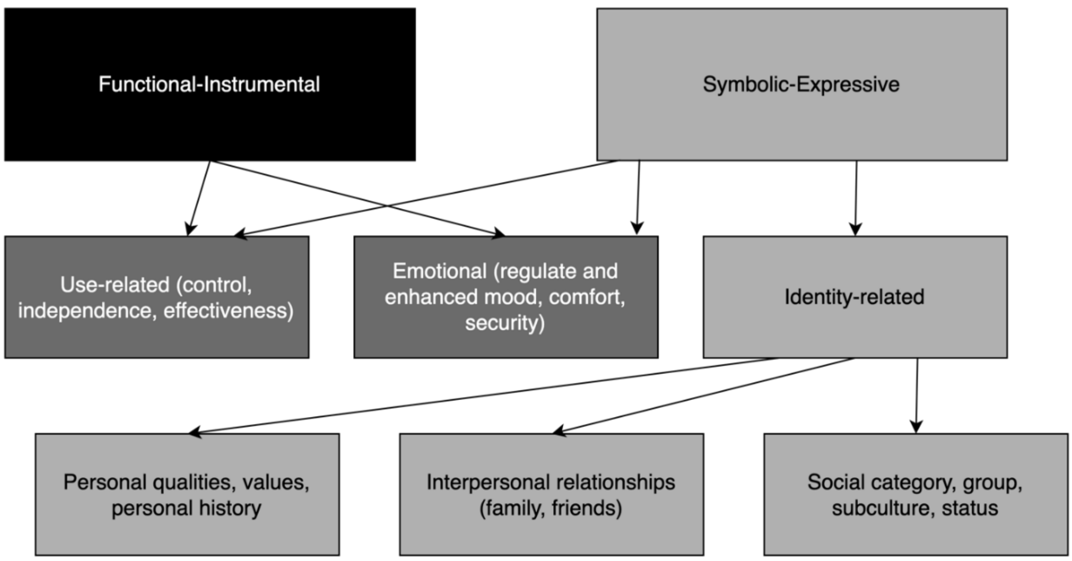

Figure 34 Integrative model of the psychological function of material possessions

Source: adapted from (Dittmar, 2008 p. 40)

Dittmar (2008) developed the model (Figure 34), which is an integrative model, providing an analytical, hierarchically ordered map of the main types of psychological functions that material possession fulfills. Dittmar (2008) made a distinction between instrumental-functional and symbolic-expressive use of material objects. The instrumental-functional use of material objects shapes everyday activities efficiently and exercises control over the environment. Symbolic functions express who one is. From the lower level in the hierarchy, it is evident that possessions have use-related and emotional functions that relate to both instrumental and symbolic dimensions. For example, the car is linked in terms of use as a means of transportation with the symbolization of freedom, independence, and sex appeal of the owner (Dittmar, 2008).

The symbolic values relate to a person's identity, they are an expression of self, are a social-categorical expression indicating the social position or group membership. Concluded, material goods have three functions: instrumental, symbolic, and affective. For cars, the instrumental function is the car as a transportation tool. The symbolic function implies self-expression through the car as well as one's social position, the affective function refers to the connection with deeper non-instrumental needs. Thus, these functions can be viewed as different types of motives for car use (Steg, 2005).

Summarizing, decision-making and behavior are not only based on information but on the individuals' states and traits, attitude, toward him- and herself, the environment or the acceptance of an innovation, the personal and social norms, and the importance of material possession such as possessing a car as a status symbol. It is assumed, that emotional barriers oppose decisions in favor of sustainable mobility behavior. The following section deals with the history of emotion research, definitions, and classification of emotions and briefly introduces the risk as a feeling hypothesis.

The origin of irrationality was already described by Plato (427 B.C. - 347 A.D.) and leBon (1895/1960) to the extent that, under the influence of masses of people, they stop thinking and become subject to social disorder (Zimbardo, 1992). The history of emotions can be divided into the phases of the "Golden Age", the “Dark Age” and the “Renaissance”. The Golden Age phase includes Darwin with his publication on the expression of emotions (Darwin, 1872), the theories of James (James, 1884), and Lange (Lange, 1887) on the nature of emotions, which was supported by Cannon (Cannon, 1929). The experiments of Wundt (Wundt, 1902) also belong to this period. In the “Dark Age”, emotions were ignored due to the behaviorists view. Emotion psychology experienced a renaissance from about 1960 by Arnold (Arnold, 1960), who proposed the idea that the appraisal of an event is crucial for the emotion that follows (Schmidt-Atzert et al., 2014). How a particular emotion is perceived depends on both physiological arousal and cognitive appraisal (Schachter, 1971). In 1986, universality studies (Ekman & Friesen, 1986) showed that emotions such as happiness, sadness, anger, fear, surprise, and disgust are universally recognizable (Zimbardo, 1992).

Emotions are a complex pattern of changes that includes physiological arousal, feelings, cognitive processes, and behaviors that occur in response to a situation that is meaningful to an individual (Kleinginna & Kleinginna, 1981). They involve an expressive component that is expressed in facial expressions, gestures, maintenance of gaze, posture, and through changes in speech behavior (Bliersbach et al., 2002). Emotions, feelings, and evaluations motivate certain behavior, such as approach, avoidance, fight, or flight. Physiological arousal comprises neural, hormonal, visceral, and muscular changes; feelings involve an affective state as well as the nature of feelings such as pleasure and disgust. Cognitive processes include interpretations, memories, and expectations of a person. Emotions are meant to motivate the organism and adaptively cope with the requirements of the environment (Ekman, 1984; Izard, 1971; Plutchik, 1980).

Elster (1988) classifies emotions as follows (Elster 1988, as cited in Dhami, 2016):

- ⇒ social emotions (anger, hatred, guilt, shame, pride, admiration, and sympathy),
- ⇒ counterfactual emotions, which arise from thinking about unrealized possibilities (e.g., regret, joy, disappointment, and elation),
- ⇒ anticipatory emotions that arise from fear of what might happen,
- ⇒ realized emotions and
- ⇒ materialized emotions that arise from possessing or not possessing objects (e.g., envy, spite, indignation, and jealousy).

Emotions are influenced by visceral factors such as moods, physical pain, hunger, thirst, and phobias, leading to irrational decisions, sub-optimal behavior, and consequently, a negative outcome. They are based on external stimulation or deprivation. These factors are often not considered when determining past, present, and future behavior. Under the influence of visceral factors, people focus more on their own needs and less on the needs of others. Visceral effects are often underestimated in terms of future behavior. As far as the past is concerned, memories of pain seem to be different from other types of memories. Decisions related to outcomes are made based on physiological signals and emotional states (Dhami, 2017).

Over the last 100 years, especially since the mid-1950s, individual transportation has increased. The car developed into a symbol of freedom, prosperity, and individuality. Undesirable consequences include emissions, accidents, and health and psychosocial effects. For some time now, efforts have been made to counteract these negative consequences of individual traffic-utilizing new concepts and technological innovations to work towards a behavior change. Different theories are used, which try to explain behavior. For example, rational choice models are consistent with the view that individuals in a decision situation use the alternative that maximizes expected utility, where utility depends on objectively measurable monetary and time expenditures. These models were criticized because individuals subjectively perceive objective features of a traffic situation. This drove the development of psychological models since attitudes, habits, values, beliefs, and emotions play a role in choosing a mode of transport (Pripfl et al., 2010). The question of whether a behavior can change is dependent not only on rational considerations but on habits, and psychological factors as well as personality aspects.

CHAPTER 3
METHODOLOGY

Environmental problems are caused by heavy car traffic, for many people, it is difficult to change travel habits. Which transport mode is chosen, depends on e.g., socioeconomic factors, life circumstances, motives and habits, and personality traits. In general, decision-making is done by using rules of thumb, choice-making is often made unconsciously and driven by habits, such as taking the car to work without thinking about it. In recent years, a great deal of transport mode research has been carried out by using behavioral models as a theoretical foundation to explain indented travel behavior.

Many issues in transport econometrics concern discrete decisions, meaning that an individual must choose one option between usually several alternatives. Almost all discrete choice models are based on the concept of the rational decision-maker: The rational decision-maker or “Homo Oeconomicus” chooses the alternative with the highest utility (e.g., Voeth, 2012). Survey methods, such as Contingent Valuation, Conjoint Analysis, and Discrete Choice Experiments, are gaining more popularity. In the 1970s, the application of Discrete Choice Experiments in business was around 1000 in the US; in the early 1980s nearly 400 per year (Cattin & Wittink, 1982; Wittink & Cattin, 1989). In the German-speaking parts of Europe, the number of experiments had more than doubled by 2001 (Sattler & Hartmann, 2008) increase of range of application increased and now includes, among others, transport (Hensher, 1994) and environmental evaluation (Hanley et al., 2002; Street & Burges, 2007).

In the following, the beginnings of the multi-attribute modeling method are presented, followed by Traditional Conjoint Analysis (TCA) and variants thereof, which are then critically discussed concerning the objectives of the dissertation. Variants of modeling travel choice are then presented and critically discussed as well. The chapter is organized as follows:

- Preference Theories, variants of Conjoint Analysis and discussion,
- Modeling Strategies, Estimation Techniques, and discussion,
- Study Design,
- Data Collection and Sampling.

3.1. Preference Theories and Variants of Conjoint Analysis

The Revealed Preference Theory was introduced by Samuelson (Samuelson, 1938) as an alternative to the utility theory. The difference between revealed and stated preferences lies in the understanding that individuals make real choices in the revealed preference method, and their preferences can be revealed through their buying behavior. In stated preference methods, utility is estimated from behavior in hypothetical situations or behavioral intentions rather than real behavior (Hanley et al., 2002; Todorova, 2016).

Stated preference methods are available under a large variety of names such as e. g. *Conjoint analysis*, Trade-Off analysis, stated choice, stated preference choice experiment, discrete choice experiment, Stated Preference (SP) experiment, or Discrete Choice Experiment (DCE) (Kroes & Sheldon, 1988; Street & Burges, 2007). There are two different survey designs, the compositional approach and the decompositional approach. In compositional approaches, the total utility for a multi-attribute is regarded as the weighted sum of the perceived attribute values of the objects and the associated value estimates, which are assessed separately (and explicitly) by the respondent. Expected value models draw on this approach (Green & Srinivasan, 1978). The advantage of this method is its ease of use. Criticisms concern the low degree of realism since a product would be evaluated holistically in reality, the low validity of decision predictions, the tendency to overestimate unimportant utility dimensions, and the danger of cognitive overload of respondents (Voeth & Hahn, 1998). In decomposition methods, respondents are asked to evaluate a whole product, then decomposed into part-worth utilities using statistical methods. The decomposition method has been well accepted, as this approach replicates the subject's judgment. Decomposition methods are considered to be closer to reality and are therefore better at measuring preferences. The underlying idea is that consumers in real-life situations are faced with the product as a whole and not with individual features of a product. The decomposition method is applied in conjoint analyses, in hybrid conjoint analysis models both methods, the compositional and decompositional methods are used (Braier & Brusch, 2009).

As cited in P.E. Green & Srinivasan, 1978, p. 103, based on the preliminary work of Debreu (1960), the start of the multi-attribute modeling (Conjoint Measurement) was in 1964 with the paper of a mathematical psychologist and a statistician (Luce/Turkey 1964) followed by several theoretical contributions (Krantz, 1964, Tversky 1967 as cited in P.E. Green &

Srinivasan, 1978, p. 103) and algorithmic developments (Kruskal 1965, Carroll 1969, Young 1969 as cited in P.E. Green & Srinivasan, 1978, p. 103) (Green & Srinivasan, 1978). The methodology of Conjoint Measurement has been discussed by Green and Rao (1969) and Green and Carmone (1979). However, it took several years until this method was introduced into marketing (Green and Rao, 1971). In the following years, further publications followed dealing with the application or algorithms. The theoretical justification was provided by the expectancy-value models and Lancasters´ (Lancaster, 1971) economic theory of consumer choice (Green & Srinivasan, 1978).

The goal of using conjoint methods is to determine the preferences for different product alternatives. Products can be regarded as a bundle of utilities; the overall utility is composed of the part-worth of the individual attributes. Preference measurement methods allow the determination of a total utility and the determination of part-worth utilities of individual attributes. How these are part-worth utilities are determined depends on the particular method (Bauer, 2014). There are several variants of the Conjoint Analysis. The Traditional Conjoint Analysis has been developed by Green and Rao (1971) and Green and Wind (1973). Based on conjoint measurement theory, a decompositional method estimates the structure of a consumer´s preference by e.g. part worths, importance weights, ideal points. (Green & Srinivasan, 1978).

Utility functions (attribute-specific preference models) can be used to assign specific utility values to the individual attribute. Preference models can be distinguished in vector model, ideal-point model, and part-worth utility model. For all models, the following is assumed (Green & Srinivasan, 1978):

$$p = 1,2, \dots., t \qquad (4)$$

indicates the set of t attributes having been selected.

The vector model of preference states that the preference s_j for the jth stimulus is given by

$$s_j = \sum_{p=1}^{t} w_p y_{jp} \qquad (5)$$

Where w_p are the individual's weights for the t attributes are in general different for different individuals. y_{jp} is considered as a continuous variable (e.g., travel time), the preferences s_j can be presented on the vector w_p in the t-dimensional attribute space (Green & Srinivasan, 1978).

The ideal-point model assumes that the preference s_j is negatively related to the weighted distance d_j^2 of the location y_{jp} to the stimulus from the individual´s ideal point x_p. d_j^2 is defined as

$$d_j^2 \ = \ \sum_{p=1}^{t} w_{p\,(y_{jp}\,-\,x_p)2} \qquad (6)$$

Stimuli that are closer to the ideal point (smaller d_j^2) will be more preferred (larger s_j). It turns out that the simultaneous estimation of w_p and x_p is feasible for the weighted Euclidean measure of distance as specified in equation 3. If exponent 2 in equation 3 is replaced by a general Minkowski metric r, the estimation of x_p is getting difficult. According to Green (1975), the Euclidean metric is close enough to approximate the Minkowski metric (Green & Srinivasan, 1978).

The part-worth model assigns a specific utility value to each individual characteristic (Braier & Brusch, 2009):

$$s_j = \sum_{p=1}^{t} f_p \ \left(y_{jp}\right) \qquad (7)$$

f_p is the function of denoting the part-worth of different levels for y_{jp} for pth attribute. In practice $f_p\ \left(y_p\right)$ is estimated only for a selected set of levels for y_p with the part-worth for intermediate y_{jp} obtained by linear interpolation. Thus, the part-worth curve is a piecewise linear curve (Green & Srinivasan, 1978). The part-worth function model provides the greatest flexibility of the presented models as it allows different shapes for the preference function. If it makes sense, interim values can be obtained by interpolation. (Braier & Brusch, 2009; Green & Srinivasan, 1978).

In the mixed model, the features of the three models are combined

$$s_j = \sum_{q=1}^{T} v_q z_{jq} \tag{8}$$

T represents the total number of estimated parameters. There are three definitions for z_{jq} from y_{jp}: a) z_j = equal to y_j: for attributes where the preference is expected to be monotone and approximately linear, b) attributes for which the preference is nonlinear or ideal point type: for each attribute p, two z variables, one equal to y and the other equal to y^2 c) for categorial attributes: for each attribute p with k levels, $(k-1)$ dummy variables are to be defined (Green & Srinivasan, 1978).

There are two approaches regarding data collection: the trade-off approach and the full-profile approach. The difference lies in the number and completeness of stimuli to be assessed simultaneously. In the trade-off approach, only the characteristics of two attributes are combined, whereas, in the full-profile approach, complete product alternatives are assessed by the respondents. Full-profile approaches are divided into metric and non-metric conjoint analyses; non-metric conjoint analysis can be divided into ordinal conjoint analysis and categorical (nominal) conjoint analysis (Brusch & Baier, 2009).

The advantages of Traditional Conjoint Analysis (TCA) can be seen in the possibility of indirect data collection that is close to reality, with indirect data collection, results closer to reality can be expected than with direct questioning (Baier, 1999). Louviere et al. (2010) criticize the TCA not being based on an underlying behavioral theory but on Conjoint Measurement, compared to Discrete Choice Experiments (DCE), which are based on the Random Utility Theory (RUT). In TCA, prior stages and processes are ignored, not the decision processes but predicting outcomes is the focus of TCA research. Traditional CA depends on orthogonal or near orthogonal arrays of attribute level combinations as ways to sample profiles from full factorial arrays of attribute levels. Data collection in the form of rankings and ratings does not correspond to the real decision-making behavior of the respondents. Last, respondents are not able to evaluate many stimuli due to limited cognitive capacities. Also, in TCA, no error component is foreseen (Louviere et al., 2010).

The critical judgment of the TCA has been formulated by Louviere et al. (2010) as follows: The CA is a “largely a curve fitting/scaling exercise where error components are largely ad hoc and lack clear interpretations” (Louviere et al., 2010 p. 69). It is “concerned with the behavior of number systems and not with the behavior of humans or human preferences” (Louviere, Flynn, & Carson, 2010 p. 59).

To address these weaknesses of the Traditional Conjoint Analysis (TCA), variations to the TCA have been developed (Skiera & Gensler, 2002), such as the Limit Conjoint Analysis (LCA). A preliminary consideration for introducing this variation was the approach of Jasny (1994), who attempted to distinguish between objects that were worth buying and objects that were not worth buying (Voeth, 2000). The LCA goes back to Voeth & Hahn (1998) integrating selection (intention) information directly into the TCA (Voeth & Hahn, 1998). This is done by asking the respondent to identify the stimuli that he or she would be willing to select, in addition to the preferred ratings of the stimuli. Thus, if the profile method is used in conjunction with an assessment of the stimulus through a ranking method, the respondent must rank the stimuli as in TCA and indicate up to which rank the stimuli presented are considered acceptable for selection. To do this, he must place an imaginary limit card behind the last stimulus acceptable to him. This limit card separates acceptable stimuli from stimuli that are no longer acceptable. By placing the limit card, the willingness to choose is limited, non-acceptable alternatives have a 0% choice probability (Skiera & Gensler, 2002; Steiner & Meißner, 2018; Voeth, 2000). The benefit of the LCA design is that a choice or no choice can be predicted depending on the simulated decision situation. The LCA is also criticized because an individual scale transformation must be done, this is possible if the position of the Limit Card is interpreted as the scale zero point (Voeth & Hahn, 1998). Rank data and nominally scaled data are regarded as ratio scaled data. It is assumed that the distance between the rank values is assessed as equidistant and that stimuli that can and cannot be selected are assessed on the same scale. Due to the combination of ordinal rank data and nominally scaled data, the data are treated like metric data in the evaluation. There can be result distortions if a smaller utility difference is perceived between two accepted stimuli than between the last accepted and the first non-accepted stimulus. The solution for overcoming the methodological weaknesses, data collection should be by using numerical rating scales instead of rankings. This produces metric input data that solves data level problems and scale transformation problems. Further, probabilistic decision rules should be avoided within the

LCA and a modified first choice rule[1] should be applied, since only this rule corresponds to the deterministic basic model of the procedure (Voeth, 2000).

A further variant of the Traditional Conjoint Analysis is the Bridging Conjoint Analysis (BCA), developed by the American software provider Bretton in the 1980s. The basic idea of this variation is that the number of alternatives to be considered is limited. Conclusively, this design divides the total number of attributes into sub-designs. Each sub-design has specific attributes and a bridging attribute that can be found in another sub-design. This bridging property serves as a bridge between the designs and is used to adjust the estimation parameters obtained in evaluating the different sub-designs. To do this, a new OLS estimation of all parameters under the restriction must be performed so that the same utility values can be assigned to the parameters of the bridging features in both sub designs. In this way, any number of features can be included in the overall design without requiring subjects to rate more than a certain number of stimuli in a sub-design (Voeth & Hahn, 1998). The BCA was criticized by Reiners (1996) in terms of the unknown statistical properties, other authors (Oppewal et al., 1994) doubted the method as a whole (Voeth, 2000).

An important milestone has been reached by using discrete choices (Louviere & Woodworth, 1983). Instead of ranking or rating product alternatives, respondents are requested to choose between choice-sets (Steiner & Meißner, 2018). In the following, the theory behind Discrete Choice Experiments (Choice-Based Conjoint Analysis) will be presented.

The theory behind Discrete Choice Experiments (Choice-Based Conjoint Analysis, in short: CBCA) is the Random Utility Theory proposed by Thurstone (1927), extended by McFadden (1974) from previously pairwise comparison to multiple comparisons. It explains the choice behavior of humans and not numbers, as in Traditional Conjoint Analysis (Louviere et al., 2010). Utility is defined as the “net benefit derived from taking some action” (Train, 2003, as cited in Street & Burges, 2007, p. 58) or “the variable whose relative magnitude indicates the direction of preference. In finding their preferred position, the individual is said to maximize utility“ (Hirshleifer et al., 2005 p.73). To Lancaster (1966), the utility of a good is a function of the utility of its characteristics (Lancaster, 1966). The Random Utility Theory (RUT) (McFadden, 1973), which is the theoretical foundation of Discrete Choice Experiments,

[1] First choice rule: Also known as maximum utility rule, assuming that the respondent chooses the simulated decision alternative that has the highest utility value of all simulated decision alternatives (Hoffer, 2015)

states, that each individual maximizes his utility by choosing a certain stimulus. However, utilities cannot be seen by researchers and are therefore latent. Latent utilities can be summarized by two components, a systematic (explainable) component and a random (unexplainable) component which can be explained by the basic axiom of RUT as follows (Louviere et al., 2010):

$$U_{in} = V_{in} + \varepsilon_{in} \tag{9}$$

U_{in} is the assessment of the "latent, unobservable utility that individual n associates with choice alternative i , V_{in} is the systematic, explainable component of utility that individual n associates with alternative i and ε_{in} is the random component associated with individual n and option i. Because there is a random component, utilities (or "preferences" are inherently stochastic as viewed by researchers. So researchers can predict the probability that individual n will choose alternative i, but not the exact alternative that individual n will choose" (Louviere et al., 2010, p. 62,63) . Probabilistic discrete choice models describe how choice probabilities respond to changes in choice options, and covariates represent differences in individual choosers. "Thus, the probability that individual n chooses option i from a set of competing options is (Louviere et al., 2010, p. 63)":

$$\mathrm{P}(\mathrm{i}|\mathrm{C_n}) = \mathrm{P}[(\mathrm{V_{in}} + \varepsilon_{\mathrm{in}}) > \mathrm{Max}(\mathrm{V_{jn}} + \varepsilon_{\mathrm{jn}}) \tag{10}$$

Equation (10) expresses that the probability that an individual n chooses alternative i from the choice set C_n is equal to the probability that the systematic and random components of alternative i for individual n are greater than the systematic and random components of all other options competing with alternative i (for all j options in choice set C_n) (Louviere et al., 2010). Other models can be derived from the equation making different assumptions about probability distributions for $\varepsilon_{\mathrm{in}}$ such as assuming the random components are distributed as non-independent, no-identically distributed normal random variates. Thurstone (1927) considered restricted cases like IID normal, but McFadden assumed that the random components were IID Gumbel. Gumbel distribution closely is slightly asymmetric, having the advantage of yielding closed from expressions of the choice probabilities if random components are IID, namely the well-known multinomial logit (MNL) model used in practical applications. The non-IID case has spawned relatively new ways to estimate choice models, such as simulated maximum likelihood or hierarchical Bayes (Louviere et al., 2010)

The Choice-Based Conjoint (CBC) method combines Green and Rao´s idea of using experimental designs to reduce the number of product evaluations and McFadden´s Multinomial Logistic Regression (MNL) that relates utilities to choice probabilities (McFadden, 1976 as cited in Steiner & Meißner, 2018, p. 10). In Choice-Based Conjoint Analysis, multiple alternatives can be taken into consideration. This approach takes longer than rating but is more realistic. Furthermore, a non-choice option is included by which respondents can express their non-interest. The advantage of choice-based data is that they reflect choices and not only preferences. Prediction of choice means valuing choice-based data, presenting products to respondents with varying product configurations, ask which one they would choose. Statistical methods such as the Hierarchical Bayes estimation helps to estimate a complete set of part-worth scores on each attribute level for each respondent (Allenby et al., 1995). The results are better than in rating-based conjoint analysis and “what-if” assumptions are more accurate in predicting market choices (Orme, 2010). The CBC is the most widely used conjoint technique in the world (“Sawtooth Software,” 2010) and is favored by researchers as no ranking or rating of product concepts are necessary, respondents are shown a set of products in full profile and asked to indicate which they would choose, also the non-option is possible. The CBC offers a high variability, e.g., rather than asking respondents to choose from each set of product concepts, it is possible to ask respondents to consider their next ten purchases, indicating how many of each product they would buy (chip allocation). It is also possible to rank a full set of product alternatives or select the best and worst within the alternative set (Orme, 2010). It is assumed that with CBC, the preferred alternative is more in line with the choices made in reality (Steiner & Meißner, 2018). Choosing is less cognitively demanding than ranking alternatives. Rating scales are often assessed differently but choices are clear, experience design is pooled between respondents, leading to more flexibility in experimental design (interaction effects can be considered), and no option is included to predict product acceptance. Simple aggregate CBC models provide reasonable market share prediction (Chapman et al., 2009; Louviere & Woodworth, 1983; Natter & Feurstein, 2002). Further, it is argued that more advanced methods might not always be beneficial (Natter & Feurstein, 2002; Steiner & Meißner, 2018). According to Rao (2014), the advantage of choice-based conjoint analysis is that the method can be easily used to predict real-world choices and availability of the option "none" as another choice alternative (Rao, 2014, p. 128).

Other authors, on the contrary, believe that real consumer behavior can be predicted very well even with TCA approaches (Tscheulin, 1991; Wittink & Bergestuen, 2001) and by direct approach (Netzer & Srinivasan, 2007; Srinivasan & de Ma Carty, 1999). Others criticize that the CBC can only weakly predict real choices (Brzoska, 2003; Drechsler et al., 2013; Fine, 2009; G. J. Johnson & Ambrose, 2009; Schlag, 2008). Schlag (2008) compared the external validity of TCA and CBC and noted poor results for both methods. However, the results of the experiment itself presented high internal validity. Choices would only capture information on the preferred alternative. There would be no information on the rank order of remaining alternatives or strength of preferences available. Thus, the CBC could be less informative (Schlag, 2008; Steiner & Meißner, 2018).

Since pure compositional and decompositional methods have their weaknesses, adaptive and hybrid approaches of the conjoint analysis have been brought to life, some of them are presented below.

The most used hybrid approaches are the Adaptive Conjoint Analysis (ACA) and the Adaptive Choice-Based Conjoint Analysis (ACBC) (Steiner & Meißner, 2018). In the 1980s, the Adaptive Conjoint Analysis (ACA) was introduced and computerized, enabling customization of the conjoint interview, focusing on attributes, levels, and tradeoffs (R. M. Johnson, 1987). Released in 1985, it started being the most popular conjoint software in the EU and USA in the 1990s (Vriens et al., 1997). The peculiarity of this method is that the respondents' answers are considered in the next question leading to the fact that every given information is revealed in the course of the interview. As a result, the computer program adapts more and more to the preferences of the individual respondent. Two phases in the ACA must be passed, the compositional and the decompositional part. In the compositional part, all attributes as well as the relative importance of the attributes, are evaluated. Following this first step, the respondent is presented with different objects, about which he then makes a judgment as to which he would prefer. The advantage of this method can be seen in the fact that the numerous attributes can be reduced as well as that the reduction of the attributes is based on the information of the respondent (Herrmann et al., 2009).

Another approach is the Adaptive Choice-Based Conjoint (ACBC), which attempts to combine the advantages of the classic adaptive and choice-based approaches, thereby minimizing the respective disadvantages. As with all adaptive methods, the procedure relies on the responses of the participants. An ACBC consists of different phases, the contents of which depend on the information provided in the preceding questions. The ACBC consists of three phases: Phase 1: BYO (Build your own section). In this phase, each respondent builds his or her preferred product from the given expressions. In the subsequent "Screening Section" phase, further products are defined based on the previously compiled product, differing in individual levels. The respondent evaluates each of these products as to whether it is suitable for him or not. Based on these answers, it is determined whether the respondent accepts certain features or not. For these Must Have´s / Unacceptables, the respondent is explicitly asked whether these must be available or must not be available under any circumstances. The third phase deals with decision questions. The preferred products of the screening phase are presented in groups, and the respondent chooses the most preferred one. This is a typical CBC choice task with no choice option. This selection is repeated until the best product (Winning Concept) is determined. In addition to these three compulsory phases, there is the possibility to precede a deselection phase or to perform calibrations (Lüken & Schimmelpfennig, 2014).

Respondents favor ACBC interviews compared to CBC surveys because they seem to be more interesting due to the different phases, it seems also to be more realistic as the ACBC collects more information at the individual level, leading to more accurate predictions than the standard CBC. To Orme, the ACBC should be chosen for situations with 7 to 14 attributes (Orme, 2010). The disadvantage is the significantly longer duration than a CBC or ACA survey (two to three times longer), resulting in a higher cognitive load on the respondent (Lüken & Schimmelpfennig, 2014).

Another variant of the Conjoint Analysis is the “Hybrid Individualized Two-level Choice-Based Conjoint” (HIT-CBC) introduced by Eggers & Sattler (Eggers & Sattler, 2009) as a response to the problem of the number-of-levels effect (NLE) occurring when the number of levels is not equally distributed across levels. The NLE effect leads to a higher importance for an attribute having more levels biasing the results. Authors have studied and discussed this effect (e.g., Currim, Weinberg, & Wittink, 1981; De Wilde, Cooke, & Janiszewski, 2008). The solution for this problem is to use an equal number of levels for all attributes, which is not feasible, especially when binary level attributes are included. In the HIT-CBC, parts of self-explicated preference measurement phases (SE) are combined with CBC using a short adaptive, computer-based survey. In this approach, the best and worst levels are elicited in an individual level und then used exclusively in the CBC part and for estimation. By including only the best and worst level, every attribute becomes represented by two levels and the NLE effect is diminished. The CBC phase is then individually adapted to a 2k factorial design (k is the number of attributes), last, intermediate levels are evaluated on a self-explicated rating scale and conjoint estimation results are adjusted according to that rating. HIT-CBC enables to integrate individualized questionnaires helping to estimate price levels helping to predict the Willingness-to-Pay (WTP) values for product stimuli that is less sensitive to the scale of utility estimates, and less likely to contain outlier values than extant procedures. Furthermore, the design of choice set is reduced to a 2k factorial design which is an efficient choice set design, is balanced and orthogonal and show minimal overlap (Huber & Zwerina, 1996). Also, prior knowledge about the evaluation of levels allows for the construction of Pareto-optimal choice sets (Green et al., 1991). A certain level of utility balance as an additional efficiency criterion is ensured (Huber & Zwerina, 1996) and easy to control with HIT-CBC because choice designs are created for substitutional best and worst features, not for specific levels (Eggers & Sattler, 2009). Another advantage of this design is that dominating alternatives in choice sets can be identified before fielding and do not require sophisticated methods that dynamically adapt respondents´ preliminary utilities during the survey (Abernethy et al., 2008; Eggers & Sattler, 2009; Toubia et al., 2004a, 2004b).

3.2. Discussion of the Variants of the Conjoint Analysis

"Conjoint Analysis" represents a large group of different methods. The various methods differ in the form of data collection, in the determination of utility values, and their objectives, such as the formation of preferences or the modeling of choice decisions and the theoretical foundation (Brusch & Baier, 2009). Methods of traditional conjoint analysis and choice-based conjoint analysis are based on different basic assumptions. Which method is appropriate has to be judged against the background of the decision process to be analyzed (Voeth, 2000). Adaptive methods adapt the analysis to the user's responses. Hybrid methods combine compositional and decompositional methods. In compositional methods, attributes and their values are presented directly in the survey, and individual judgments are combined to form overall judgments. The partial utility values determined in this way are combined into total utility values or preference values in the data analysis (Sattler, 2006, Lehnert, 2009, Bauer, 2014). In decompositional methods, preference judgments are collected holistically, and data collection is done in a composed manner in terms of preference. Only during the data analysis, the preferences are decomposed into partial utility values (Lehnert 2009, Bauer 2014.) The ACBC and HIT-CBC are adaptive hybrid procedures. In both analyses, the survey techniques of the CBC analysis are used. The advantage of the TCA is that the results are closer to reality (Baier, 1999), weaknesses are to be found in the fact that the analysis does not focus on the decision-making process, and data collection in the form of rankings and ratings does not correspond to cognitive capacities.

Furthermore, the TCA is not recommended for computer-assisted procedures (Schwedes et al., 2015). The benefit of LCA is the placement of an imaginary limit card behind the last accepted stimulus, which limits the willingness to choose, unaccepted alternatives consequently have a choice probability of 0%, a choice or no choice can be predicted depending on the simulated decision situation. The combination of ordinal rank data and nominal scaled data implies that the data are treated as metric data in the analysis, which leads to biases if a smaller utility difference is perceived between two accepted stimuli than between the last accepted and the first unaccepted stimulus. Since many evaluations have to be performed in BCA because of its "bridging" character, some authors have doubted the method overall. In contrast to the TCA, BCA, and LCA, the CBC offers the possibility of not making a choice. The CBC seems to be more in line with choices made in reality, is less cognitively demanding than ranking as in TCA. The disadvantage is to be seen because choice sets only include information of a preferred alternative.

Moreover, there is no information on the rank order of remaining alternatives or strength of preferences available. Adaptive methods such as the ACA combine the advantages of compositional and decompositional methods. It is widely used, it is oriented towards the respondent's information behavior, product combinations are adapted during the interview, and the adaptive process has the advantage of reducing the respondent's cognitive load. The ACBC also has the same advantages, except that more product alternatives are possible (Schwedes et al., 2015), however, the survey is two or three times longer (Lüken & Schimmelpfennig, 2014).

In the HIT-CBC, large sets are integrated into one design, which eliminates the number of levels effect. An advantage is the shorter and easier to manage conjoint survey as well as the high reliability of the utility values due to the small number of items. The disadvantage is the focus on single values, which changes the whole conjoint approach. Another disadvantage is the dependence of the utility values on the choice of the rating scale and the possibly longer survey time and higher complexity of the survey (Lüken & Schimmelpfennig, 2014).

In summary, the elicitation of preferences is an elaborate procedure. Since other variables are also considered, attention must be paid to selecting a conjoint method that does not exceed the time frame so as not to overtax the participants and to counteract the risk of the survey being abandoned. After considering all the advantages and disadvantages of the techniques presented, the author concludes that choice-based conjoint analysis (CBC) is a suitable tool for answering the research questions in this thesis. Nevertheless, it is also important to capture life circumstances and psychographic characteristics in addition to daily travel behavior, as they provide important insights into the overall context. For the author, capturing non-choice is an important aspect, as respondents may not be able to find the optimal choice for them and, as a result, drop out of the survey. Accordingly, the questionnaire thus contains a compositional and a decompositional part: the compositional approach assesses the results of the current behavior (Revealed Preferences (SP) method), while the decompositional part assesses the hypothetical behavior (Stated Preference (SP) method).

The following subchapter describes several models and estimation techniques used in Conjoint Analyses followed by a discussion.

3.3. Modeling Strategies and Estimation Techniques

For analyzing choice data, it is important to have knowledge about what is meant by choice processes since the understanding of both choice processes and random utility theory is essential for developing and analysis of those data (Rao, 2014, p. 128). A model considers external factors which are past experience/behavior, choice context, social situation describing latent constructs leading to choose (Rao, 2014, p. 129). To choice theory, “an individual makes a choice from a set of alternatives such that his utility is maximized. Thus, the utility of the item chosen is the highest among the utilities of all the alternatives (items) under consideration” (Rao, 2014, p. 129).. As already stated above, utility of an item has a deterministic (observable factors) and a random (unobservable factors) component. The model is calibrated with data on stated (or revealed) choices (Rao, 2014). “A behavioral model is defined as one which represents the decisions that consumers make when confronted with alternative choices” (Khan, 2007, p. 18) (…)” there are also known as discrete choice models” (Khan, 2007, p. 18).

Logit modeling techniques are a suitable method to capture the correlation between subsets of alternatives of a multidimensional choice set. Choudhury et al. (2018) list the following examples on page 17: “Logit models and Nested Logit (NL) models for destination and mode choice (Ben-Akiva and Lerman, 1985), Multinomial Probit (MNP) models for brand choice (Paap and Franses, 2000), Mixed Logit Models and Ordered Logit Models for residential location and car ownership decision (Bhat and Guo, 2007), Error-Component Logit Models for time-of-day and mode choice (De Jong et al., 2003), Structural Equations Models (SEM) for land-use patterns, location choice and travel behavior (de Abreu e Silva and Goulias, 2009), and Multi-Nested Generalized Extreme Value (GEV) Models for route choice in multimodal transport networks (Bovy and Hoogendoorn-Lanser, 2005)” (Choudhury et al., 2018, p. 17).

As above, logit models are the most used modal split models. The mathematical basis is the theory of utility maximization: the probability of an individual i selecting a mode n out of M number of total available modes is (Khan, 2007):

$$P_{in} = \frac{\exp(V_{in})}{\sum_{m\varepsilon M}\exp(V_{im})} \tag{11}$$

where,

V_{in} is the utility function of mode n for individual i

V_{im} is the utility function of any mode m for an individual i

P_{in} is the probability of individual i selecting mode n; and

M is the total number of available traveling modes in the choice set for individual i

(based on the utility function of a mode m: $U_{mi} = \theta_1 x_{mi1} + \theta_2 x_{mi2} + \dots + \theta_k x_{mik}$ (net utility function, with zero mean and an extreme value distribution) and on the assumptions regarding the error term E_m: $U_m = V_m + E_m$, where E_m is Gumbel distributed, independently distributed, and identically distributed. The last two refer to IIA property) (Khan, 2007).

Logit models are distinguished into binary and multinomial logit models. In binary choice models, participants can only choose between two possible alternatives (car or public transport); multinomial logit models imply more than two alternatives. Binary and multinomial nested logit models allow correlation between utilities of the alternatives in common groups ;subsets of correlated alternatives are grouped in hierarchy or nests (Khan, 2007).

Multinomial logit models are generally estimated using the maximum likelihood method, with its formulation as follows (Khan, 2007):

$$L = \prod_{m=1}^{M} P\ (t_m\ , m) \qquad (\ 12\ )$$

where
L is the likelihood the model assigns to the vector of available alternatives;
M is the total number of available alternatives.
m is an alternative present in the set of available alternatives
t_m is the mode observed to be chosen in alternative m and
$P\ (t_{m,} m)$ is the probability for choosing alternative m.

Probit Models have complex estimation algorithms transport planners prefer using logit models. General Extreme Value Models are a simplification of MNL-models and are based on stochastic utility maximization. Model estimation of logit models is easy compared to Probit Models and General Extreme Value Models and also the application and accuracy of logit models are high compared to other models. However, the major limitation of logit models is that error terms should necessarily be identically and independently distributed (not necessarily needed in Probit and GEV models) (Khan, 2007).

The Multinomial Logit Model (MNL) is appropriate for analyzing CBC data. Multinomial Logit Modelling (MNL) assumes, “that the errors are distributed according to extreme value distribution and are independent” (Rao, 2014, p. 130) and further...” The model for the probability of choice is not linear (however, the underlying model for utility is linear)” (Rao, 2014, p. 130).

Table 6 presents an overview of alternatives to Multinomial Logit Models (MNL):

Choice model (alternative to multinomial logit model)	Relevant assumptions
Multinomial probit model	Errors are assumed to follow a multivariate normal distribution (with or without covariances). There will be additional (n - 2) variance terms if no covariances are used and additional (n - 2) x (n - 2)/2 covariance terms in the model
Heteroscedastic logit model (HEV Model)	Errors are assumed to have unequal variances, with one variance set equal to 1
Random coefficients logit model	The coefficients are assumed to be specific to the individual in the sample. The coefficient for the i-th individual for the k-th attribute (b_{ik}) is modeled as: $b_{ik} = \bar{b}_k + z_i\theta_k + \sigma_k v_{ik}$ where v_{ik} is assumed to be normally distributed and z_i is a vector of individual-specific characteristics. The parameter $\bar{b}_k$ is the mean value around which individual-level coefficients vary. θk and b_{ik} are the parameters to be estimated at the attribute level. In some cases, the coefficients are simply assumed to be random with no specified relationship to individual-level characteristics.

Table 6 Choice model alternatives to the Multinomial Logit Model (MNL)

Source: adapted from (Rao, 2014, p. 163)

Green and Hensher (2003) noted, that due to the assumption of Independence from irrelevant alternatives in MNL models, mixed logit models are the most significant extensions of multinomial logit models. Based on this approach the authors provide "a semi-parametric extension of the MNL, based on the latent class formulation, which resembles the mixed logit model but which relaxes its requirement that the analyst makes specific assumptions about the distributions of parameters across individuals" (Greene & Hensher, 2003, p. 681). The Latent Class Model (LCM) is based on the theory "that individual behavior depends on observable attributes and on latent heterogeneity that varies with factors that are unobserved by the analyst" (Greene & Hensher, 2003, p. 682) . "Both models offer alternative ways of capturing unobserved heterogeneity and other potential sources of variability in unobserved sources of utility." (Greene & Hensher, 2003, p. 697). The authors compared the two models and found that it is impossible to give preference to either approach because each model has its own merits. However, both models allow for a variety of information about behavior to be obtained (Greene & Hensher, 2003).

In the following course, estimation techniques for logit models are described. The method maximum likelihood calibrates the logit model using data at an individual level. (Rao 2014, p. 158).

The formulation of the maximum likelihood is as follows (Rao (2014, p. 157):

$$L_i = \prod_{m=1}^{S} P_{im}^{y_{im}} \qquad (13)$$

The likelihood of observing the choices $(y_{i1}, \dots, y_{iS})$ for the ith individual with a choice set

$$S_i = \{1,2,3, \dots, S_i\} \qquad (14)$$

The joint likelihood of the function as a whole is

$$L = \prod_{i=1}^{N} L_i \qquad (15)$$

where L is a function of the unknown b-parameters; $L = L(b_1, \dots, b_T)$. The b-values are determined by maximizing L with respect to be b´s calculus methods. The resulting first-order equations are not linear. They are solved using optimization algorithms of the kind available in GAUSS, MATLAB, or LIMDEP software (Rao, 2014, p. 158 and 159).
According to Rao (2014), the model fit can be tested by

$$U^2 = p^2 = 1 - \frac{L(X)}{L_0} \qquad (16)$$

Explained,
L(X) = log-likelihood of the calibrated model with explanatory variables, X, and
L_o = log-likelihood of the null model.

Logarithms are natural logarithm values; the null model is for which choice probabilities are equal to the market shares of choice alternatives. For testing the model Chi-square statistic, Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) can be used. For nested models, chi-square with degrees of freedom is equal to the difference between the degrees of freedom for model B and model A. AIC or BIC is used for non-nested models (Rao, 2014 p. 159). A consequence of logit modeling is that the “ratio of probabilities of choice of any two alternatives is independent of other alternatives in the choice set. This property is called independence of irrelevant alternatives" (Rao, 2014 p. 159, 160). This characteristic results from the assumption of independent errors. Exemplified when two alternatives are similar, but the third alternative is different from the other two alternatives. If there is a similarity structure between the items, the problem of IIA in the logit model is eliminated; such a model is the nested multinomial logit model. If data are aggregated to a group level, the weighted least square method can be used for estimating the b-value in the MNL model (Rao, 2014). Details can be found in Rao (Rao, 2014, p. 180-181).

Structural Equation Modeling (SEM) and Hybrid Conjoint Measurement (HCM) can also evaluate psychological factors in discrete choice models. If SEM modeling is performed, factor and path analysis is the choice, if an underlying behavioral theory is used (Galdames et al., 2011). The authors estimated several models “including psychological factors into the discrete choice models with latent indicators” (Galdames et al., 2011, p. 72). The model included the attitude toward the mode used, being calculated for every subject in the sample using the SEM analysis output. To the authors, the inclusion of psychological attributes as latent variables in this study have helped to explain people's transportation choice behavior. Compared to works in which psychological attributes are included as dummy variables (Domarchi et al., 2008 as cited in Galdames et al. (2011), the presented approach has shown high potential in modeling. Thus, “The latent variables approach used in this work is an advance over the dummy variables approach because it does not depend on the subjective definition of boundaries for generation of the values of 0 to 1 required in the dummy approach” (Galdames et al., 2011, p. 73). The inclusion of a latent variable in the mode choice model made it possible to identify the real importance of cost and service level variables on the individual decision process (Galdames et al., 2011). Choudhury et al. (2018) investigated the acceptability of smart mobility options using a stated preferences (SP) survey capturing the complex correlations using multi-dimensional mixed logit models (Choudhury et al., 2018). Özlem et al. (2015) studied the role of transportation preferences, attitudes toward transportation use, and car use habits in the use of transportation. Car users and users of public and health modes of transportation were compared in terms of their transportation priorities. Using structural equation modeling (SEM) analysis, the authors examined whether demographic variables, transportation use priorities, attitudes toward transportation use, and car use habits helped to forecast behavioral intention to switch to public transport (Şimşekoğlu et al., 2015).

Especially in marketing research, Structural Equation Modelling (SEM), is a “second-generation multivariate data analysis method that is often used in marketing research”

(Wong, 2013, p. 1). An advantage of SEM is that latent (not observable) variables can be used. As seen (Figure 35), SEM models contain two submodels, namely an inner model specifying relationships between the independent und dependent latent variable, and the outer model specifying relationships between latent variables and observed indicators. Variables are either exogenous or endogenous. As seen, the exogenous variables has path arrows pointing outwords and none leading to it, endogenous variables has at least one path leading to it and represents the effects of other variables (Wong, 2013).

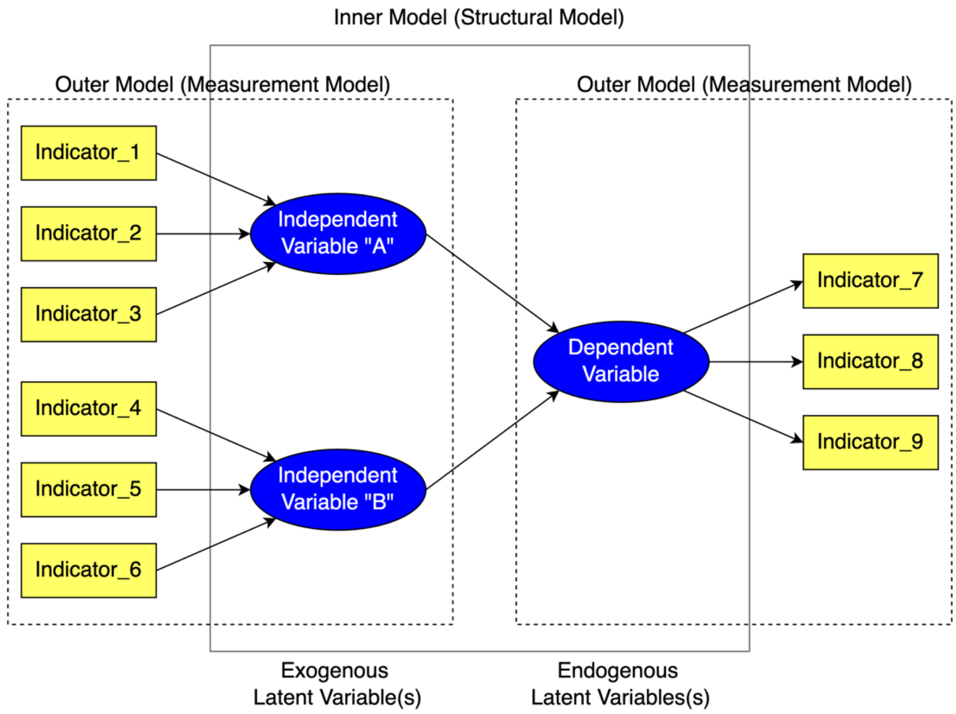

Figure 35 Inner vs. outer model in a Structural Equation Model (SEM) Diagram

Source: adapted from (Wong, 2013, p. 2)

Four different approaches to SEM modeling can be distinguished as follows: covariance-based SEM (CB-SEM) and partial least square (PLS), the latter focusing on the analysis of variances. Other approaches include component-based SEM (Generalized Structured Component Analysis = GSCA) or nonlinear universal structural relational modeling (NEUSREL). PLS-SEM has been applied in many research projects, guidelines for its application with relevant references can be found in Wong (2013, p. 6).

The design of a conjoint analysis is challenging because the goal is to obtain enough data with few questions to determine partworths at the individual level. The higher the number of questions, the greater the likelihood that respondents will become fatigued and give incorrect answers. Incorrect estimates can also occur when standard estimation methods are used. If the data are analyzed at the level of a segment or the entire sample, the same problem can occur. Hierarchical Bayesian (HB) methods estimate the partworths information about the partworths of all respondents in the used sample. For this, “each respondent’s partworths are characterized by a known distribution to describe the uncertainty in the partworths. Next, the parameters of that distribution are assumed to be different across the population (or the sample). Prior distributions (beliefs) are specified for the parameters, which are updated by data using the Bayesian theorem. Given that the two stages are specified, the procedure becomes a hierarchical Bayesian approach. The resulting equations for estimating the parameters are not amenable to analytical solution” (Rao, 2014, p. 168). However, they can be estimated using Gibbs sampling and Metropolis-Hastings algorithms methods (Rao, 2014, p. 168).

Which estimation method should be chosen depends on the number of partworths being estimated (Rao, 2014). This view was verified by an analysis of choice conjoint data conducted by Huber and Train (Huber and Train, as cited in Rao, 2014 p. 169/170), in which Bayesian and classical maximum simulated likelihood methods were being compared. In both methods, the partworths are assumed to follow a normal distribution at the individual level and the probability of choosing an alternative is equal to the multinomial logit function. They also found that the prediction of a non-choice is almost identical for both. For many partworths to be estimated, the likelihood function for the classical approach may have multiple maxima and consume many degrees of freedom; in such a case, the Bayesian approach can be very useful. Moreover, identification is less problematic in the Bayesian approach since the prior distributions for the parameters can provide the required identification. However, there are differences in the way the partworths are interpreted in both methods (Huber and Train, 2001 as cited in Rao, 2014, p. 169/170). Hein et al. (2022) studied the use of HB draws for choice share predictions and compared five choice rules, which are the first choice rule the logit choice rule, the randomized choice rule, the traditional choice rule, and the finally the traditional logit choice rule. They presented a Monte Carlo study to investigate the choice share predictions based on the different choice rules. The results demonstrated that the combination of the first-choice rule or the logit choice rule using HB draws enhances the predictions of choice shares over the other choice rules (Hein et al., 2022).

A stated preference survey based on the Theory of Planned Behavior (TPB) (2017) has been conducted by integrating psychological factors and habit as latent variables, together with service attributes as explanatory variables, with the objective to explore the effects of psychological factors on mode choice behavior. The authors have chosen a hierarchical regression analysis revealing that the psychological factor "subjective norm" determines the intention to use public transport (Kaewkluengklom et al., 2017). Heterogeneity models that are frequently applied are the "latent class model, the single multivariate normal distribution, or a mixture of multivariate normal distributions" (Voleti et al., 2017, p. 325). The authors compared alternative models (aggregate model, single normal, a mixture of normal, latent class models, DPP (Dirichlet Process Prior), and DPM (Dirichlet Process Mixture) against eleven CBC datasets with different features and found, that "the DPM model provides the best predictive power (percentage of correctly predicted decisions) for each of the datasets examined and represents a significant improvement over existing models of heterogeneity." (Voleti et al., 2017, p. 325).

3.4. Discussion of the Modeling Strategies and Estimation Techniques

Based on the previous considerations, the author chooses PLS-SEM Modeling as SEM is "a well-known technique allowing the detection of a correlation between latent variables and determination of the importance of each latent attribute" (Galdames et al., 2011, p. 71). To Shliselberg et al. (2020), "SEM Modelling has the ability to represent both latent and observed variables by simultaneously estimating the measurement equation representing the latent variables, the relationship between socio-economic characteristics and the latent variables as well as the relation between the latent dependent and independent variables" (Shliselberg et al., 2020, p. 73). Cheng (2019) studied the acceptance of technology by comparing the TAM and the TBP theories using factor-based partial least squares structural equation modeling and concluded that this modeling technique is more robust than regression-based SEM (Cheng, 2019). Other researchers investigated the determinants of environmentally friendly behavior using SEM modeling and found that personal norms and situational factors are significant predictors of behavioral travel mode choice (Lind et al., 2015). Van Acker et al. (2010) developed a conceptual model based on social psychology theories using their key variables and adding several concepts (e.g. lifestyle) using a multilevel SEM modeling technique (Van Acker et al., 2010). The examples described illustrate that the authors used different theoretical foundations in the context of SEM modeling. As already stated, the EBM model (Engel et al., 1995) serves as the theoretical basis in this thesis.

The following subchapter explains the structure of the questionnaire used. In the further course, it will be illustrated how the respective sections of the questionnaire have been assigned to the theoretical framework of the EBM model. In addition, a further embedding into a conceptual framework is made and justified.

3.5. Study Design

The flexibility and easiness of computer-assisted interviewing resulted in a decline of postal surveys, face-to-face interviews, and paper-and-pencil surveys. Computer-assisted interviewing has major advantages over other surveying methods such as the format providing an interesting and flexible presentation. It has a consistent format, automatic question branching and prompting, data coding and storage is automated and plausibility checks can be implemented to avoid inconsistent or wrongly entered answers (Galdames et al., 2011). When designing a survey instrument, it is important to avoid unrealistic combinations and dominant options, attributes must be appropriate and plausible; otherwise, respondents do not take them seriously or are confused. Too many choice sets lead to respondents becoming tired and as a result, more variable results are possible in the experiment (Khan, 2007). Bias can also occur in the selection of responses: affirmation bias involves respondents choosing answers that are consistent with what they perceive to be the goal of the experiment at hand. The solution here would be to include attributes that are not of immediate interest. Rationalization bias involves responses that justify the actual behavior and serve to reduce cognitive dissonance. Strategic or political response bias may arise because stated preference (SP) experiments are not associated with transaction costs. In addition, respondents try to answer in a way that they believe will affect the chance or magnitude of change in the real world. People are unwilling to state preferences that they perceive as socially unacceptable or politically incorrect (Brazell & Louviere, 1998; Melles & Holling, 1998;Street & Burges, 2007) or make choices to satisfy morality (B. Walker et al., 2002). The completion of a questionnaire should not take longer than 10-15 minutes because participants show signs of fatigue after only 15 minutes and stop participating (Carlsson & Martinsson, 2003).

To Rao (2014), five steps are required to design a choice-based conjoint study: the first step involves creating a set of profiles, followed by the creation of choice sets with alternative options, designing a hypothetical situation and deciding whether to include the no-choice option. The penultimate step involves conducting data collection followed by analyzing the data using an appropriate analytical model to determine partial values for different levels of each attribute (Brace, 2018 as cited in Schnell, 2012).

The survey instrument used in this dissertation includes 37 questions, divided into six sections (Section A – Section F). First, the individual sections are described followed by the description how the questions in the survey are assigned to the theoretical foundation.

Section A seeks personal information with questions relating to marital status, household structure, sociodemographic information (gender, age group, employment status, and highest school degree, household income, and city characteristics. To Khan (2007), household attributes are perceived to influence travel behavior (Khan, 2007). To Engel et al. (1995), the decision process is influenced by environmental influences e.g. social class, the family and personal situation and as individual differences e.g. consumer resources (Engel et al., 1995).

Section B concerns changes in life and job situation within the previous 24 months. For example, Rau and Manton (2016) investigated "existing research on mobility biographies" (Rao, 2014, p. 131) and found that life events have a relative effect on mobility behavior (Rau & Manton, 2016, p. 25). Engel et al. (1995) also postulate that fundamental changes in the live bibliography may also change the current social class (Engel et al., 1995).

Section C concerns attitudes, personal and subjective norms toward the environment. Attitudes are captured by statements e.g. "I think that environmentally friendly transport modes reduce air pollution and "I think that commuting by environmentally friendly transport modes can meet our daily travel demand" rated by a five-point Likert Scale (I strongly agree to I strongly disagree). An attitude toward a behavior "refers to the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question" (Ajzen, 1991).

The following two statements "people who are important to me usually support my use of environmentally friendly transport modes" and "people who are important to me expect me to use environmental-friendly transport modes to meet my travel demands” reflect the Subjective Norms (SN) of an individual, which is the “perceived social pressure to perform or not to perform a behavior” (Ajzen, 1991, p. 188). It is the moral obligation of everyone to reduce car travel” reflects the personal norms (PN) as feeling to the moral obligation to perform or refrain from specific actions (Ajzen, 1991, p. 188). Perceived behavioral control reflects the perceived difficulty or ease with the behavior may be performed (J. I. M. De Groot & Steg, 2009; H. Schwartz & Howard, 1981). This is assessed through a statement that a respondent could switch to public transportation or more environmentally friendly modes of transportation at any time if he/she wanted to. The response alternatives range from “strongly agree” to “strongly disagree”, a five-point Likert Scale.

Attitudes and intentions related to transport mode use have been studied along with the Theory of Reasoned Action (Fishbein & Ajzen, 1975) and Theory of Planned Behavior (Ajzen, 1991) showing that attitudes influence transport mode use (Bamberg et al. 2007, Heath and Gifford, 2002 as cited in (Fishbein & Ajzen, 1975). Other authors explored the effects of psychological factors on travel choice behavior using the Theory of Planned Behavior (TPB) as a theoretical foundation (Kaewkluengklom et al., 2017). The role of attitudes and norms can also be found in the EBM model as variables influencing the decision process (Engel et al., 1995).

Section D captures the respondents´ feelings concerning car noise and traffic and experienced feelings while using their main mode of transportation. Studies on the effects of noises have been carried out during the past two decades, for a broad literature review see Kumar (Kumar, 2019). To the Norm Activation Model developed by Schwartz (1977), individuals must be aware of the problem of car and freight traffic and have awareness of their own behavior and feel responsible for the consequences (S. H. Schwartz, 1977). The statement on concern about the environmental impact of car and freight traffic reflects this. This is also measured by using a five-point Likert scale (I strongly agree to I strongly disagree). To capture the experienced feelings during travel with their primary mode of transportation, respondents may select from 1 to 3 answers (“anxiety, worry, apathy, boredom, relaxation, control, flow and arousal”), also, the no choice option (I don´t know/no comment) is possible.

Mental states and experienced feelings were the focus of a mobility study conducted from Te Brömmelstroet et al. (2021) confirming that the most recognized mental states during travel are “flow”, “relaxation” and “arousal” (Te Brömmelstroet et al., 2021). To other authors, mental states and experienced feelings depend on perceived skills, environmental and personal conditions (Møller et al., 2018). Meenar et al. (2019) studied the nature of cycling users' emotions and identified that “anger” was the most often reported emotion, being followed by “disgust, fear, sadness and joy” (Meenar et al., 2019). Feelings and habits have been widely studied in the field of mobility and behavioral change; by using the theoretical framework of the Theory of Planned Behavior (Ajzen, 1991), or the Theory of Interpersonal Behavior (TIB) (1977) and the Norm Activation Model (NAM) developed by Schwartz (1977) (Meenar et al., 2019). Further studies show that mobility is associated with positive and negative feelings and impacts wellbeing (De Vos et al., 2013). To Engel et al. (1995), attitudes are based on feelings and beliefs, e.g., “the pleasure of driving a car and the belief in the reliability of the car” (Engel et al., 1995, p. 366).

Section E is divided into questions about travel status, motives of driving, and habitual car usage. In the last part of this section, respondents are asked to choose their preferred mode of transportation in a hypothetical situation. The individual questions are explained and discussed below.

First, respondents are required to indicate the possession of a driver’s license and car ownership (choosing “yes” or “no”) and are asked to indicate the number of cars in their household and to indicate, if they own either a hybrid or an electric car, also by selecting “yes” or “no”. Researchers investigated the barriers in adopting other transport modes than car driving and concluded that “current unimodal car users are the least likely to adopt MaaS” (Alonso-González et al., 2020, p. 378). Liljamo et al. (2020) studied the willingness-to pay for Mobility as a Service (MaaS) and found that almost half of the respondents would consider this service in case all mobility costs are covered (Liljamo et al., 2020). Lebeau et al. (2016) found out that “the benefits of battery vehicles are less valued than their disadvantages” (P. Lebeau et al., 2016, p. 245). Nazari et al. (2019) studied the acceptance of battery electric vehicles (BEV) and concluded BEV owners are more likely to purchase another BEV than those who own cars with other fuel types. (Nazari et al., 2019).

The following questions concern the motives for car usage. To Dittmar (1992), car usage does not only fulfill instrumental functions but has also an affective and symbolic motivation (Dittmar, 1992 as cited in Steg, 2005). Steg (2005) found out, that “respondents with a positive car attitude, male and younger respondents valued non-instrumental motives for car use" (Steg, 2005, p. 147). Steg´s (2005) statements concerning car motives were included into the survey that correlated most strongly with the individual factors (instrumental motives: factor loadings between .46 and .64), symbolic motives: (factor loadings between .46 and .49), affective motives (factor loadings between .45 and .61) (Steg, 2005)). Respondents can select between "I strongly agree" and "I strongly disagree" (five-point Likert scale).

Statements to habitual car usage are captured using the revised Self-Report Habit Index (SRHI) scale, a nine-item scale (Şimşekoğlu et al., 2015). The original scale is a 12-item scale, developed by Verplanken and Orbell (2003). Habit is "a history of repetition, automaticity (lack of control and awareness, efficiency), and expressing identity" (B. Verplanken & Orbell, 2003, p. 1313). Şimşekoğlu et al., (2015) argue, that the instrument must be adjusted to a specific behavior, the authors argumentation is followed in the thesis. The response alternatives range from "I strongly agree" to "I strongly disagree", using a five-point Likert Scale, higher scores refer to a weaker car use habit, lower scores a stronger car use habit.

The role of psychological factors in mode choice models has been investigated by Galdames (2011), using Triandis´ (1977) Theory of Interpersonal Behavior (TIB) as a theoretical foundation. In short, the theory postulates, that "observed behavior corresponds to an intention that is mediated by habit and facilitating conditions with intention depending on three factors: attitude, affect and social aspects" (Galdames et al., 2011, p. 68). "Facilitating conditions are mode availability, level-of-service and cost-related attributes, the individual socioeconomic context, journey restrictions and so on." (Galdames et al., 2011, p. 68). For the authors, "facilitating conditions" include, for example, level of service, cost-related attributes, mode availability, as well as individual socioeconomic context and travel constraints (Galdames et al., 2011, p. 68). To Engel et al. (1995), psychological factors are "individual differences" influencing the choice process (Engel et al., 1995).

In the further course of this section, respondents are asked about the distance to their nearest public transportation. Here, respondents can choose between "more than 400 meters" and "less than 400 meters". The next question concerns the respondent's number of kilometers traveled a typical study/workday and travel time using the main mode of transportation. Respondents can choose between" car self-driven, car as a passenger, car/taxi-sharing, public transportation (bus, tram, metro, railway), active traveling (cycling, walking) and "other" (e.g., scooter). It is of importance of capturing various modal parameters as they reflect the current travel behavior (Galdames et al., 2011; Khan, 2007). Commuting patterns have been investigated by Shannon et al. (2006) revealing, that reducing barriers to active traveling e.g. travel time, has the greatest impact on commuting patterns (T. Shannon et al., 2006).

The following question addresses the respondents 'experience in car/taxi sharing or bike-sharing", in both questions they can select between "yes" or "no". In the further course, the estimation of transportation costs each month is questioned. Liljamo et al. (2020) studied current mobility costs and willingness to pay for Mobility as a Service (Maas). The results revealed, that a switch to environmentally friendly transport such as MaaS, is possible if the costs for MaaS are lower than the current mobility costs (Liljamo et al., 2020). Urbanek (2021) examined, at which level the cost of car use would push drivers to switch to public transportation. It was found that not public transportation fares or fuel prices that are effective tools for changing travel behavior but psychological factors (Urbanek, 2021).

In the further course of the survey, the reasons for not using the preferred travel mode (e.g., using Public Transportation, but the preferred mode is car driving and vice versa) is addressed. The respondents can select up to their three most important ones (time, costs, convenience, directness, punctuality, emotional aspects such as joy, status, independence, freedom, environment, parking, lack of other possibilities). Also, the option "this does not concern me" can be chosen. The main drivers for choosing a mode of transport have been investigated in a survey, in which participants were able to choose between 15 different possibilities (directness, ownership, timesaving, costs, comfort, flexibility, transportation possibility of people and belongings, reliability, relaxing, enjoyable, environmentally friendly, and safe, healthy, show status, and other. Results revealed that ownership is the most relevant reason for the mode of transport to use, followed by time-saving, and flexibility (Urbanek, 2021). Kang et al. (2019) examined underutilization of public transportation and found that convenience, flexible service, and barriers to commuting influence willingness to switch. Šucha et al. (2018) concluded, that the reasons for using a car are comfort and time saving.

The following question is about finding out the conditions to be fulfilled to switch to other means of transport. Respondents may select up to three possibilities (e.g., "increase gasoline price, less parking space, increased parking fee, the speed limit of 30 km/h in inner cities, free public transportation, increase in the frequency of public transportation, strengthening the safety through escorts/video surveillance, expansion of park and ride/bike and ride, increase of flexible sharing services”), the option “this does not concern me” is also available. Thøgersen & Møller (2008) studied the effect of a free travel card and concluded that only in the short run, (not on the long run, i.e. four months after the experience) the free travel card neutralized the impact of car habits on mode choice (Thøgersen & Møller, 2008).

As the main objective is “to predict the choices made by a sample of individuals for a new item which is described in terms of a set of attributes” (Rao, 2014, p. 127), a choice-based conjoint analysis has been used in this survey. In conjoint analysis, “the respondents are asked to compare each hypothetical profile against another and evaluating them one at a time” (Rao, 2014, p. 56). Thus, the respondents are confronted with two choice-based conjoints, representing two travel scenarios. In both scenarios, respondents can choose between five travel options (car as a passenger, car/taxi sharing, public transport, active traveling, walking combination of different transport mode), the sixth option which can also be chosen is the “no choice option” (none of them/other).

The first hypothetical situation is about an employer/client offering various incentives if transportation other than a private car is used to get to work. Figure 36 illustrates the choice sets for Conjoint question #1 given in the questionnaire.

Option 1: Car (as a passenger)	Option 2: Car/Taxi Sharing	Option 3: Public Transport (Bus, Tram, Metro, Train)	Option 4: Cycling/E-Scooter (Sharing), Walking	Option 5: Combination of different transport modes*)	Option 6: none of them/other
Your access/waiting time is 15-20 minutes ☐	Your access/waiting time (sharing point) is 5-10 minutes ☐	Your access/waiting time (at the station) is 5-10 minutes ☐	Your access/waiting time (in case of sharing) is 5-10 minutes ☐	Your access/waiting time (to the nearest sharing point/station) is 5-10 minutes ☐	
Your travel time is 25-30 minutes ☐	Your travel time is 30-35 minutes ☐	Your travel time is 30-35 minutes ☐	Your travel time is 35-40 minutes ☐	Your travel time is 30-35 minutes ☐	
Your walking distance to your workplace is less than 50 meters ☐	Your walking distance to your workplace is less than 200 meters ☐	Your walking distance to your workplace is less than 400 meters ☐	Your walking distance to your workplace is 5 meters ☐	Your walking distance to your workplace is 5-10 meters ☐	
You are traveling with a maximum of 2 passengers ☐	You are traveling with less than 4 passengers ☐	You are traveling with more than 2 passengers ☐	You are traveling alone ☐	The number of passengers traveling with you depends on your choice of transport mode ☐	
Your employer/client pays 20% of the transportation costs ☐	Your employer/client pays 30% of the transportation costs ☐	Your employer/client pays 50% of the transportation costs ☐	Your employer/client rewards you with a new E-Bike or E-Scooter ☐	Your employer/client pays 50% of the transportation costs and rewards you with a conventional bike or scooter ☐	

*) Car/Taxi (sharing), Bus, Tram, Metro, Train, Cycling, Walking, E-Scooter

Figure 36 Conjoint question #1: employers’ incentives

Source: own illustration

In the second scenario (Figure 37), respondents are confronted with a hypothetical situation being in town and having no car available to get home.

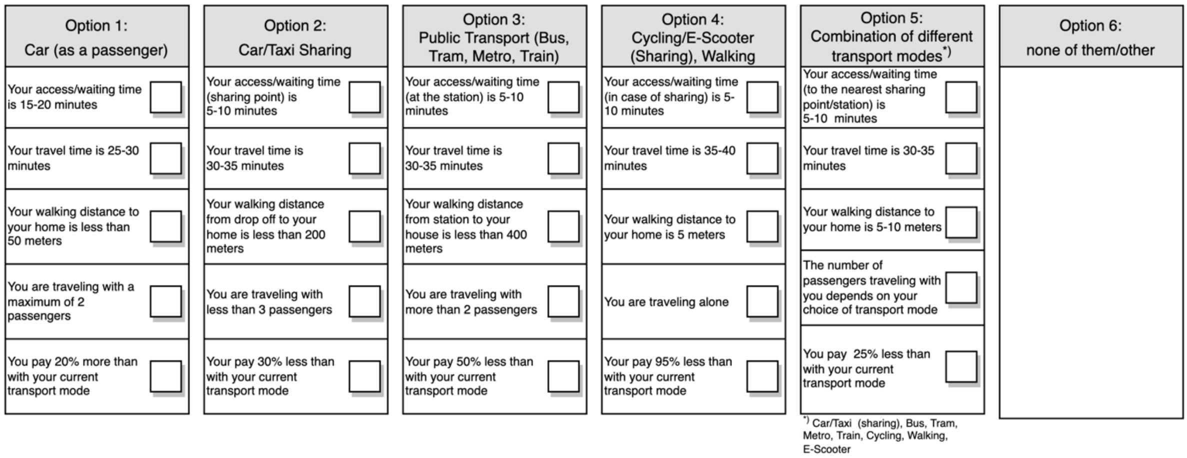

Figure 37 Conjoint question #2: non-availability of the car to get home

Source: own illustration

Travel choice and acceptance of other transport modes than the car by using a Conjoint Analysis has been investigated by several researchers. Papadima et al. (2019) investigated the acceptance of driverless buses in Greece (Papadima et al., 2020). Khan (2007) developed several mode choice models reflecting the current travel behavior and forecasting the mode shares under different travel scenarios. His study focused on using motorized and non-motorized traveling modes as alternatives to the car. Lebeau et al. (2016) investigated the adoption of electric vehicles by transport companies, Urbanek (2021) conducted a stated preference survey among individuals commuting by car. Zhang et al. (2014) used a multivariate probit modelling approach to determine the factors influencing behavioral change and revealed that incentives (reduced ticket fares, free wireless internet) have an impact on behavioral change of travel behavior. Kirkman (2019) compared groups of possible users of municipal bike-sharing systems offering them two different incentives (discount value and free rides) and found that offering free bike-sharing increases bicycle use. Biehl et al. (2019) studied the adaption of bike-sharing using two-level logit modeling proving, that actions need to be tailored to different stages of the decision process in order to shift intention into behavior. The corresponding publications are listed in Table 7.

Author	Topic	Models and Methods, Results (examples)
Papadima et al. (2019)	Acceptance of Autonomous buses and optimization of services	Conjoint Analysis, positive attitude of passengers towards the acceptance of autonomous buses, is confirmed
Kahn (2007)	Forecasting travel behavior for trip purposes and trip lengths, the influence of captive users on future travel behavior	how do values of estimated model parameters vary with the change in trip purpose, trip length Multinomial logit models, nested binary logit model
Lebeau et al. (2016)	Adoption of electric vehicles in city logistics	Choice-based conjoint analysis; advantages of electric vehicles are less appreciated than their disadvantages
Urbanek (2021)	Attitudes and willingness to switch to public transport	Stated preference survey (multiple-choice questions, ranking choice questions, nominal questions) Economic factors are not effective in changing transport behavior; psychological factors are decisive factors for not switching to public transport
Zhang et al. (2014)	Determination of factors influencing behavioral change	Multivariate probit modelling Incentives have an impact on the change of travel behavior
Kirkman (2017)	Incentives for using municipal bike-sharing systems	Design of postcards with different framings, binary logistic regression model, Free bike-sharing increases bicycle use
Biehl et al. (2019)	Study of the Adoption process of Bike Share	Two-level nested logit modeling, the theoretical framework is the Transtheoretical Model (TTM), the model helps to tailor actions to shift intention into behavior

Table 7 Overview of surveys using stated preference methods

Source: own illustration

A choice-based conjoint analysis offers the advantage that choice sets can be designed in a way “very similar to the actual marketplace choices that people make” (Rao, 2014, p. 128). ”The no-purchase option allows them to indicate that no product alternative is acceptable” (Parker & Schrift, 2011 as cited in Gensler, et al. 2012, p. 369).

Section F assesses the “Personality” by using the 10-item measure of the Big Five (BFI-10) developed by Rammstedt et al. (2014), measuring the five dimensions of personality (extraversion, agreeableness, conscientiousness, neuroticism, openness), rated on a five-point Likert scale from “I strongly agree” to “I strongly disagree” (Rammstedt, 2007). This test has been used on several occasions in the field of mobility. For example, results from a study revealed, that driving anger can be explained by demographic variables and personality factors (Hussain et al., 2020). The last question in this section captures the risk tolerance of the respondents by using parts of the Risk Propensity Scale (RPS) (Meertens & Lion, 2008). Participants are asked to rate their general willingness to take risks on a five-point rating scale from “I strongly agree” to “I strongly disagree”. The theoretical basis for the Risk-Averseness Scale is Zuckerman's Sensation Seeking Theory, described in chapter two. This scale is used, because the Big-Five Model does not sufficiently take into account the willingness to take risks (Sârbescu et al., 2012).

The last questions in the survey capture information made by the respondents on the personality trait "Optimism-Pessimism" scale developed by Kemper et al. (2012). A seven-point rating scale is used to capture the responses, the response categories of the SOP 2 (Scale Optimism-Pessimism) range from „not at all optimistic (1)” to “very optimistic (7)” and “not at all pessimistic (1)” to “very pessimistic (7)” (Kemper et al., 2012). Psychological characteristics specify choice behavior (Schumann & Schon, 2005 as cited in Kemper et al. 2012), characteristics such as conscientiousness and optimism have an influence on physical and mental health (Kemper et al., 2012). Optimists assume that mostly "good things" will happen to them, pessimists tend to expect "bad things" (Scheier & Carver 1985, as cited in Kemper et al., 2012). Expectations relate to all areas of life. Interindividual differences in this personality trait have profound effects on self-concept, life satisfaction, coping with problems and challenges (Kemper et al., 2012). This scale is very rarely used in transportation surveys so far.

The assignment of the individual parameters is based on the theoretical foundation of the EBM model by Engel et al. (1995), which is presented in the second chapter. The decision process in the EBM model of Engel et al. (1995) comprises five stages, namely "need recognition, search, pre-purchase alternative evaluation and purchase (Engel et al., 1995 p. 263, eighth version "Consumer Behavior, International Edition"). Since this thesis concerns a choice decision rather than a purchase decision, the term "Pre-Purchase Alternative Evaluation" is changed to "Pre-Choice Alternative Evaluation" and the term "Purchase" is changed to "Choice". Han et al. (2020) analyzed the mechanism of the effect of a booking information system on destination and departure time choice using this model and applied the term "choice" in their framework as well (Han et al., 2020). How the stages were adapted to the model can be seen from Figure 38.

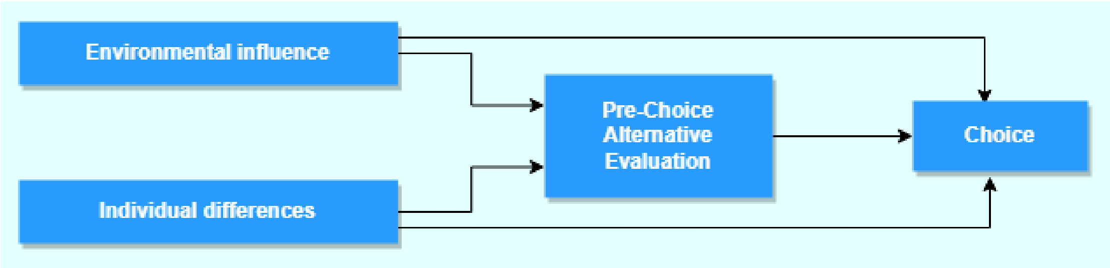

Figure 38 Adaption of the Stages of the EBM Model (1995)

Source: adapted from (Engel et al., 1995)

The EBM model became known as early as 1968 by the name Engel, Kollat and Blackwell (EKB model) and has undergone numerous revisions to date. The 1982 model (presented in the fourth edition of the book “Consumer Behavior”, included the word "choice" instead of "purchase” (Ashman et al., 2015; Sajikumar & Ajithkumar, 2021).

In a next step, the sections of the questionnaire are assigned to the "modified" EBM model accordingly (Figure 39). The inserted points one to three shall illustrate the steps in the decision process. As already outlined, the decision process proceeds in such a way that the choice sentences activate the attention of the respondent. The respondent first searches internally in his memory for experiences and information he has already gathered; if this information is insufficient, he proceeds to an external search. The attributes and their characteristics in the transportation options act as stimuli that are processed in memory according to information processing. The pre-choice alternative evaluation phase then evaluates the options offered; the choice represents the actual behavior. As seen in Figure 39, the variables have been assigned to the EBM model as follows: to the category “environmental influences”, the sociodemographic variables from Section A and “life circumstances” (changes in living conditions and job situation of the last 24 months) from Section B were assigned. Variables on "travel status” (access to nearest public transport mode, number of kilometers traveling using primary mode of transport) from Section E were also assigned to this category. To the same Section E, the variables “Conditions to switch (transport policy instruments)” were assigned. Variables to „participation in sharing modes" were assigned to both categories since to the authors opinion, this applies equally to both. Experience in sharing modes can arise from situational conditions or can also express individual values such as environmental protection (Engel et al., 1995, p. 460).

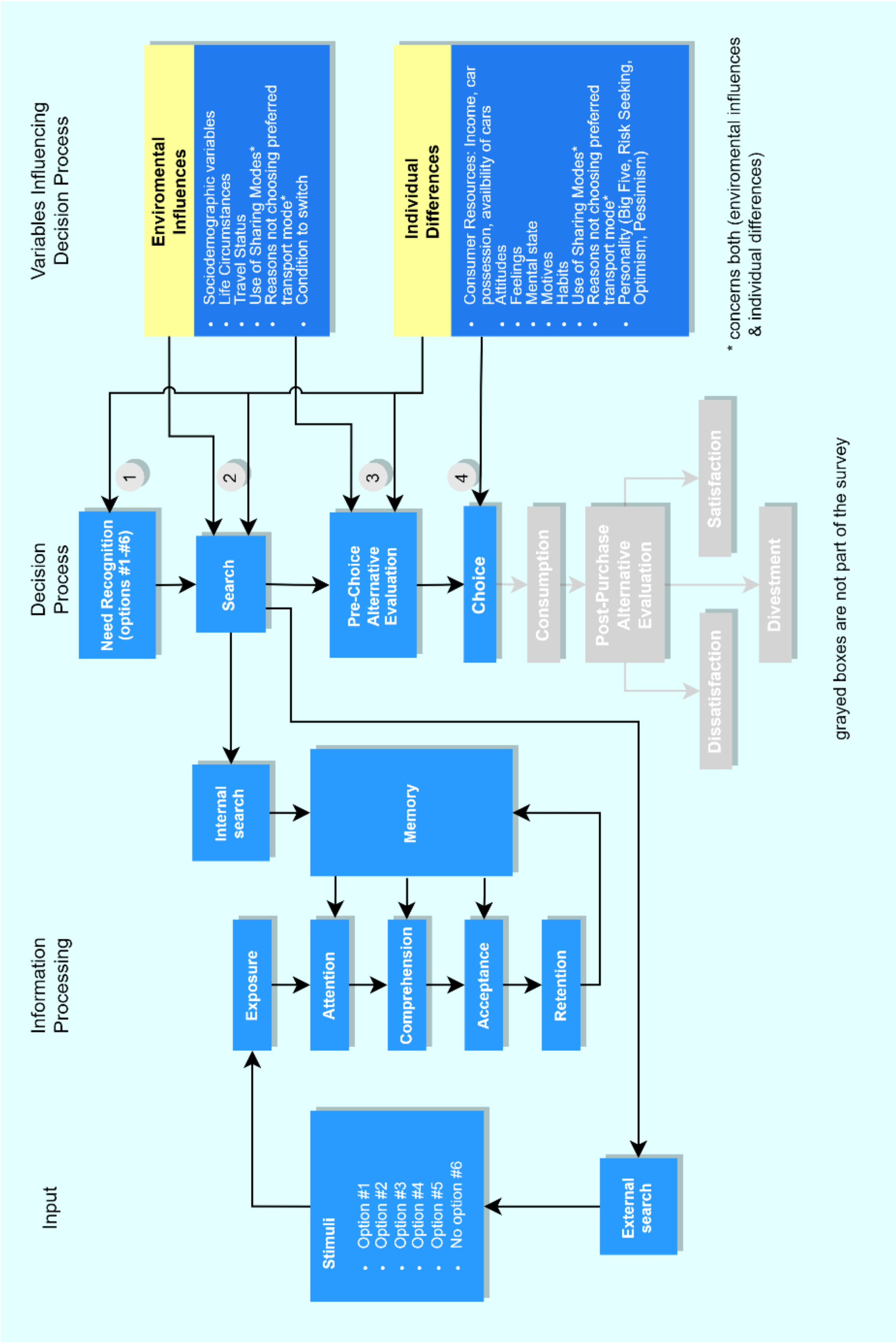

Figure 39 Modified EBM Model (1995): assignment of the variables

Source: adapted from (Engel et al., 1995)

The variable "reasons for not choosing preferred transport modes" was also assigned to both categories since the possible options relate to situational circumstances (e.g., lack of other possibilities) and individual differences (e.g., emotional aspects).

To the category “individual differences”, variables from Section A to income, possession of a driver’s license, number of cars per household and car ownership were assigned, as those are seen as a consumer resource, since decision making is a matter of” (1) time, (2) money, and (3) information reception and processing capabilities” (Engel et al., 1995 p. 144). The variable “availability of a hybrid car” is in the authors ‘opinion both a consumer resource as well as an expression of lifestyle. “Feelings” (environmental noise) and “mental state while traveling with preferred transport mode” from Section D, as well as “motives” and “habits” from Section E are assigned to the same category.

The discrepancy between present and ideal state, driven by utilitarian or hedonic benefits, might motivate behavioral change (Engel et al. 1995, p. 425). The variables “participation in sharing modes” and “reasons for not choosing another transport mode” from Section E of the questionnaire can be assigned to both categories. Personality aspects vary from individuals; thus, this Section F is assigned to this category.

Van Acker et al. (2010) criticized the missing relationship between travel behavior and spatial, socioeconomic and personality characteristics resulting in the development of a conceptual framework (Van Acker et al., 2010, p. 14).

The framework distinguishes between reasoned influences (perceptions), unreasoned influences (habits), and behaviors. The authors implemented feedback mechanisms and anchored their model in a framework consisting of three levels: “individual level, social environment level, and spatial environment level” (Van Acker et al., 2010, p. 14).

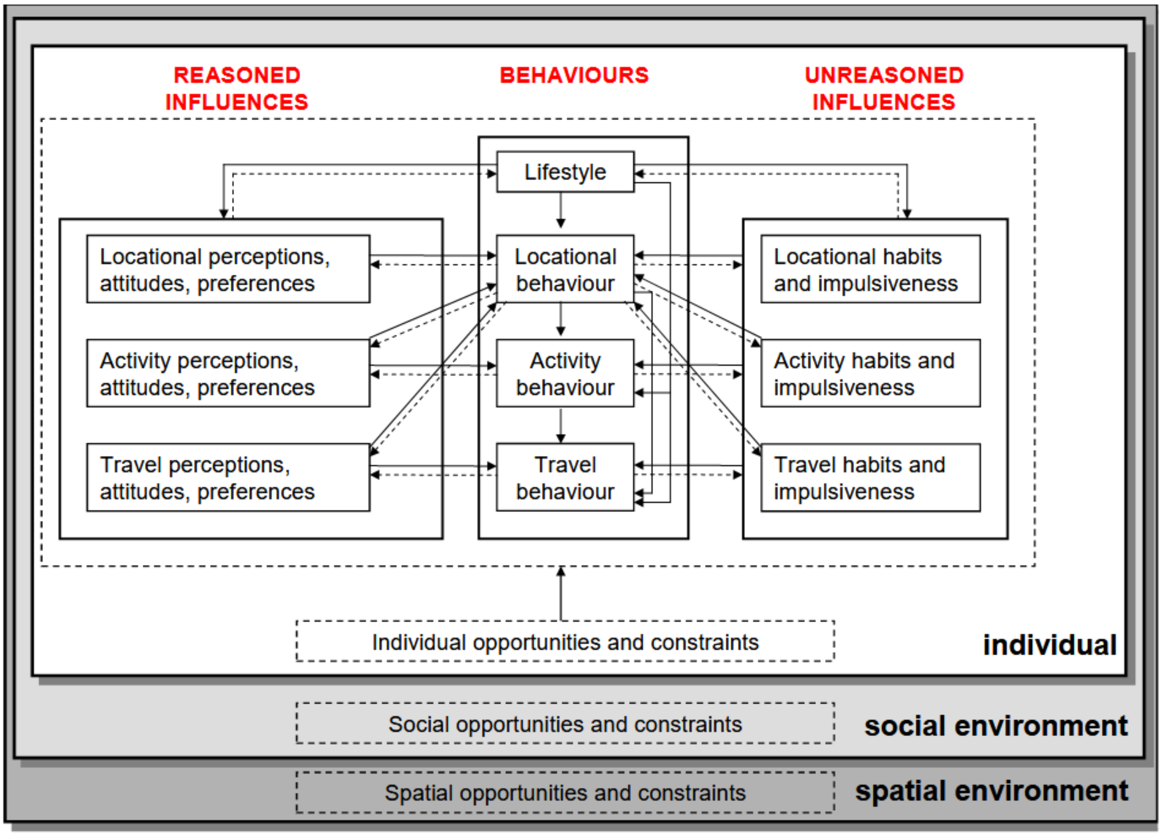

Figure 40 “Conceptual model of travel behavior”

Source: (Van Acker et al., 2010, p. 14)

Choosing a mode of transportation is a highly complex decision-making process that is influenced by many factors such as individual characteristics and past experiences. The original framework from the authors can be retrieved from Figure 40. The feedback mechanism (dotted line) explains that individuals can have the capacity to learn from earlier experiences, however, individual differences “are not fixed in time” (Van Acker et al., 2010, 14). Since these three levels are part of the survey, the first four stages of the decision-making process and the variables that influence the decision-making process from the EBM model are embedded into Van Acker´s et al. (2010) theoretical framework (Figure 41).

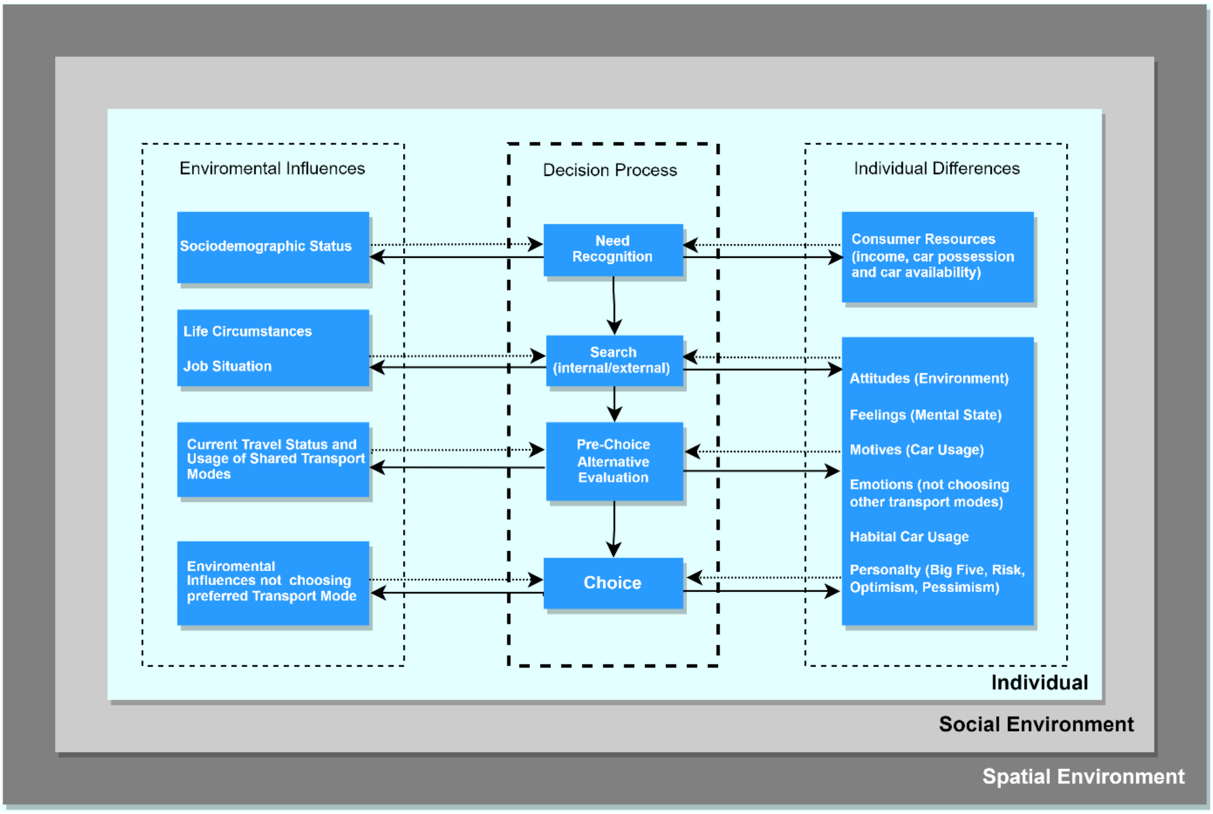

Figure 41 Embedding the stages of the EBM Model (1995) in van Acker´s (2010) theoretical framework

Source: on illustration, adapted from (Engel et al., 1995 and van Acker et al., 2010)

As previously stated, the author chooses the Partial Least Squares Structural Equation Modeling (PLS-SEM) technique as it is method very well-known method for estimating complex path models with latent variables and their relationship to each other (Sarstedt et al., 2017). PLS-SEM modelling is widely used in research of behavioral change, for example, Kang et al. (2019) developed a research model using the TIB (Triandis, 1980) and the Rubicon Model (Gollwitzer, 1999) showing that intention to switch served as a primary predictor of behavioral change in terms of using public transport (Kang et al., 2019).

The procedure for structural equation models with latent variables generally begins with the formulation of a model, followed by parameter estimation and subsequent evaluation of the estimation results. (Backhaus et al., 2015).

Modelling is of central importance for the explanation and prediction of various objects of observation as models describe complex facts and estimate future developments. A prerequisite for this is a well-founded understanding of the interrelationships in a theory (Backhaus et al., 2018). The formulation of the model is based on the theoretical framework of the EBM model (Engel et al., 1995). As shown in Figure 42, individual sections of the questionnaire have been assigned to the theoretical structure of the EBM model as follows:

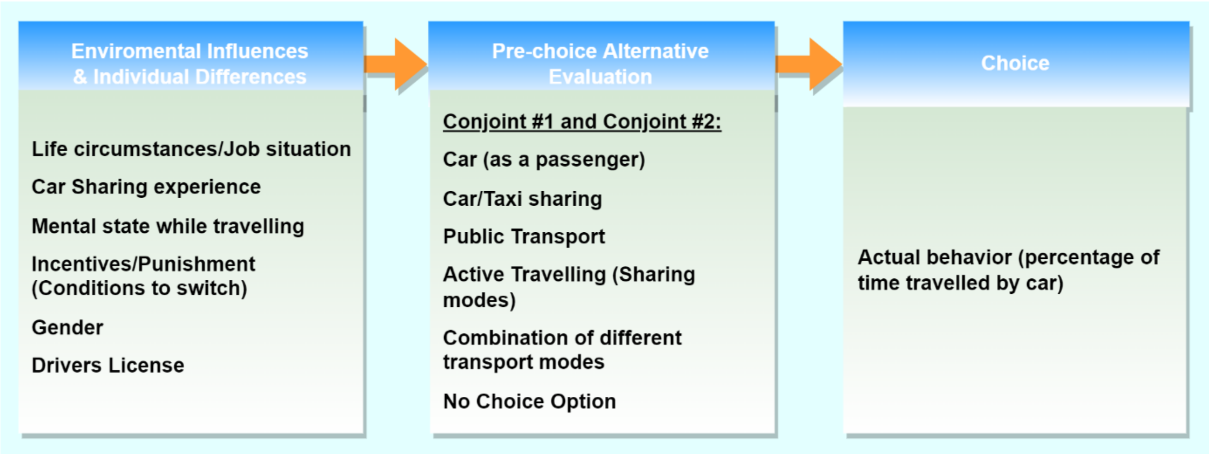

Figure 42 Assignment of the variables to the EBM Model (Engel et al., 1995)

Source: own illustration, adapted from original EBM Model (Engel et al., 1995)

As outlined, a structural equation model (SEM) is a complex model with several variables to be explained, for which a causal relationship is assumed. In addition, a simultaneous examination of all relationships is subsequently conducted. Dependent variables are called endogenous variables and are explained by the other variables. The explanatory variables are called exogenous variables (Backhaus et al., 2018). The present model is a model with latent endogenous and exogenous variables, which are measured by suitable indicator variables. A SEM comprises two sub models, with the inner model, describing the relationships between the independent and dependent variables and the outer model describing the relationships between the latent variables and their observed indicators, the latent variables are either exogenous or endogenous, PLS-SEM is an approach analyzing variances (Backhaus et al., 2018; Wong, 2013).

Prior to the actual analysis, the categorical variable "conditions to switch (policy instruments)" is distinguished in two main constructs "punishment" and "incentives," further subdivided into six subconstructs (“punishment-cost”, “punishment-convenience”, “punishment-joy” and “incentive-cost”, “incentive-convenience” and “incentive-safety”. The variable "mental state/experienced feelings” is divided into "pleasant mental state/experienced feelings," "unpleasant mental state/experienced feelings," and "other."

All variables are analyzed using the chi-square test and ANOVA, followed by factor analysis. The development of the structural equation model (SEM) is based on the results. It has to be noted, that in a factor analysis, care must be taken not to lose too much information during the extraction process (Backhaus et al., 2018). A structural equation analysis follows the approach of factor analysis, which assumes that the empirical indicator variables of a latent variable are characterized by high correlations, where the correlations are caused by the respective latent variable under consideration, manifest variables are interpreted as latent variables (Backhaus 2018). The structural equation analysis used here is a model with manifest variables, which are consequently interpreted as latent variables. The modeling is preceded by a factor analysis.

Type of Analysis	**Exploratory Factor Analysis (EFA)**	**Confirmatory Factor Analysis (CFA)**
Model	No model formulation	Theoretical model formulation is a priori
Objective	Discovery of factors as causal variables for highly correlated variables	testing the relationships between indicator variables and hypothetical variables
Assignment of indicator variables to factors	Is done by the procedure based on statistical criteria	Given a priori by the researcher
Estimation of the factor loading matrix	A full factor loading matrix is estimated	As a rule, a single structure of the factor loading matrix is assumed
Number of factors	Determined on the basis of statistical criteria as part of the analysis	Is specified a priori by the researcher
Rotation of the factor loading matrix	Is done for easier interpretation of the factor structure	Not applicable, since the factor structure is given a priori
Interpretation of factors	Is done a posteriori with the help of the factor loading matrix	Specified by constructs from the user

Table 8 Exploratory versus confirmatory factor analysis

Source: on illustration, adapted from (Backhaus et al., 2015, p. 128)

The goal of a factor analysis is to make a causal interpretation (Backhaus 2018). For factor analysis, a distinction can be made between “Exploratory Factor Analysis” (EFA) and “Confirmatory Factor Analysis (CFA) (Backhaus 2015). The differences between both factor analyses can be retrieved from Table 8.

The modeling of the PLS-SEM model used based on a performed exploratory factor analysis (EFA), since the data structure is not yet known and the factors as causal variables for highly correlated variables are not known yet. Since the objective of the thesis is to find out to what extent the respondents' statements about a hypothetical situation correspond to actual behavior, the author believes that respondents' statements must first be examined (independently) of possible hypotheses to identify correlations. EFA has the advantage of examining data without prior hypothesis formulation. In the next step, the model parameters are estimated and evaluated simultaneously, that is, the structure as a whole and the evaluation of the part structures (Backhaus 2018). The results can be found in chapter four.

3.6. Data Collection and Sampling

The survey data is collected via a self-completion questionnaire including 37 questions, approved by the Faculty of Economics, University of Gdansk. The instrument for data collection was developed by using the open-source platform LimeSurvey, Version 3.17.0+190402 (LimeSurvey, 2018). A printed version of the questionnaire in German and Polish language can be retrieved from the Appendix. There are numerous survey platforms that can be used for creating a questionnaire, an overview about several platforms can be seen at Hoffer (2015, p. 21). An analysis of the potential of online survey services for conducting stated preference experiments in transportation planning was conducted by Hoffer (2015), who concluded that LimeSurvey is the most suitable open-source platform for stated preference surveys (Hoffer, 2015).

The questionnaire is available in English and Polish, as the survey will be conducted allover in Poland. Inclusion criteria for the study are residents in Poland over 18 years. It is expected that nearly 950 people will complete the questionnaire. The questionnaire used for this purpose includes 37 questions and can be found in the Appendix. To avoid multiple responses, the IP addresses are tracked. Most items are mandatory to prevail missing data. Statistica (Version Dell 13.1) and SmartPLS V. 3.0 (SmartPLS, 2020) is used to analyze the data.

CHAPTER 4
RESULTS

In this dissertation, the effect of economic, social and psychological factors on the transport behavior of polish citizens using a conjoint analysis approach has been studied. The main objective of the thesis was to investigate to what extent the statements made by the respondents about a hypothetical situation correspond to the actual behavior.

For this, a total of 918 valid responses were collected using CATI (Computer Assistant Telephone Interviewing) and CAWI (Computer Assistant Web Interviewing) methods. Common research methods include CATI, CAWI and CAPI (Computer Assistant Personal Interviewing) procedures. Computer-Assisted Personal Interviewing (CAPI) involves the interviewer recording respondents' answers on a computer. It is considered an improved method of personal interviewing by an interviewer because it reduces interview errors, and the data is stored securely. The CAPI method can be used to collect quantitative and qualitative data and reaches all population groups, but it is more expensive and laborious than the other two methods presented. CATI is a method in which interviewers contact respondents, usually via a central call center. The advantage of this method is that these persons can explain questions about the surveys, and the data is stored securely and reaches a large part of the population. Disadvantages are that interviewers must be trained, and low-income persons cannot be interviewed (Elliott, 2021). CAWI surveys are conducted via a web browser or mobile application, with links sent via email or mobile applications, for example. They may not provide as detailed qualitative data because they are not supported by an interviewer. This method is suitable for large samples as it does not require trained interviewers and is, therefore, less expensive. However, this method can only reach educated people or people with an internet connection. CAWI is less suitable for qualitative data collection (Elliott, 2021).

The web-based program LimeSurvey, Version 3.17.0+190402 (LimeSurvey, 2018), was used to capture the data. The data were downloaded into the statistical software Statistica 64, version 13.1 (Dell Inc., 2016). To analyze mobility behavior, socioeconomic characteristics were collected along with psychographic data.

The following chapter presents various statistical analysis performed on the sample of the survey and is structured into the three subchapters reflecting the following topics:

- Results on socio-demographics, travel aspects and conjoint questions (frequency tables and Chi-Square results)
- Results on experienced feelings (mental state and life circumstances) and conjoint questions (frequency tables and Chi-Square results)
- Results on attitudes and personality (Analysis of Variances ANOVA/Levene´s test, Kruskal-Wallis test, Factor Analysis) and PLS-SEM Model: path analysis, model fit, test, demonstration of the significant results

4.1. Results on Socio-Demographics and Travel Aspects

918 participants completed the questionnaire. From the 918 respondents, 440 respondents are married and 371 are not married, 74 are divorced and 31 are widowed. Thus, the group of married and unmarried people represents the largest group in approximately equal measure. Two respondents did not state their marital status.

Age and Gender			
Age	Gender 1=female	Gender 2=male	Row Totals
1 = younger than 18 years	52	41	93
2 = 18 – 30 years	87	102	189
3 = 31 – 50 years	197	211	408
4 = 51 – 65 years	97	78	175
5 = above 65 years	34	19	53
All groups	467	451	918

Table 9 Frequency table: age and gender

Source: own calculations (Statistica 64, version 13.1)

Table 9, of these 918 respondents, the age group between 31-50 years is most presented, followed by the age group between 18-30 years old and 51-65 years old. 467 respondents are female (which is almost 51% of the total respondents) and 451 respondents are male (49% of the total respondents). This means that the largest group is the group of 31–50-year-olds who filled in the questionnaire and that the gender proportion is balanced.

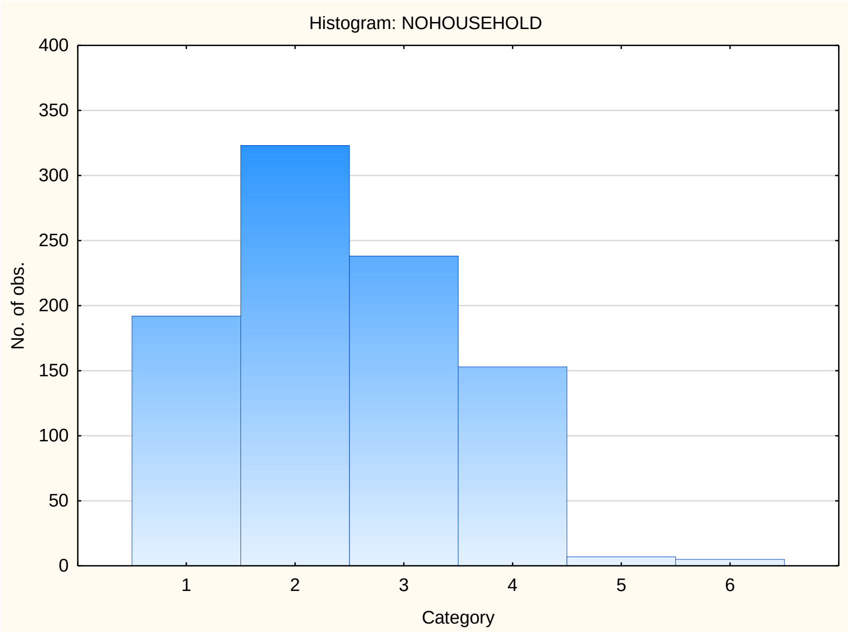

Figure 43 Household size

Source: own calculations (Statistica 64, version 13.1)

Looking at the average household size (Figure 43), the 2-person households are the most represented, followed by the 1-person households and the 3-person households. Of the 4-person households, a total of 26 households participated in the survey.

Number of persons per household and number of people older than 18 years per household						
Household characteristics	Number of people older than 18 years per household					
	younger than 18 years	18-30 years	31-50 years	51-65 years	older than 65 years	Row Totals
1-person household	4	65	76	51	15	211
2-person household	78	116	205	95	25	519
3-person household	11	6	106	29	7	159
4-person household	0	1	20	0	5	26
5-person household	0	1	1	0	1	3
All groups	93	189	408	175	53	918

Table 10 Frequency table: household characteristics and number of people older than 18 years

Source: own calculations (Statistica 64, version 13.1)

Table 10, the 31-50 age group is the most represented age group living in two-person households, and the 18-30 age group is most often found in 2-person households. The 51-65 age group lives mostly in 2-person households, and those over 65 live in 2- or 1-person households. The two largest groups that participated in this survey, 18- to 30-year-olds and

31- to 50-year-olds, are predominantly from households with 2 persons.

Of the remaining 42%, 16.55% earn more than PLN 7000 per month, followed by 11.76% of respondents who have an income between PLN 5000-7000. For the remaining respondents, the income is lower. The residents of Poland earn on average 6000 PLN gross per month. This follows from the data of the Central Statistical Office (GUS). However, the breakdown into voivodeships shows that incomes in the country vary depending on the region (*Polenjournal.De*, 2020). Thus, 28% of the respondents who stated their income in this regard are in the average income range in Poland.

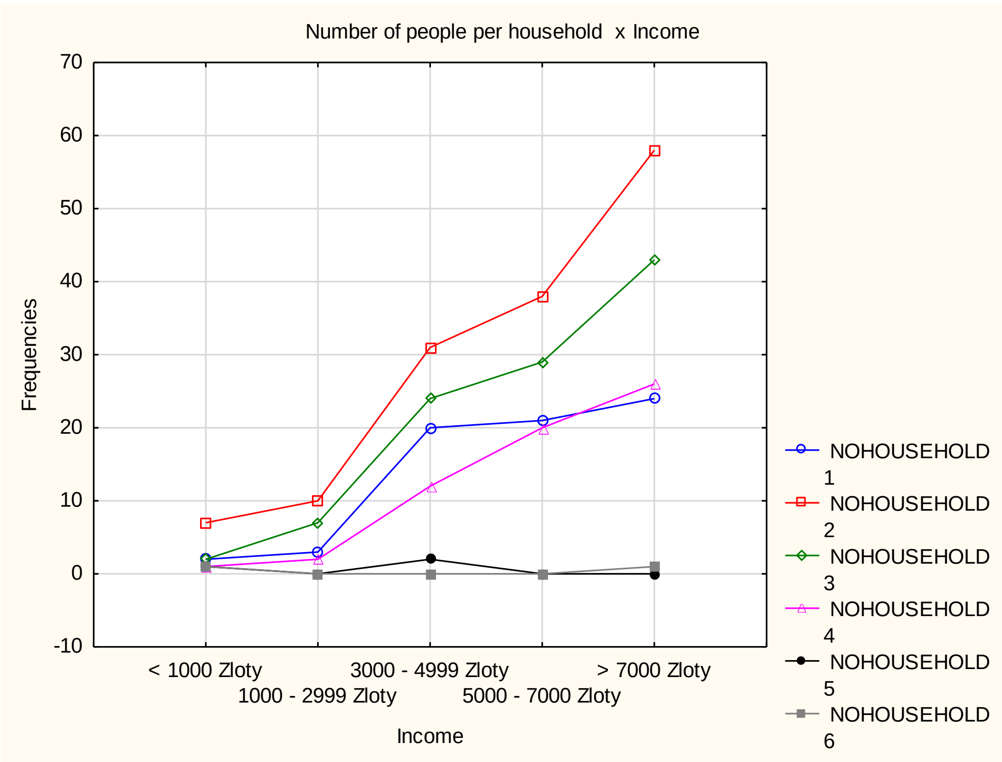

Figure 44 Number of people per household and income

Source: own calculations (Statistica 64, version 13.1)

Figure 44 shows the number of people per household and income. As seen, the group of 2- and 3-person households, followed by the group of 4-person households and 1-person households are the most represented with an income above PLN 7000. In the income group up to PLN 7000, the 2-person households are again the most represented, followed by the 3-person households. The 2-person households are most represented in the income group between 3000 and 7000 PLN. In the income group of 1000-2999 PLN, the 2-person households are also the most represented, followed by the 3-person households.

As seen from Figure 45, more than half of the respondents (63%) are apartment owners, followed by 15% living in rental apartments and 14% of respondents owning a house, 5% of the respondents live in a rented house. As shown, most respondents who own an apartment live in cities between 100,000 and 500,000 inhabitants, followed by respondents who live in cities under 100,000 inhabitants, followed by apartment owners in cities over 500,000 inhabitants. This indicates that most of the respondents live in their own apartments and in larger cities between 100,000 and 500,0000 inhabitants.

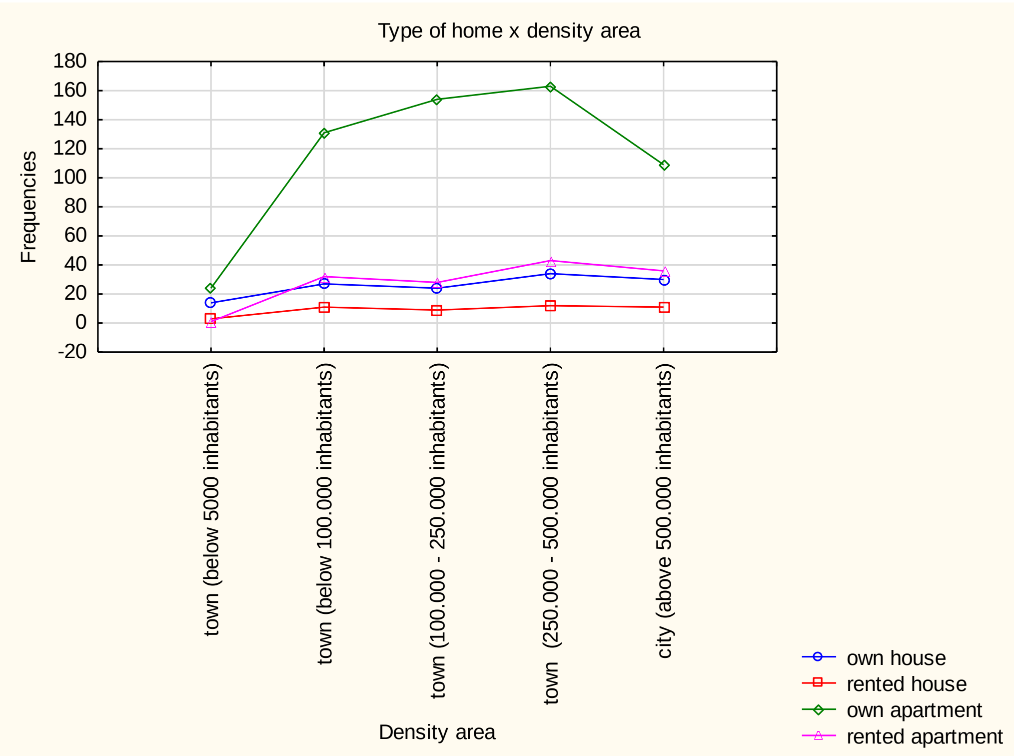

Figure 45 Interaction Plot Type of home x density area

Source: own calculations (Statistica 64, version 13.1)

Of the 918 (100%) respondents, 72.77% are car owners and live in cities between 250,000 and 500,000 inhabitants. This is also found in the group of respondents who do not own a car. Thus, it can be stated that most respondents live in larger cities, with a predominance of car owners.

As far as school graduation or academic education is concerned, out of 918 (100%) of the respondents, 95 persons (10%) left primary school and 430 (46%) respondents left middle school. A total of 3 people (0.3%) obtained a degree from high school. 116 (13%) respondents hold a bachelor's degree and 269 (29.3%) a master's degree. Less than 1% obtained a doctorate degree. Accordingly, among the school-leaving qualifications, the group with an intermediate school-leaving qualification is the most strongly represented. Among the respondents who have an academic degree, the group with a master's degree is the most represented.

Regarding employment, of the 918 participants, 603 (65.69%) reported being fully employed, including self-employment. 55 (5.99%) reported part-time employment and 93 (10.13%) respondents are still in school. 51 (5.56%) are students and 42 (4.58%) reported being working students, 51 (5.56%) reported being retired, and 21 (2.51%) did not report their employment status. Accordingly, more than half of the respondents who participated in this survey are fully employed.

Among the respondents owning a car, 307 (45.95%) have fewer than 400 meters and 361 (54.04%) have a distance of more than 400 meters to the nearest public transport. Of the respondents who do not have a car, 115 (46%) have a distance fewer than 400 meters and 135 (54%) have a distance of more than 400 meters to public transportation. Of the respondents who do not own a car, 115 (46%) are less than 400 meters away from public transportation and 135 (54%) are more than 400 meters away. Thus, the two groups are similar in terms of distances to the nearest mode of transportation. The ownership of a hybrid vehicle is present in only 2,90% of respondents´ households.

Table 11 illustrates the respondents' statements concerning their plans of buying or selling the car-dependent on car ownership. As seen, most car owners do not plan to buy a car within the next 12 months, also almost all respondents do not possess a car plan to buy one. As seen, no big changes are planned concerning buying or selling. It can be assumed that, on the one hand, the respondents are currently satisfied concerning car ownership, or that other financial, personal, and environmental reasons play a role in not changing the status quo now.

Intentions of buying a car within the next 12 months and car ownership			
Category	Car ownership Yes	Car ownership No	Row Totals
Yes	25	1	26
No	597	217	814
Uncertain	46	32	78
All groups	668	250	918

Table 11 Intentions of buying a car within the next 12 months and car ownership

Source: own calculations (Statistica 64, version 13.1)

Table 12 provides a detailed overview of the mobility costs distinguished between car ownership and non-car ownership. As seen, most of the car owners have monthly travel costs between 601-1000 PLN followed by the group with estimated travel costs between 300 and 600 PLN. Most of the respondents who do not possess a car have monthly travel costs of less than 300 PLN.

	Monthly travel costs (including expenses e.g., tax, insurance, maintenance)							
	Car Owners hip	< 300 PLN	300 - 600 PLN	601 - 1000 PLN	1001 - 1500 PLN	1501 - 2000 PLN	I don´t know /no comment	Row Totals
Count	Yes	49	108	193	27	4	287	668
Row Percent		7.34%	16.17%	28.89%	4.04%	0.60%	42.96%	
Count	No	138	25	0	0	1	86	250
Row Percent		55.20%	10.00%	0.00%	0.00%	0.40%	34.40%	
Count	all groups	187	133	193	27	5	373	918
Total Percent		20.37%	14.49%	21.02%	2.94%	0.54%	40.63%	

Table 12 Monthly travel costs and car ownership

Source: own calculations (Statistica 64, version 13.1)

Summarized, respondents who do not own a car spend significantly less than those who do. Further, it is noticeable that 42.96% of car owners are not fully aware of their travel expenses compared to 34.4% of respondents who do not own a car. It may be assumed that the monthly cost of travel is not consciously perceived or is not considered important.

As far as car-sharing is concerned, only 4.5% of the female and 6.65% of the male respondents have taken part in such offers so far. To bike-sharing, only 3.85% of the female and 6.65% of the male respondents made use of such offers. Concluded, only limited use has been made of sharing offers to date. It can be assumed that for reasons of habit or other individual and environmental conditions, such offers have not yet been made use of. It may also be, that such offers are not sufficiently publicized from the public side. Concerning the main transport used for daily travel, the majority (54.8%) travels by their own car. 20.59% use public transport and 7.29% commutes by train. Only 0.44% travel as a passenger in the car. One (0.1%) respondent reported traveling by bicycle and 25.7% are walking. None of the respondent's indicated commuting by car-sharing or taxi sharing or by scooter. This is not surprising, as the data on car-sharing above reflect this fact. Thus, the car is the primary means of transportation.

Table 13 shows the frequency of responses for choosing a mode of transportation other than the preferred one ("if preferred transport mode is car driving but current transport mode is public transport").

Category (reasons not using preferred transport mode)	If preferred transport mode is car driving but current transport mode is public transport			
	Count	Cumulative Count	Percent	Cumulative Percent
0 = no choice	716	716	77.99%	77.99%
1 = time and cost	93	809	10.13%	88.13%
2 = convenience, directness, punctuality, emotional aspects, parking, lack of other options	96	905	10.45%	98.58%
3 = environment	13	918	1.42%	100%
Missing	0	918	0.00%	100%

Table 13 Frequency table: reasons choosing not preferred transport mode (car driving)

Source: own calculations (Statistica 64, version 13.1)

Respondents could select a maximum of three from the following answer choices: time (1), cost (2), convenience (3), directness (4), punctuality (5), emotional aspects (6), environment (7), parking (8), and lack of other possibilities (9) and the no-choice option.

The nine response options were grouped into four areas as follows:

⇒ 0 = no choice
⇒ 1 = time and cost
⇒ 2 = convenience, directness, punctuality, emotional aspects, parking, lack of other options
⇒ 3 = environment.

As seen, time, and cost reasons as well as other reasons such as convenience, punctuality, directness, and lack of other possibilities play an equally important role in the decision to use public transport instead of the preferred car. Only a few of the respondents take public transport to protect the environment. However, these statements should be interpreted carefully, as 78% of the respondents did not take a position on this.

Table 14 shows the frequency of responses for choosing a mode of transportation other than the preferred one ("if preferred transport mode is public transport but current transport mode is car driving"). Apart from the no-choice option, which was most frequently chosen, the reasons for using the car are mostly found in aspects of convenience, directness, punctuality, emotional aspects, parking facilities and lack of other options, followed by time and cost reasons. Here, too, the results should be interpreted with caution, as the no choice option was selected by 93.7 percent.

Category (reasons not using preferred transport mode)	If preferred transport mode is public transport, but current transport mode is car driving			
	Count	Cumulative Count	Percent	Cumulative Percent
0 = no choice	860	860	93.68%	93.68%
1 = time and cost	14	874	1.53%	95.21%
2 = convenience, directness, punctuality, emotional aspects, parking, lack of other options	42	916	4,57%	99.78%
3 = environment	2	918	0.22%	100.00%
Missing	0	918	0.00%	100.00%

Table 14 Frequency table: reasons choosing not preferred transport mode (public transport)

Source: own calculations (Statistica 64, version 13.1)

Table 15 provides the results regarding the conditions (in the form of transport policy instruments) that would have to be met to switch to environmentally friendly modes of transport. Three at most could be selected or the page could be left empty. The policy instruments were categorized as follows: “punishment – costs” (category 0: increased gasoline prices and increased parking fee), “punishment - convenience” (category 1: less parking spaces), “punishment- joy” (category 2: Speed limit of 30 km/h in inner cities) and “incentives - costs” (category 3: free public transportation), “incentives convenience” (category 4: increase in the frequency of public transportation, expansion of park and ride/bike and ride, increase of flexible sharing services and integrated public transport system and “incentives safety” (category 5: strengthening of safety through video surveillance and accompanying security personnel) and none of them/other (category 6). For most of the respondents, an increase in prices for gasoline and parking would be a reason to switch to other modes, followed by impairments in terms of convenience in the form of fewer parking options. Incentives regarding more convenience or even lower costs have less impact on a possible switch. Thus, it could be assumed that policy instruments only work if the cost of gasoline and parking fees increase, as well as if the space for parking cars is restricted.

Category (transport policy instruments)	Conditions to be met to switch to environmentally friendly transport modes			
	Count	Cumulative Count	Percent	Cumulative Percent
0 = punishment-costs	720	720	78.43%	78.43%
1 = punishment -convenience	100	820	10.89%	89.32%
2 = punishment - joy	22	842	2.40%	91.72%
3 = incentives costs	12	854	1.31%	93.03%
4 = incentives convenience	20	874	2.18%	95.20%
5 = incentives safety	39	913	4,25%	99.46%
6 = none of them/other	5	918	0.54%	100.00%
Missing	0	918	0.00%	100.00%

Table 15 Frequency table: transport policy instruments

Source: own calculations (Statistica 64, version 13.1)

The remainder of this chapter presents the results with respect to the two conjoints used in this survey. First, the Conjoint#1 used in case of employer’s incentives is seen Figure 46. It illustrates the transport mode choice options used in the questionnaire for the hypothetical situation where an employer offers different incentives to facilitate the switch to environmentally friendly modes of transport (Conjoint #1). As illustrated, the respondents could choose between the options as seen.

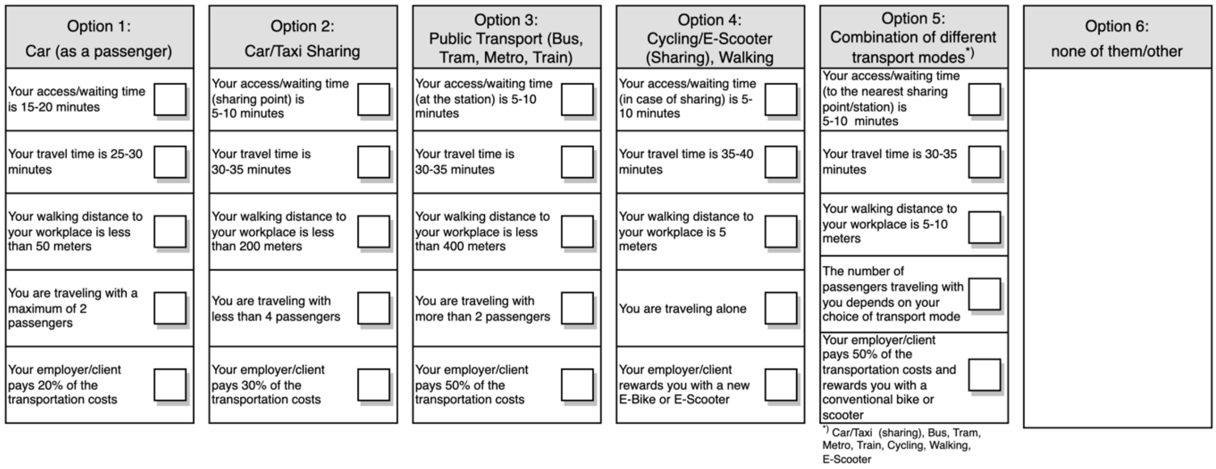

Figure 46 Conjoint #1: Employer´s incentives

Source: own illustration

Table 16, most respondents would switch to car/taxi sharing if given appropriate incentives by their employer, followed by a switch to public transport. In third place is the "car as passenger" option. In fourth place is option five, which involves a combination of different modes of transport. In fifth place is option four, which is active traveling. However, 213 (23.20%) chose none of them/other option.

This indicates that even with incentives from the employer, the car in shared form (car or taxi) with a waiting time of 5-10 minutes, longer travel time than with their own car and a distance of 200 meters would be accepted. Also, for respondents who chose this option, it would be acceptable to travel with up to four passengers. Also, the employer's contribution to travel costs at 30% could be the factor for many having chosen this option as their first. Second choice, in this case, would be public transportation, which involves longer travel time, greater walking distance, and more passengers, but also has the advantage that the employer pays half of the travel costs. Car as a passenger follows in third place, here it can be assumed that the 20% share of travel costs paid by the employer does not play such an important role and that option two (car/taxi sharing) is, therefore, more likely to be preferred. However, the frequent choice of the no-choice option/other option could indicate that incentives from the employer do not play a role for many to switch to other modes of transport or none of the options fit the respondent´s situation.

Category (Options)	Imagine you are employed or self-employed. Your employer/client offers you different options if you use other means of transportation than your own car. Please select the option you would choose. If none of the options suits you or applies to you choose “none of them/other”.			
	Count	Cumulative Count	Percent	Cumulative Percent
#1: Car (as a Passenger)	135	135	14.70%	14.70%
#2: Car/Taxi Sharing	221	356	24.07%	38.78%
#3: Public Transport	208	564	22.66%	61.44%
#4: Cycling/E-Scooter (Sharing), Walking	46	610	5.01%	66.45%
#5: Combination of different transport modes (Car/Taxi (sharing), Bus, Tram, Metro, Train, Cycling, Walking	95	705	10.35%	76.80%
#6: none of them/other	213	918	23.20%	100.00%
Missing	0	918	0.00%	100.00%

Table 16 Frequency table: Conjoint #1 – employers’ incentives

Source: own calculations (Statistica 64, version 13.1)

Figure 47 illustrates the transport mode options in case of non-availability of the car to get home (Conjoint #2). As seen, the respondents could choose between the following options:

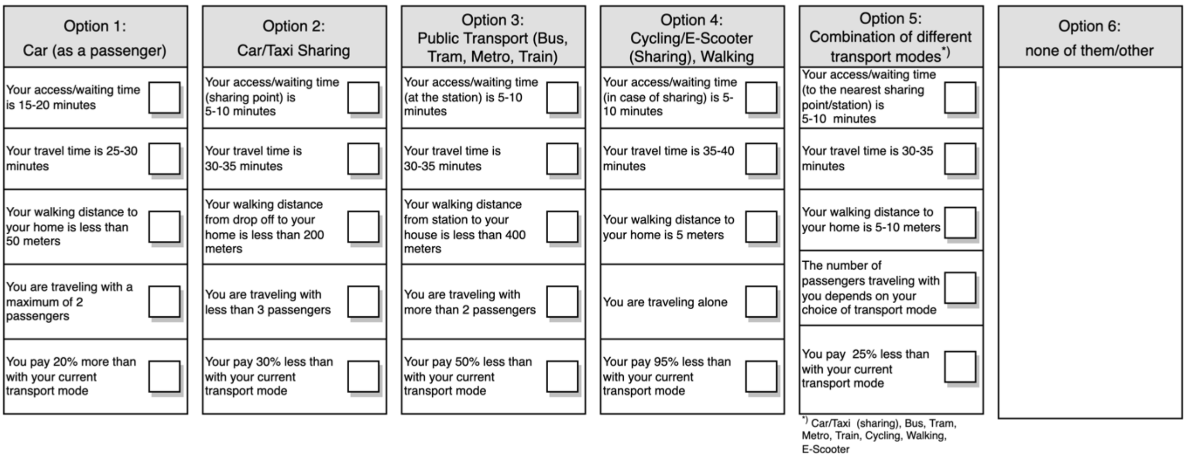

Figure 47 Conjoint #2: Non-availability of car

Source: own illustration

As seen in Table 17, in case of non-availability of the car most of the respondents would choose “public transport”, followed by “car/taxi sharing”. Option “car as a passenger” was chosen in third place, followed by option “combination of different modes of transport”. The last option respondents would consider is “active traveling”. It can be assumed that the respondents have chosen the options in the way that best suits their situation in terms of distance from the place of residence and available options. As far as public transport is concerned, it could be concluded that this mode of transport was chosen primarily because of the short waiting time, the short distance between the station and the place of residence, and the lower travel costs. However, car/taxi sharing also seems to be attractive. Here, one could assume that the short travel time and the walking distance to the home are so appealing that a 20% increase in travel costs is accepted. However, the high number of respondents who chose the no-choice option raises the question of what modes of transportation they would choose if a car were not available. It could be assumed that they have not thought about this yet or none of the options fit the respondent´s situation.

Category (Options)	Please imagine the following situation: You are in town (e.g., doctor's appointment, shopping, meeting with friends, etc.) under normal weather conditions. Your car (if you own one) is not available to take you home. Please select the option you would choose. If none of the options suits you or applies to you choose “none of them/other”.			
	Count	Cumulative Count	Percent	Cumulative Percent
#1: Car (as a Passenger)	118	118	12.85%	12.85%
#2: Car/Taxi Sharing	137	255	14.92%	27.78%
#3: Public Transport	146	401	15.90%	43.68%
#4: Cycling/E-Scooter (Sharing), Walking	90	491	9.80%	53.48%
#5: Combination of different transport modes (Car/Taxi (sharing), Bus, Tram, Metro, Train, Cycling, Walking	113	604	12.31%	65.79%
#6: none of them/other	314	918	34.20%	100.00%
Missing	0	918	0.00%	100.00%

Table 17 Frequency table: Conjoint #2 – non availability of car

Source: own calculations (Statistica 64, version 13.1)

Table 18 provides an overview of the frequency of options chosen in the hypothetical situation where an employer offers various incentives to facilitate the switch to environmentally friendly modes of transportation (Conjoint question #1) in the context of previous car-sharing experiences. As seen, the respondents with no car-sharing experience, would prefer car/taxi sharing first, followed public transport. In third place is driving as a passenger in a car, followed by combining different modes of transport, the least favored option is active traveling. It could be assumed that those who have not participated in car-sharing before would choose car-sharing to gain experience. Further it could be assumed, that the respondents rejecting car-sharing would prefer public transportation. For choosing the option “public transport” it could be assumed that the employer's incentive to pay part of the costs for this plays an important role. Most of the respondents who have experience with car-sharing, would choose car-sharing again: here, it can be assumed that those respondents have had good experiences with this transport mode in the past. The reason for choosing public transport by the respondents with car-sharing experience might be due to the fact of the employer's cost incentives. However, the results could also indicate, that the respondents without car-sharing experience probably would not use any other means of transportation than their own car to get to work. Thus, it could be assumed that the respondents who have not yet used a car-sharing service are the car drivers who are generally not open to other means of transport.

Frequency Table: Conjoint question #1 (employer offers incentives) and car-sharing experience							
Car Sharing	*Option #1* Car (as a passenger)	*Option #2* Car/Taxi sharing	*Option #3* Public transport	*Option #4* Active traveling	*Option #5* Combination of different transport modes	*Option #6* none of them/other	Row Totals
1 yes	8	13	11	4	4	11	51
2 no	127	208	197	42	91	202	867
All groups	135	221	208	46	95	213	918

Table 18 Frequency Table: Conjoint #1 - employers´ incentives and car-sharing experience

Source: own calculations (Statistica 64, version 13.1)

Table 19 provides an overview of the frequency of options chosen in the hypothetical situation of being in town and the car is not available to return home (Conjoint question #2) in the context of car-sharing experience. Respondents with no car-sharing experience would preferably switch to “public transport” to get home. It can be assumed that for this group this can be attributed to not having had any previous experience with car-sharing. In second place is the option “car/taxi sharing”, followed by “car as a passenger”. Concerning the chosen option “car as a passenger”, it could be presumed that those respondents would contact friends or family members to get home in such a situation. From the respondents who chose a combination of different modes of transport (fourth place) it is assumed that they have some experience in using different modes of transport and thus, would choose several transport modes in combination to get home. The fifth place is “active traveling”, here it can be assumed that the distance from the city to home can be managed with these modes of transportation. However, 297 respondents chose the “none of them/other option”, which leaves the question open, of how they would get home in such a case. Likewise, it could be that none of the above options reflects the individual situation.

Of the respondents having car-sharing experience, most would travel as a passenger in a car, followed by public transport and a combination of different transport modes. In fourth place, car or taxi/sharing would be chosen in such a situation. The last option would be active traveling. It could be assumed that the experience with car-sharing contributes to the fact that car as a passenger and the combination of different modes of transport do not represent a hurdle for most people to switch to other transport modes in such a case.

Frequency Table: Conjoint question #2 (being in town and no car is available to return home) and car-sharing experience							
Car Sharing	*Option #1* Car (as a passenger)	*Option #2* Car/Taxi sharing	*Option #3* Public transport	*Option #4* Active traveling	*Option #5* Combination of different transport modes	*Option #6* none of them/ other	Row Totals
1 yes	9	6	8	3	8	17	51
2 no	109	131	138	87	105	297	867
All groups	118	137	146	90	113	314	918

Table 19 Frequency Table: Conjoint #2 - non availability of car and car-sharing experience

Source: own calculations (Statistica 64, version 13.1)

Table 20 provides an overview of the frequency of options chosen in the hypothetical situation where an employer offers various incentives to facilitate the switch to environmentally friendly modes of transportation (Conjoint question #1) in the context of the conditions (in the form of policy instruments) that would have to be met to switch to other transport modes than the car. As can be seen, most respondents indicating a switch in case of rising costs, chose car/taxi sharing first, followed by public transportation. In the third place the option “car as a passenger” was chosen, followed by “combination of different transport modes” and last “active traveling”. However, 177 respondents would not switch to other modes of transportation, leading to the conclusion that non-switchers would accept rising costs to avoid losing amenities, nor would employer incentives help persuade convinced drivers to switch. For the respondents open to other transport modes in case of rising costs, it is assumed that the financial punishments will have a negative impact on their living conditions. In this case, respondents would choose lower-cost options. However, which of the options is chosen depends on e.g., distance, lack of other possibilities and personal situation. Few respondents would prefer active travel or choose a combination of different modes of transportation. For the latter two options, choosing a combination of transportation or active travel does not seem attractive because it is too much of a hassle or simply not possible due to distance or other reasons.

Frequency Table: Conjoint question #1 (employer offers incentives) and conditions to switch to environmentally transport modes							
Conditions to switch (transport policy instruments)	*Option #1* Car (as a passenger)	*Option #2* Car/Taxi sharing	*Option #3* Public transport	*Option #4* Active traveling	*Option #5* Combination of different transport modes	*Option #6* none of them/ other	Row Totals
0 = punishment costs	102	169	168	32	72	177	720
1 = punishment convenience	17	26	22	8	13	14	100
2 = punishment joy	2	6	6	2	2	4	22
3 = incentives costs	2	2	2	1	3	2	12
4 = incentives convenience	3	6	3	2	3	3	20
5 = incentives safety	9	8	6	1	2	13	39
6 = none of them/other	0	4	1	0	0	0	5
All groups	135	221	208	46	95	213	918

Table 20 Frequency Table: Conjoint #1 - employers´ incentives and policy instruments

Source: own calculations (Statistica 64, version 13.1)

It can be concluded that employers' incentives regarding cost- sharing play a major role and that in the case of higher costs for gasoline and parking, there is more of an inclination to take advantage of such offers from employers. Should transport policy instruments limit convenience, most of the respondents would choose car/taxi sharing in the context of employer’s incentives, followed by public transport and car (as a passenger). Regarding convenience, the reasons for choosing car-sharing could be that no parking space is needed anymore, and respondents still get to work in a motorized way.

Table 21 provides an overview of the frequency of options chosen in the hypothetical situation, when the car is not available to get home (Conjoint question #2) and information provided regarding the conditions (in the form of transport policy instruments) that would have to be met to switch to environmentally friendly modes of transport. As in the previous hypothetical situation, rising costs in particular play a major role in switching to other modes of transport. It is assumed that most respondents would switch to public transport as being the cheapest transport mode in the conjoint, followed by car/taxi sharing and car as a passenger.

Frequency Table: Conjoint question #2 (being in town and no car is available to return home) and conditions to switch to environmentally friendly transport modes							
Conditions to switch (transport policy instruments)	*Option #1* Car (as a passenger)	*Option #2* Car/Taxi sharing	*Option #3* Public transport	*Option #4* Active traveling	*Option #5* Combination of different transport modes	*Option #6* none of them/ other	Row Totals
0 = punishment costs	97	106	110	65	87	255	720
1 = punishment convenience	11	15	22	12	14	26	100
2 = punishment joy	1	5	2	3	2	9	22
3 = incentives costs	1	3	2	1	3	2	12
4 = incentives convenience	3	2	3	2	6	4	20
5 = incentives safety	4	6	7	5	1	16	39
6 = none of them/other	1	0	0	2	0	2	5
All groups	118	137	146	90	113	314	918

Table 21 Frequency Table: Conjoint #2 - non availability of car and policy instruments

Source: own calculations (Statistica 64, version 13.1)

Further, it can be assumed that the respondents being in such a situation and not having a car available to return home, would choose the option as presented. Which option is chosen may depend on individual and situational aspects. As seen in Table 21, impairments in terms of convenience would make only a few respondents to other transport modes. However, increase in safety is also an aspect to switch to other transport modes but it is not known to which one, as the none of them/other option was chosen. Here, it could be surmised that if safety were increased, other options than the provided would be chosen. However, as in the other hypothetical situation, despite increasing costs and cuts in convenience, many respondents decided to choose the none of them/other option, leaving open the question of how they would get home in such a case if no car was available. Again, it could be assumed that the options offered are not attractive enough or do not fit the individual current situation.

In the further course the combination between Conjoint #1 (employers´ incentives) and gender can be seen from Table 22, illustrating, that more females than males would switch to car as a passenger, public transport, and active traveling in case of incentives by the employer.

Frequency Table: Conjoint question #1 (employer offers incentives) and gender							
Gender	*Option #1* Car (as a passenger)	*Option #2* Car/Taxi sharing	*Option #3* Public transport	*Option #4* Active traveling	*Option #5* Combination of different transport modes	*Option #6* none of them/ other	Row Totals
1 = female	72	110	112	26	39	108	467
2 = male	63	111	96	20	56	105	451
All groups	135	221	208	46	95	213	918

Table 22 Frequency Table: Conjoint #1 - employers´ incentives and gender

Source: own calculations (Statistica 64, version 13.1)

Male respondents would rather prefer car/taxi sharing and the combination of different modes of transport. Why the females would prefer these modes could be because they would feel safer traveling as a passenger in the car or using public transport or cycling. For men, it can be assumed that convenience and distance is an aspect for choosing less the public transport mode option and active traveling. However, it is also evident here that almost as many men as women would not switch to other modes of transport, as offered, even with incentives from the employer.

Table 23 shows the combination between Conjoint #2 (hypothetical situation of being in town and no car is available to return home) and gender. As can be seen from the table, more female than male would choose car as a passenger, active traveling, public transport, or a combination of different modes of transport in such a situation.

Frequency Table: Conjoint question #2 (being in town and no car is available to return home) and gender							
Gender	*Option #1* Car (as a passenger)	*Option #2* Car/Taxi sharing	*Option #3* Public transport	*Option #4* Active traveling	*Option #5* Combination of different transport modes	*Option #6* none of them/ other	Row Totals
1 = female	65	59	74	55	58	156	467
2 = male	53	78	72	35	55	158	451
All groups	118	137	146	90	113	314	918

Table 23 Frequency Table: Conjoint #2- non availability of car and gender

Source: own calculations (Statistica 64, version 13.1)

It could be assumed that females would choose car as a passenger because they would then travel home with a familiar person. However, it is also evident here that almost as many men as women would not switch to other modes of transport in case the car is not available to get home. This leaves open the question of what other means of transportation are used to get home or whether the options are not attractive enough.

Table 24 presents the combination of Conjoint question #1(employers’ incentives) and possession of a driver’s license. Among respondents who have a driver's license, most would switch to car-sharing. It is assumed that having a driver's license would tend to use the same mode of transportation under the given conditions, but in a shared mode. This choice is followed by public transportation mode. The reasons for choosing public transport could be found in the fact, that the switch to this transport mode is financially supported by the employer, as the previous results also indicated that under a corresponding cost pressure they would switch. It is assumed, that people generally respond to financial incentives. However, it is also evident that for many (158) respondents who have a driver's license, even incentives in terms of money or gifts in form of bikes and scooters do not help to switch to other transport modes than the car. The high number of respondents who chose the no-choice/other option suggests, on the one hand, that the employer's incentives are not attractive enough to abandon the car, however, this must also be seen in connection with the possession of the driver's license.

Frequency Table: Conjoint Question #1 (employers´ incentives) and possession of a driver's license							
Drivers´ license	*Option #1* Car (as a passenger)	*Option #2* Car/Taxi sharing	*Option #3* Public transport	*Option #4* Active traveling	*Option #5* Combination of different transport modes	*Option #6* none of them/ other	Row Totals
1 = yes	109	184	163	37	76	158	727
2 = no	26	37	45	9	19	55	191
All groups	135	221	208	46	95	213	918

Table 24 Frequency Table: Conjoint #1 - employers' incentive and driver's license

Source: own calculations (Statistica 64, version 13.1)

The majority of the respondents not having a driver´ license would choose public transport, followed by car/taxi sharing. It could be assumed that the offer in terms of cost and convenience as indicated in the choice options facilitates the switch to these means of transport under these conditions. The option "Car as a passenger" and "combination of multiple transport modes" would likely be less attractive: it could be assumed that respondents already rely on other transport modes such as public transport. However, more than a quarter chose the non-choice/other option, which could indicate satisfaction with the mode of transportation they have used to date. Nevertheless, it could also be suspected that the options offered are not attractive enough or do not reflect the individual situation

Table 25 provides the combination of "conjoint question #2 (hypothetical situation of being in town and no car is available to return home)” and “possession of a driver’s license”. The majority who have a driver's license would choose the car-sharing option, followed by public transport and car as a passenger to get home. As already considered in the hypothetical situation above, the reason could be that having a driver's license tends to make one more likely to use a car mode option to get home in such a case. This choice is followed by the group choosing public transport assuming, that the characteristics of this options are attractive enough in terms of time and cost and fits to the individual situation as well. This also applies to option five, the combination of different transport modes.

Frequency Table: Conjoint Question #2 (being in town and no car is available to return home) and possession of a driver's license							
Drivers´ license	*Option #1* Car (as a passenger)	*Option #2* Car/Taxi sharing	*Option #3* Public transport	*Option #4* Active traveling	*Option #5* Combination of different transport modes	*Option #6* none of them/ other	Row Totals
1 = yes	90	118	111	74	93	241	727
2 = no	28	19	35	16	20	73	191
All groups	118	137	146	90	113	314	918

Table 25 Frequency Table: Conjoint #2 – non availability of car and driver’s license

Source: own calculations (Statistica 64, version 13.1)

However, many respondents chose the none of them/other option, which leaves open the question of how respondents would get home without a car. It can be assumed that the options presented do not fit the individual and environmental conditions. Of the respondents not having a driver's license, most would choose public transportation in the first place, followed by car (as a passenger) (and a combination of different transportation modes in the third place. It can be assumed that for respondents who do not have a driver's license and already use public transportation, this is the only option they would consider in this case. However, the “none of them/other” option was also chosen, which again leaves open the question of what mode of transportation they use to get home. It could be assumed that the options offered do not cover the respective individual situation.

Table 26 combines “daily travel time in minutes by car” with “Conjoint question #1 (employers’ incentives)”. As already stated, a total of 503 respondents travels daily using the car, more than half of the respondents participating in the survey. If the employer were to implement the incentives offered, most of the respondents traveling between 15 and 30 minutes every day would switch to other transport modes. The majority would switch to public transport, followed by car/taxi sharing and combination of different transport modes in the third place, followed by car as a passenger. The majority traveling between 30 and 60 minutes per day favor car/taxi sharing, followed by public transport and car as a passenger in the third place. It is assumed that the employer's contribution to the travel costs contributes making the switch.

Frequency Table: Conjoint question #1 (employers 'incentives) and daily travel time by car						
Category (Options)	0-15 min	15-30 min	30-60 min	60-120 min	> 120 min	Row Totals
#1: Car (as a passenger)	10	41	21	5	0	77
#2: Car/Taxi sharing	15	56	37	10	1	119
#3: Public Transport	15	66	35	11	0	127
#4: Cycling/E-Scooter (sharing), walking	2	15	8	1	0	26
#5: Combination of different transport modes (car/taxi (sharing), bus, tram, metro, train, cycling, walking	8	31	18	3	0	60
#6: none of them/other	6	48	32	7	1	94
All groups	56	257	151	37	2	503

Table 26 Frequency Table: Conjoint #1 - employers´ incentive and daily travel time by car

Source: own calculations (Statistica 64, version 13.1)

Of the respondents traveling between 15 and 30 minutes a day 15 find the offer of active traveling made by their employer attractive. It can be assumed that the prospect of receiving an e-scooter or e-bike as a gift from the employer increases the incentive to switch to active traveling modes. The combination of different transport modes would be chosen mostly from respondents traveling between 15 and 30 minutes. It can be assumed that the prospect of receiving 50% of the travel costs and a conventional bicycle or scooter as a gift would increase the switch to this mode of transport. however, many respondents traveling between 15 and 60 minutes per day chose the none of them/other option. It can be assumed here, that none of the offers from the employer appear so appealing that people switch to other modes of transport than their own car or the individual situation does not permit switching to other means of transportation despite the employer's incentives.

Table 27 combines “Conjoint question #2 (hypothetical situation being in town and no car is available to return home)” with “daily travel time in minutes by car”. Car drivers who travel between 15 and 30 minutes a day would choose public transport first, followed by the combination of different modes of transport, and in third place car/sharing. Drivers who travel between 30 and 60 minutes would prefer public transport and car (as a passenger) in such a case, followed by the combination of different modes of transport, with car-sharing in third place. For commuters who drive between 60 and 120 minutes a day, car/taxi sharing would come first, followed by public transport, and in third place the combination of different modes of transport. This suggests that if the car is not available to get home, public transport would be the first option for drivers who travel between 15 and 60 minutes. In the case of those who chose the car as a passenger option, it can be assumed that this is then a person from the social environment. It is interesting to note that drivers who travel long distances prefer car/taxi sharing first. It is suspected that this is a case of resorting to the mode of transport to which people are most accustomed. However, these results should be interpreted with caution, as many chose none of them/other choice. The question arises here whether the offers do not reflect the individual situation.

Frequency Table: Conjoint question #2 (being in town and no car is available to get home) and daily travel time by car						
Category (Options)	0-15 min	15-30 min	30-60 min	60-120 min	> 120 min	Row Totals
#1: Car (as a passenger)	6	27	23	5	0	61
#2: Car/Taxi sharing	13	38	21	7	1	80
#3: Public Transport	11	42	23	6	0	82
#4: Cycling/E-Scooter (sharing), walking	7	27	13	1	0	48
#5: Combination of different transport modes (car/taxi (sharing), bus, tram, metro, train, cycling, walking	8	40	22	4	0	74
#6: none of them/other	11	83	49	14	1	158
All groups	56	257	151	37	2	503

Table 27 Frequency Table: Conjoint #2 – non availability of car and daily travel time by car

Source: own calculations (Statistica 64, version 13.1)

In summary, the different situations presented, such as employer incentives as well as the unavailability of the car, could encourage a switch to other modes of transport. However, these results should be interpreted with caution, as many of the respondents chose the non-choice option.

4.2. Results on Experienced Feelings (Mental State and Life Circumstances)

In the further course of this chapter, the independence of two variables is examined using a chi-square test. Cross tabulation makes it possible to display the results of a survey in tabular form to identify a possible relationship between the variables. If the frequencies of one variable are the same (homogeneous) for different values of the other variable except for random deviations, there is no correlation between the variables. If the frequencies of one variable differ significantly for different values of the other variable, a significant correlation can be assumed. This correlation can be tested by means of a Chi-Square test (Backhaus et al., 2018) .

Pearson Chi-square: 1.36270, df=5, p=.928350							
Car-sharing	*Option #1* Car (as a passenger)	*Option #2* Car/Taxi sharing	*Option #3* Public transport	*Option #4* Active traveling	*Option #5* Combi-nation of different transport modes	*Option #6* none of them/ other	Row Totals
1 = yes	7.5000	12.2778	11.5556	2.55556	5.27778	11.8333	51.0000
2 = no	127.5000	208.7222	196.4444	43.44444	89.72222	201.1667	867.0000
All groups	135.0000	221.0000	208.0000	46.00000	95.00000	213.0000	918.0000

Table 28 Expected frequencies in grouped variables - Conjoint question #1: employers' incentives and car-sharing experience

Source: own calculations

The expected frequencies for the variable “experience in car-sharing“ and the variable “Conjoint question #1 (employers’ incentives)” is provided in Table 28. As seen, the p-value is 0.0928350 confirming that there is no significant association between both variables, assuming that other reasons than the experience in car-sharing are a responsible choice of transport in case of offered incentives. It is more likely that other reasons, such as the distance to the nearest public transportation or car-sharing station, or the incentives provided by the employer play a role in whether the switch is made.

Table 29 provides the expected frequencies for the variable “experience in car-sharing“ and the variable “Conjoint question #2 (no car available to get home)”. As seen, the p-value is 0.748087 confirming that there is no significant association between both variables, assuming that other reasons than the experience in car-sharing are responsible choice of transport in case of the non-availability of the car to return home. As above, the choice of the car as a passenger as a transport mode could be found in the fact that the social environment is used in such a case. Depending on how far away the home is, in such a situation, if the car is not available, the distance can also be managed with a bicycle or e-scooter or, depending on the possibility, different transport modes can be combined. Thus, car-sharing experiences also have no connection with the choice of transport in such a situation, since the goal is to get home in the event of unavailability, regardless of one's own circumstances.

Pearson Chi-square: 2.68712, df=5, p=.748087							
Car-sharing	*Option #1* Car (as a passenger)	*Option #2* Car/Taxi sharing	*Option #3* Public transport	*Option #4* Active traveling	*Option #5* Combination of different transport modes	*Option #6* none of them/ other	Row Totals
1 = yes	6.5556	7.6111	8.1111	5.00000	6.2778	17.4444	51.0000
2 = no	111.4444	129.3889	137.8889	85.00000	106.7222	296.5556	867.0000
All groups	118.0000	137.0000	146.0000	90.00000	113.0000	314.0000	918.0000

Table 29 Expected frequencies in grouped variables – Conjoint question #2: no car available to get home and car-sharing experience

Source: own calculations (Statistica 64, version 13.1)

Transport policy instruments in terms of “punishments” or “incentives” are ways to make car driving less attractive: through higher gasoline prices, elimination of parking spaces, or even speed limits within cities, which would amount to “punishment”. Free public transport, better park- and ride conditions, and increased safety for the commuters could be seen as an "incentive" to switch to more environmentally friendly modes of transportation (Diekstra & Kroon, 2004).

Table 30 shows the crosstabulation "transport policy instruments/conditions to switch" and "density area". The density area was divided into five areas, and the transport policy instruments into six areas. The Pearson Chi-square is 17.7279 (df=24) and the p-value is p=0.816004 which is p > 0.05, meaning that, that there is no significant correlation between the variables "density area" and "transport policy instruments". The decision to switch to other modes of transport based on policy instruments has nothing to do with the size of a city the person lives in. Therefore, it can be assumed that there are other reasons, such as personal circumstances, financial reasons, the distance to the nearest public station, and personal factors, that play a role in whether people switch to environmentally friendly modes of transportation through policy instruments.

Pearson Chi-square: 17.7279, df=24, p=.816004						
Conditions to switch (transport policy instruments)	Density area *(number of inhabitants)*					
	< 5000	*5000 - <100.000*	*100.000-250.000*	*250.000-500.000*	*> 500.000*	Row Totals
0 = punishment-costs	32.94118	160.7843	173.3333	203.1373	149.8039	720.0000
1 = punishment - convenience	4.57516	22.3312	24.0741	28.2135	20.8061	100.0000
2 = punishment - joy	1.00654	4.9129	5.2963	6.2070	4.5773	22.0000
3 = incentives - costs	0.54902	2.6797	2.8889	3.3856	2.4967	12.0000
4 = incentives - convenience	0.91503	4.4662	4.8148	5.6427	4.1612	20.0000
5 = incentives - safety	1.78431	8.7092	9.3889	11.0033	8.1144	39.0000
6 = none of them/other	0.22876	1.1166	1.2037	1.4107	1.0403	5.0000
All groups	42.00000	205.0000	221.0000	259.0000	191.0000	918.0000

Table 30: Expected frequencies in grouped variables - conditions to switch and density area

Source: own calculations (Statistica 64, version 13.1)

In the subsequent course, the objective is to analyze whether there is a correlation between "transport policy instruments/conditions to switch" and "sharing experiences". As seen in Table 31, there is no correlation between transport policy instruments and experience in car-sharing, which can be seen from the p-value, which is > 0.05 (p= 0.052132). Car-sharing experience has no influence on switching to other modes of transport induced by policy instruments, thus, it is concluded, that there are other underlying circumstances, such as personal circumstances, distance to the nearest public station, financial reasons, and personal factors that play a part in determining whether people switch to environmentally friendly modes of transportation through policy instruments.

Pearson Chi-square: 12.4772, df=6, p=.052132			
Conditions to switch (transport policy instruments)	Experience in car-sharing		
	1 = yes	2 = no	Row Totals
0 = punishment-costs	40.00000	680.0000	720.0000
1 = punishment-convenience	5.55556	94.4444	100.0000
2 = punishment-joy	1.22222	20.7778	22.0000
3 = incentives-costs	0.66667	11.3333	12.0000
4 = incentives-convenience	1.11111	18.8889	20.0000
5 = incentives safety	2.16667	36.8333	39.0000
6 = none of them/other	0.27778	4.7222	5.0000
All groups	51.00000	867.0000	918.0000

Table 31: Expected frequencies in grouped variables - conditions to switch and car-sharing experience

Source own calculations (Statistica 64, version 13.1)

Table 32 shows the Chi-square results of the variable "transport policy instruments/conditions to switch" and "bike-sharing experience". As seen from the p-value with p=0.173999, there is no significant correlation between experience in bike-sharing and transport policy instruments. As in the case of car-sharing, it is assumed that it is not the sharing experiences but other factors that play a role in whether the switch is made through transport policy instruments.

Pearson Chi-square: 8.99252, df=6, p=.173999			
Conditions to switch (transport policy instruments)	Experience in bike-sharing		
	1=yes	2=no	Row Totals
0 = punishment-costs	37.64706	682.3529	720.0000
1 = punishment-convenience	5.22876	94,7712	100.0000
2 = punishment-joy	1.15033	20.8497	22.0000
3 = incentives-costs	0.62745	11.3725	12.0000
4 = incentives-convenience	1.04575	18.9542	20.0000
5 = incentives safety	2.03922	36.9608	39.0000
6 = none of them/other	0.26144	4.7386	5.0000
All groups	48.00000	870.0000	918.0000

Table 32: Expected frequencies in grouped variables - conditions to switch and bike-sharing experience

Source: own calculations (Statistica 64, version 13.1)

Table 33, the existence of a significant correlation between possible incentives or punishment systems through transport policy instruments and the occupational status can be seen. In this case, there is a significant correlation (p=0.019082) between the type of occupation and the opportunities offered to switch to environmentally friendly modes of transport. The increase in gasoline prices and parking fees is related to employment status, since, for example, a person who works full time might not decide to give up the car due to higher costs. Another person who is not working full time, or not working at all, or receiving a pension, for example, would be more likely to switch in the event of rising costs.

Pearson Chi-square: 55.7072, df=36, p=.019082								
Conditions to switch (transport policy instruments)	Employment							
	Full time	Part time	School	Student	Working Student	retired	Other	Row Totals
0= punishment costs	472.9412	43.13725	72.94118	40.00000	32.94118	40.00000	18.03922	720.0000
1= punishment convenience	65.6863	5.99129	10.13072	5.55556	4,57516	5.55556	2.50545	100.0000
2= punishment joy (2)	14.4510	1.31808	2.22876	1.22222	1.00654	1.22222	0.55120	22.0000
3=Incentives costs	7.8824	0.71895	1.21569	0.66667	0.54902	0.66667	0.30065	12.0000
4= incentives-convenience	13.1373	1.19826	2.02614	1.11111	0.91503	1.11111	0.50109	20.0000
5=incentives safety	25.6176	2.33660	3.95098	2.16667	1.78431	2.16667	0.97712	39.0000
6= none of them/other	3.2843	0.29956	0.50654	0.27778	0.22876	0.27778	0.12527	5.0000
All groups	603.0000	55.00000	93.00000	51.00000	42.00000	51.00000	23.00000	918.0000

Table 33: Expected frequencies in grouped variables - conditions to switch and employment

Source: own calculations (Statistica 64, version 13.1)

Table 34 shows the results of the chi-square test for independence for the variables “access to public transport” divided between “less than 400 meters” and” more than 400 meters” and “transport policy instruments/conditions to switch”. As above, no significant correlation was seen (p= 0.37190). As above, reasons other than access to the nearest public transport might play a role in making the switch to environmentally friendly transport, for example time, cost, and personal circumstances, play a role in whether people switch to environmentally friendly modes of transportation. The distance to the nearest public transport station has nothing to do with transport policy instruments in the form of incentives and punishments. It is more likely that there are other reasons, such as individual, personal, or financial reasons, that are related to whether people switch due to incentives and penalties through transport policy instruments. It can also be assumed that the convenience aspect plays a major role, that the distance to the next public transport station is not of interest.

Pearson Chi-square: 6.48514, df=6, p=.371090			
Conditions to switch (transport policy instruments)	Access to next public transport station		Row Totals
	1 = less than 400 meters	2 = more than 400 meters	
0 = punishment costs	330.9804	389.0196	720.0000
1 = punishment convenience	45.9695	54.0305	100.0000
2 = punishment joy	10.1133	11.8867	22.0000
3 = incentives costs	5.5163	6.4837	12.0000
4 = incentives convenience	9.1939	10.8061	20.0000
5 = incentives safety	17.9281	21.0719	39.0000
6 = none of them /other	2.2985	2.7015	5.0000
All groups	422.0000	496,0000	918.0000

Table 34 Expected frequencies for grouped variables - conditions to switch and access to nearest public transport

Source: own calculations (Statistica 64, version 13.1)

Table 35 provides the results for the grouping variable “preferred transport mode is car driving but the current mode of transport is public transport” and “transport policy instruments/conditions to switch”. As seen, the p-value is 0.000124 which is $p < 0.05$, confirming a significant association between both variables. It is assumed that the reasons for choosing car driving which is not the preferred transport mode impacts considerations to make the switch in case of punishment and incentives. The relationship between the non-preferred mode of transportation "public transport" and "transport policy instruments" could be explained by the fact that increasing costs of driving and convenience limitation are reasons to switch to public transport modes, as they are usually cheaper and more environmentally friendly.

Pearson Chi-square: 48.5723, df=18, p=.000124					
Conditions to switch (transport policy instruments)	Preferred transport mode is car driving but current transport mode is public transport (reasons)				
	No choice (= 0)	time and cost (=1)	convenience /emotional aspects (=2)	environment (=3)	Row Totals
0 = punishment-costs	561.5686	72.94118	75.29412	10.19608	720.0000
1 = punishment - convenience	77.9956	10.13072	10.45752	1.41612	100.0000
2 = punishment - joy	17.1590	2.22876	2.30065	0.31155	22.0000
3 = incentives - costs	9.3595	1.21569	1.25490	0.16993	12.0000
4 = incentives - convenience	15.5991	2.02614	2.09150	0.28322	20.0000
5 = incentives - safety	30.4183	3.95098	4,07843	0.55229	39.0000
6 = none of them/other	3.8998	0.50654	0.52288	0.07081	5.0000
All groups	716.0000	93.00000	96.00000	13.00000	918.0000

Table 35 Expected frequencies in grouped variables - conditions to switch and reasons for not choosing car driving

Source: own calculations (Statistica 64, version 13.1)

Table 36, the results for the expected frequencies for the grouped variable “preferred transport mode is public transport, but current transport mode is car driving” and ““transport policy instruments/conditions to switch” are provided. As seen, for all variables, the p-value is 0.000000 which is $p < 0.05$, confirming a significant association. The presumed reasons for the correlation are to exert pressure on car drivers through transport policy instruments through rising costs or by offering incentives to switch to environmentally friendly modes of transport and then to use the preferred mode of transport, namely public transport.

Pearson Chi-square: 106.491, df=18, p=.000000					
Conditions to switch (transport policy instruments)	Preferred transport mode is public transport, but current transport mode is car driving (reasons)				
	No choice (= 0)	time and cost (=1)	convenience /emotional aspects (=2)	environment (=3)	Row Totals
0 = punishment-costs	674.5098	10.98039	32.94118	1.568627	720.0000
1 = punishment - convenience	93.6819	1.52505	4.57516	0.217865	100.0000
2 = punishment - joy	20.6100	0.33551	1.00654	0.047930	22.0000
3 = incentives - costs	11.2418	0.18301	0.54902	0.026144	12.0000
4 = incentives - convenience	18.7364	0.30501	0.91503	0.043573	20.0000
5 = incentives - safety	36.5359	0.59477	1.78431	0.084967	39.0000
6 = none of them/other	4.6841	0.07625	0.22876	0.010893	5.0000
All groups	860.0000	14.00000	42.00000	2.000000	918.0000

Table 36 Expected frequencies in grouped variables - conditions to switch and reasons for not choosing public transport

Source: own calculations (Statistica 64, version 13.1)

The expected frequencies for the variable “income”, divided into six categories and “conditions to switch/transport policy instruments” are provided in Table 37. The p-value is 0.098975 confirming that there is no significant association between both variables, assuming that other reasons than income are responsible for the conditions to switch to environmentally friendly transport modes. It can be assumed that personal reasons, reasons of habit or convenience, or even lack of opportunities such as good transport connections play a role in whether people switch to other modes of transport rather than income. Furthermore, it can be assumed that there is rather a connection between the aspects of driving and transport policy instruments because a non-car driver is not affected by the punishment instruments.

Pearson Chi-square: 40.3113, df=30, p=.098975							
Conditions to switch (transport policy instruments)	Income (PLN)						
	< 1000 PLN (1)	1000-2999 PLN (2)	3000-4999 PLN (3)	5000-7000 PLN (4)	> 7000 PLN (5)	other (6)	Row Totals
0 = punishment-costs	10.98039	17.25490	69.80392	84.7059	119.2157	418.0392	720.0000
1 = punishment - convenience	1.52505	2.39651	9.69499	11.7647	16.5577	58.0610	100.0000
2 = punishment - joy	0.33551	0.52723	2.13290	2.5882	3.6427	12.7734	22.0000
3 = incentives - costs	0.18301	0.28758	1.16340	1.4118	1.9869	6.9673	12.0000
4 = incentives - convenience	0.30501	0.47930	1.93900	2.3529	3.3115	11.6122	20.0000
5 = incentives - safety	0.59477	0.93464	3.78105	4.5882	6.4575	22.6438	39.0000
6 = none of them/other	0.07625	0.11983	0.48475	0.5882	0.8279	2.9031	5.0000
All groups	14.00000	22.00000	89.00000	108.0000	152.0000	533.0000	918.0000

Table 37 Expected frequencies in grouped variables - conditions to switch and income

Source: own calculations (Statistica 64, version 13.1)

The expected frequencies for the variable “car ownership“ and the variable “conditions to switch/transport policy instruments” are provided in Table 38. A significant association is seen which is confirmed by a very low p-value (p = 0.000000). Based on the Chi-square test result presented, it can be assumed that there must be a correlation between the conditions to switch (in terms of incentives and punishment) to environmentally friendly modes of transport and the ownership or non-ownership of a car. Transportation policy tools such as increasing gasoline and parking costs would also make it more expensive for car drivers. It would be also more inconvenient for car drivers if less parking would be available.

Pearson Chi-square: 61.8759, df=6, p=.000000			
Conditions to switch (transport policy instruments)	Car ownership		
	1 = yes	2 = no	Row Totals
0 = punishment-costs	523.9216	196.0784	720.0000
1 = punishment - convenience	72.7669	27.2331	100.0000
2 = punishment - joy	16.0087	5.9913	22.0000
3 = incentives - costs	8.7320	3.2680	12.0000
4 = incentives - convenience	14.5534	5.4466	20.0000
5 = incentives - safety	28.3791	10.6209	39.0000
6 = none of them/other	3.6383	1.3617	5.0000
All groups	668.0000	250.0000	918.0000

Table 38 Expected frequencies in grouped variables - conditions to switch and car ownership

Source: own calculations (Statistica 64, version 13.1)

Pearson Chi-square: 95.6403, df=30, p=.000000							
Conditions to switch (transport policy instruments)	Monthly travel costs (including all expenses)						
	1: < 300 PLN	2: 300 - 600 PLN	3: 601 - 1000 PLN	4: 1001 - 1500 PLN	5: 1501 - 2000 PLN	6: I don´t know/no comment	Row Totals
0 = punishment-costs	146.6667	104.3137	151.3725	21.17647	3.921569	292.5490	720.0000
1 = punishment - convenience	20.3704	14.4880	21.0240	2.94118	0.544662	40.6318	100.0000
2 = punishment - joy	4,4815	3.1874	4.6253	0.64706	0.119826	8.9390	22.0000
3 = incentives - costs	2.4444	1.7386	2.5229	0.35294	0.065359	4.8758	12.0000
4 = incentives - convenience	4.0741	2.8976	4.2048	0.58824	0.108932	8.1264	20.0000
5 = incentives - safety	7.9444	5.6503	8.1993	1.14706	0.212418	15.8464	39.0000
6 = none of them/other	1.0185	0.7244	1.0512	0.14706	0.027233	2.0316	5.0000
All groups	187.0000	133.0000	193.0000	27.00000	5.000000	373.0000	918.0000

Table 39 Expected frequencies in grouped variables - conditions to switch and monthly travel costs

Source: own calculations (Statistica 64, version 13.1)

Table 39 provides the expected frequencies for the variable “travel costs per month“ and the variable “conditions to switch/transport policy instruments”. As seen, the p-value is very low ($p = 0.000000$) which is $p < 0.05$ meaning that the monthly estimated travel costs and conditions to switch are associated with each other. Thus, monthly travel costs impact considerations to switch in case of punishment and incentives. The relationship between travel costs and policy instruments such as increases in gasoline costs and parking fees, therefore, leads to the assumption that monthly travel costs would increase even more. It is assumed, that people not knowing their monthly travel expenses be sensitized to rising costs. In Table 40, the expected frequencies for the variable “plans to buy a car within the next 12 months“ and the variable “conditions to switch/transport policy instruments” are provided. As seen, the p-value is again very low ($p = 0.000000$) which is $p < 0.05$ meaning that the plans of buying a car and transport policy instruments are associated with each other. Plans to buy or not to buy a car impact consideration to switch in case of punishment and incentives, since transport policy incentive and punishment instruments have an influence on whether a car is purchased or not. It can be assumed that if the pressure from politics is increased on drivers by means of higher prices or fewer parking possibilities, plans regarding the purchase of a car could be discarded.

Pearson Chi-square: 58.2122, df=12, p=.000000				
Conditions to switch (transport policy instruments)	Plans to buy a car			
	1-yes	2-no	3-uncertain	Row Totals
0 = punishment-costs	20.39216	638.4314	61.17647	720.0000
1 = punishment - convenience	2.83224	88.6710	8.49673	100.0000
2 = punishment - joy	0.62309	19.5076	1.86928	22.0000
3 = incentives - costs	0.33987	10.6405	1.01961	12.0000
4 = incentives - convenience	0.56645	17.7342	1.69935	20.0000
5 = incentives - safety	1.10458	34.5817	3.31373	39.0000
6 = none of them/other	0.14161	4.4336	0.42484	5.0000
All groups	26.00000	814.0000	78.00000	918.0000

Table 40 Expected frequencies in grouped variables - conditions to switch and plans to buy a car within the next 12 months

Source: own calculations (Statistica 64, version 13.1)

The expected frequencies for the variable “plans to sell the car within the next 12 months“ and the variable “conditions to switch/transport policy instruments” are seen in Table 41. . As seen, the p-value is very low (p = 0.000351) which is $p < 0.05$ meaning that the plans to sell the car and conditions to switch are associated with each other. Considerations on selling the car impact consideration to switch in case of punishment and incentives through policy instruments. Incentive and punishment mechanisms influence on whether the car is sold or not. It is assumed, that rising prices or better transport connections could lead to the car being sold.

Pearson Chi-square: 35.7873, df=12, p=.000351				
Conditions to switch (transport policy instruments)	Plans to sell the car			
	1-yes	2-no	3-uncertain	Row Totals
0 = punishment-costs	29.01961	627.4510	63.52941	720.0000
1 = punishment - convenience	4.03050	87.1460	8.82353	100.0000
2 = punishment - joy	0.88671	19.1721	1.94118	22.0000
3 = incentives - costs	0.48366	10.4575	1.05882	12.0000
4 = incentives - convenience	0.80610	17.4292	1.76471	20.0000
5 = incentives - safety	1.57190	33.9869	3.44118	39.0000
6 = none of them/other	0.20153	4.3573	0.44118	5.0000
All groups	37.00000	800.0000	81.00000	918.0000

Table 41 Expected frequencies in grouped variables - conditions to switch and plans to sell the car within the next 12 months

Source: own calculations (Statistica 64, version 13.1)

In summary, travel costs, car ownership, and intention to buy or sell a car are significantly related to the conditions for switching to green transportation, for example, if incentives are provided in the form of lower costs (e.g., free public transportation), increasing convenience (e.g., increase in sharing services), and increasing safety, or by penalizing driving through increased gasoline prices, fewer parking spaces, or speed limits to 30 km/h in inner cities.

Table 42 presents the expected frequencies for the variable "conditions to switch/transport policy instruments" and the variable "Conjoint question #1 (employers' incentives)". As can be seen, the p-value is 0.386802, which confirms that there is no significant relationship between the two variables. It can be assumed that there are other reasons than such as incentives and punishments through policy instruments to switch to other means of transportation when the employer offers incentives to switch to environmentally friendly means of transportation. It can be assumed that the policy instruments are not associated with switching to other modes of transportation, since the employer already offers incentives in the form of gifts in addition to financial incentives.

Pearson Chi-square: 31.5907, df=30, p=.386802							
Conditions to switch (transport policy instruments)	*Option #1* Car (as a passenger)	*Option #2* Car/Taxi sharing	*Option #3* Public transport	*Option #4* Active traveling	*Option #5* Combination of different transport modes	*Option #6* none of them/ other	Row Totals
0 = punishment-costs	105.8824	173.3333	163.1373	36.07843	74.50980	167.0588	720.0000
1 = punishment - convenience	14.7059	24.0741	22.6580	5.01089	10.34858	23.2026	100.0000
2 = punishment - joy	3.2353	5.2963	4.9847	1.10240	2.27669	5.1046	22.0000
3 = incentives - costs	1.7647	2.8889	2.7190	0.60131	1.24183	2.7843	12.0000
4 = incentives - convenience	2.9412	4.8148	4.5316	1.00218	2.06972	4.6405	20.0000
5 = incentives - safety	5.7353	9.3889	8.8366	1.95425	4.03595	9.0490	39.0000
6 = none of them/other	0.7353	1.2037	1.1329	0.25054	0.51743	1.1601	5.0000
All groups	135.0000	221.0000	208.0000	46.00000	95.00000	213.0000	918.0000

Table 42 Expected frequencies in grouped variables - Conjoint question #1: employers' incentives and conditions to switch/transport policy instruments

Source: own calculations (Statistica 64, version 13.1)

Table 43 presents the expected frequencies for the variable "conditions to switch/transport policy instruments" and the variable "Conjoint question #2 (no car available to get home)". As can be seen, the p-value is 0.384321, which confirms that there is no significant relationship between the two variables. It can be assumed that there are other reasons than such as incentives and punishments through Policy Instruments to switch to other means of transportation when the car is not available to get home.

It is assumed that there is no correlation between the two variables, as the circumstances of the unavailability of a car are more likely to choose the most suitable means of transport to get home. Again, social circumstances, as well as the distance to the nearest public transport or car-sharing station as well as the distance home, are more likely to play a role in which means of transport can be used at all in the absence of a car.

Pearson Chi-square: 31.6428, df=30, p=.384321							
Conditions to switch (transport policy instruments)	*Option #1* Car (as a passenger)	*Option #2* Car/Taxi sharing	*Option #3* Public transport	*Option #4* Active traveling	*Option #5* Combination of different transport modes	*Option #6* none of them/ other	Row Totals
0 = punishment-costs	92.5490	107.4510	114.5098	70.58824	88.6275	246.2745	720.0000
1 = punishment - convenience	12.8540	14.9237	15.9041	9.80392	12.3094	34.2048	100.0000
2 = punishment - joy	2.8279	3.2832	3.4989	2.15686	2.7081	7.5251	22.0000
3 = incentives - costs	1.5425	1.7908	1.9085	1.17647	1.4771	4.1046	12.0000
4 = incentives - convenience	2.5708	2.9847	3.1808	1.96078	2.4619	6.8410	20.0000
5 = incentives - safety	5.0131	5.8203	6.2026	3.82353	4.8007	13.3399	39.0000
6 = none of them/other	0.6427	0.7462	0.7952	0.49020	0.6155	1.7102	5.0000
All groups	118.0000	137.0000	146.0000	90.00000	113.0000	314.0000	918.0000

Table 43 Expected frequencies in grouped variables - Conjoint question #2: no car available to return home and conditions to switch/transport policy instruments

Source: own calculations (Statistica 64, version 13.1)

Pearson Chi-square: 5.42504, df=5, p=.366235							
Gender	*Option #1* Car (as a passenger)	*Option #2* Car/Taxi sharing	*Option #3* Public transport	*Option #4* Active traveling	*Option #5* Combination of different transport modes	*Option #6* none of them/ other	Row Totals
1=female	68.6765	112.4259	105.8126	23.40087	48.32789	108.3562	467.0000
2=male	66.3235	108.5741	102.1874	22.59913	46.67211	104.6438	451.0000
All groups	135.0000	221.0000	208.0000	46.00000	95.00000	213.0000	918.0000

Table 44 Expected frequencies in grouped variables - Conjoint question #1: employers' incentives and gender

Source: own calculations (Statistica 64, version 13.1)

Table 44 shows the expected frequencies for the variable "gender" and the variable "Conjoint question #1 (employers' incentives)". As can be seen, the p-value is 0.366235, confirming that there is no significant relationship between the two variables. It can be assumed that the respective gender is not decisive in switching to another means of transport if the employer offers incentives. It is more likely that employer incentives, personal circumstances, attitudes and habits, and individual factors are related to the choice of transport mode, rather than gender.

Pearson Chi-square: 8.14321, df=5, p=.148518							
Gender	*Option #1* Car (as a passenger)	*Option #2* Car/Taxi sharing	*Option #3* Public transport	*Option #4* Active traveling	*Option #5* Combination of different transport modes	*Option #6* none of them/ other	Row Totals
1=female	60.0283	69.6939	74.2723	45.78431	57.4847	159.7364	467.0000
2=male	57.9717	67.3061	71.7277	44.21569	55.5153	154.2636	451.0000
All groups	118.0000	137.0000	146.0000	90.00000	113.0000	314.0000	918.0000

Table 45 Expected frequencies in grouped variables - Conjoint question #2: no car available to get home and gender

Source: own calculations (Statistica 64, version 13.1)

In Table 45, the expected frequencies for the variable "gender" and the variable “Conjoint question #2 (no car available to get home)" are shown. As seen, the p-value is 0.148518, which confirms that there is no significant relationship between the two variables. Gender is not related to the choice of transport mode, as it is rather assumed that other individual and situational circumstances are responsible for the choice of transport mode, such as the social environment and the distance to the nearest public transport or car-sharing station. In addition, the goal is rather to get home in such a situation, regardless of gender, using available transportation options.

Table 46 provides the expected frequencies for the variable “possession of a driver’s license“ and the variable “Conjoint question #1 (employers incentives)”. As seen, the p-value is 0.323094 confirming that there is no significant association between both variables, assuming that other reasons than the possession of a driver’s license are responsible choice of transport in case of offered incentives.

Pearson Chi-square: 5.83019, df=5, p=.323094							
Driver´s license	Option #1 Car (as a passenger)	Option #2 Car/Taxi sharing	Option #3 Public transport	Option #4 Active traveling	Option #5 Combination of different transport modes	Option #6 none of them/ other	Row Totals
1=yes	106.9118	175.0185	164.7233	36.42919	75.23420	168.6830	727.0000
2=no	28.0882	45.9815	43.2767	9.57081	19.76580	44.3170	191.0000
All groups	135.0000	221.0000	208.0000	46.00000	95.00000	213.0000	918.0000

Table 46 Expected frequencies in grouped variables - Conjoint question #1 - employers’ incentives and driver’s license

Source: own calculations (Statistica 64, version 13.1)

It is rather to be assumed that the respective different incentives on the part of the employer contribute to switching to other modes of transport, irrespective of the possession of a driver's license. In addition, it is assumed that the individual situation such as personal and situational factors play a role in the choice of transport mode under the given situation when the employer offers gifts for switching in addition to financial incentives. Thus, the possession of a driver's license does not influence the choice of transportation in the hypothetical situation presented. Moreover, the driver's license then also no longer plays a role when switching to other modes of transport.

Table 47 illustrates the expected frequencies for the variable "possession of a driver's license" and the variable "Conjoint question #2 (no car available to get home)". As seen, the p-value is 0.167519 confirming that there is no significant association between both variables, believing that reasons other than having a driver's license are responsible for the choice of transportation when no car is available for the trip home. It can be assumed that there is no correlation between the possession of a driving license and the choice of other means of transport than the car because the hypothetical situation of the unavailability of the car is already given.

Pearson Chi-square: 7.80152, df=5, p=.167519							
Driver's license	*Option #1* Car (as a passenger)	*Option #2* Car/Taxi sharing	*Option #3* Public transport	*Option #4* Active traveling	*Option #5* Combination of different transport modes	*Option #6* none of them/ other	Row Totals
1=yes	93.4488	108.4956	115.6231	71.27451	89.4891	248.6688	727.0000
2=no	24.5512	28.5044	30.3769	18.72549	23.5109	65.3312	191.0000
All groups	118.0000	137.0000	146.0000	90.00000	113.0000	314.0000	918.0000

Table 47 Expected frequencies in grouped variables – Conjoint question #2: no car available to get home and driver's license

Source: own calculations (Statistica 64, version 13.1)

In Table 48, the expected frequencies for the variable “travel time in the car“ and the variable “Conjoint question #1 (employers’ incentives)” are provided.

Pearson Chi-square: 8.89240, df=20, p=.984120						
Conjoint question #1 (employer offers incentives) Choice Options	Travel time by car per day in minutes					
	0-15 min	15-30 min	30-60 min	60-120 min	More than 120 min	Row Totals
Option #1: Car (as a passenger)	8.57256	39.3419	23.1153	5.66402	0.306163	77.0000
Option #2: Car/taxi sharing	13.24851	60.8012	35.7237	8.75348	0.473161	119.0000
Option #3: Public transport	14.13917	64.8887	38.1252	9.34195	0.504970	127.0000
Option #4: Cycling/e-scooter (sharing), walking	2.89463	13.2843	7.8052	1.91252	0.103380	26,0000
Option #5: Combination of different transport modes (car / taxi (sharing), bus, tram, metro, train, cycling, walking	6.67992	30.6561	18.0119	4.41352	0.238569	60.0000
None of them/other	10.46521	48.0278	28.2187	6.91451	0.373757	94.0000
All groups	56.00000	257.0000	151.0000	37.00000	2.000000	503.0000

Table 48 Expected frequencies in grouped variables – Conjoint question #1: employers’ incentives and daily travel time in the car

Source: own calculations (Statistica 64, version 13.1)

As seen, the p-value is 0.984120 confirming that there is no significant association between both variables, assuming that other reasons than the daily travel time in the car are responsible choice of transport in case of offered incentives. It could be assumed that it is rather the respective incentives of the employer that play a role in whether and to which environmentally friendly mode of transport a switch is made, independent of the individual travel time per day. Further, that individual factors such as previous habits, distance to the next sharing point or even public transport and the respective incentives of the employer are more likely to be related to the choice of transport mode than the daily travel time.

Table 49 illustrates the expected frequencies for the variable "travel time in the car" and the variable "Conjoint question #2 (no car available to get home)". As can be seen, the p-value is 0.824765, which confirms that there is no significant relationship between the two variables.

Pearson Chi-square: 14.1121, df=20, p=.824765						
Conjoint question #2 (being in town, no car available to get home) Choice Options	Travel time by car per day in minutes					
	0-15 min	15-30 min	30-60 min	60-120 min	more than 120 min	Row Totals
Option #1: Car (as a passenger)	6.79125	31.1670	18.3121	4.48708	0.242545	61.0000
Option #2: Car/taxi sharing	8.90656	40.8748	24.0159	5.88469	0.318091	80.0000
Option #3: Public transport	9.12922	41.8966	24.6163	6.03181	0.326044	82.0000
Option #4: Cycling/e-scooter (sharing), walking	5.34394	24.5249	14.4095	3.53082	0.190855	48.0000
Option #5: Combination of different transport modes (car / taxi (sharing), bus, tram, metro, train, cycling, walking	8.23857	37.8091	22.2147	5.44334	0.294235	74.0000
None of them/other	17.59046	80.7276	47.4314	11.62227	0.628231	158.0000
All groups	56.00000	257.0000	151.0000	37.00000	2.000000	503.0000

Table 49 Expected frequencies in grouped variables – conjoint #2: no car available to return home and daily travel time in the car

Source: own calculations (Statistica 64, version 13.1)

There might be other reasons than the individual daily travel time that influence the choice behavior in such a situation if other modes of transport have to be used when a car is not available. For example, proximity to the nearest stop or even personal circumstances such as the availability of a social network could determine which mode of transportation would be chosen in this case. Thus, car as a passenger could be chosen if one can be picked up, or car/taxi sharing and public transport if these are also available. Cycling and scooter would possibly be chosen if these sharing options were available, and the way home could be managed by bicycle or scooter.

4.3. Results related to Life Situation and Mental State (Experienced Feelings)

Life circumstances and changing working conditions can have an enormous impact on mobility behavior (Rau & Manton, 2016). In the following course, the frequency tables for life changes within the previous 24 months as well as the experienced feelings (mental state) while travelling with the primary transport mode are provided.

For changes in life circumstances and job situation within the previous 24 months, the variables “marriage”, “divorce”, “childbirth”, “relocation (moving to a more or less urbanized area)”, “working situation (new job at a new place, retirement, getting promoted) were grouped together to the variable “other”. Since many death cases were reported, this variable got its own category. If no changes occurred, the third category is “none of them above”.

As seen from Table 50, more than 50% of the respondents (470 participants) had no changes in their living and working situation within the last 24 months. 205 respondents (22.33%) reported a death case in their household and 103 (11.22%) participants moved to a more or less urbanized area or had a childbirth. Consequently, there were 22.33% deaths cases within the last 24 months alone compared to 26.47% other changes. It is supposed that such significant events in life have an impact on travel behavior.

Category	Changes in life circumstances and job situation within the previous 24 months			
	Count	Cumulative Count	Percent	Cumulative Percent
death case	205	205	22.33%	22.33%
other	243	448	26.47%	48.80%
nothing	470	918	51.20%	100.00%
missing	0	918	0.00%	100.00%

Table 50 Changes in life and job situation within the previous 24 months

Source: own calculations (Statistica 64, version 13.1)

Mobility, especially commuting to work, is often associated with unpleasant feelings (Te Brömmelstroet et al., 2021). Thus, the eight mental states of "apathy, worry, anxiety, arousal, flow, control, relaxation, and boredom" developed by Csikszentmihalyi in 1977 (Csikszentmihalyi, 1977, p. 31 as cited in Te Brömmelstroet et al. 2021) were used in this questionnaire. According to Te Brömmelstroet et al. (2021), mental state can also be described as experienced feelings, which is why both terms are used in the thesis.

Category	Most experienced feelings (mental state) when traveling with primary transport mode			
	Count	Cumulative Count	Percent	Cumulative Percent
pleasant	310	310	33.77%	33.77%
unpleasant	60	370	6,54%	40.31%
no choice/no comment	548	918	59.69%	100.00%
missing	0	918	0.00%	100.00%

Table 51 Experienced feelings (mental state) when traveling with primary transport mode

Source: own calculations (Statistica 64, version 13.1)

As seen from Table 51, the division of the different mental states/experienced feelings into categories was done as follows: "relaxation, control, flow, and arousal" is grouped in the first category "pleasant mental state." In the second category, "unpleasant mental state," "anxiety, worry, apathy, and boredom" are grouped together. The terms "pleasant" and "unpleasant" are based on the circumplex model of core effects developed by Västfjäll et al. 2002 (Västfjäll, Friman, Gärling, & Kleiner, 2002 as cited in Te Brömmelstroet et al., 2021, p.5). The third category is "no choice/no comment" for respondents, who did not choose any of the above feelings. As shown in Table 51, 310 respondents (33.77%) reported a pleasant mental state while 60 respondents (6.54%) reported unpleasant feelings while traveling with their current transport mode. From the responses it is evident, that more positive feelings occur during travel. 548 respondents (more than 59%) did not provide any information in this regard; therefore, a cautious interpretation is given. Depending on the means of transport, different positive or negative feelings might occur during travel, however, situational conditions or even personal character traits also play a role how travel is experienced.

Table 52 provides the expected frequencies for the variable “life situation“ and the variable “Conjoint question #1 (employers incentives)”. As seen, the p-value is very low ($p = 0.004487$) which is $p < 0.05$ meaning that the changes in life and job situation within the previous 24 months and employers’ incentives to make the switch are associated with each other. It can be assumed that changing life situations, such as a death in the family, changed housing and living circumstances, or even taking up a new job or quitting a previous job, influence he choice of transport mode if the employer offers incentives. For example, the creation of incentives in connection with a change of residence can result in the use of other modes of transport. A change in financial situation or the loss of someone in the family could also result in employer incentives being picked up, thus influencing the choice of transportation mode.

Pearson Chi-square: 25.4919, df=10, p=.004487							
Life situation	*Option #1* Car (as a passenger)	*Option #2* Car/Taxi sharing	*Option #3* Public transport	*Option #4* Active traveling	*Option #5* Combination of different transport modes	*Option #6* none of them/ other	Row Totals
1=death case	30.1471	49.3519	46.4488	10.27233	21.21460	47.5654	205.0000
2= other	35.7353	58.5000	55.0588	12.17647	25.14706	56.3824	243.0000
3 = nothing	69.1176	113.1481	106.4924	23.55120	48.63834	109.0523	470.0000
All groups	135.0000	221.0000	208.0000	46.00000	95.00000	213.0000	918.0000

Table 52 Expected frequencies in grouped variables - Conjoint question #1: employers' incentives and life situation

Source: own calculations (Statistica 64, version 13.1)

Pearson Chi-square: 1.,6560, df=10, p=.189270							
Life situation	*Option #1* Car (as a passenger)	*Option #2* Car/Taxi sharing	*Option #3* Public transport	*Option #4* Active traveling	*Option #5* Combination of different transport modes	*Option #6* none of them/ other	Row Totals
1=death case	26.3508	30.5937	32.6035	20.09804	25.2342	70.1198	205.0000
2 = other	31.2353	36.2647	38.6471	23.82353	29.9118	83.1176	243.0000
3 = nothing	60.4139	70.1416	74.7495	46.07843	57.8540	160.7625	470.0000
All groups	118.0000	137.0000	146.0000	90.00000	113.0000	314.0000	918.0000

Table 53 Expected frequencies in grouped variables - Conjoint question #2: no car available to return home and life situation

Source: own calculations (Statistica 64, version 13.1)

The expected frequencies for the variable "life situation" and the variable "Conjoint question #2 (no car available to return home)" is provided in Table 53. The p-value is 0.189270 confirming that there is no significant association between both variables, meaning that the changes in life and job situation within the previous 24 months and the conjoint "no car available to get home" to make the switch are not associated with each other. Life situation and job situation does impact transport mode choice in if there is no car available to return home. It can be assumed that other reasons, such as the distance to the nearest public transport station or car-sharing station, as well as personal circumstances, play a role in how people get home. The choice of the car as a passenger as a transport mode could be found in the fact that the social environment is used in such a case. Depending on how far away the home is, in such a situation, if the car is not available, the distance can also be managed with a bicycle or e-scooter or, depending on the possibility, different transport modes can be combined. Personal circumstances also have no connection with the choice of transport in such a situation, since the goal is to get home in the event of unavailability, regardless of one's own circumstances.

Pearson Chi-square: 11.6136, df=10, p=,311746							
Mental state/ experienced feelings	*Option #1* Car (as a passenger)	*Option #2* Car/Taxi sharing	*Option #3* Public transport	*Option #4* Active traveling	*Option #5* Combination of different transport modes	*Option #6* none of them/ other	Row Totals
Pleasant	45.5882	74.6296	70.2397	15.53377	32.08061	71.9281	310.0000
Unpleasant	8.8235	14.4444	13.5948	3.00654	6.20915	13.9216	60.0000
No choice/no comment	80.5882	131.9259	124.1656	27.45969	56.71024	127.1503	548.0000
All groups	135.0000	221.0000	208.0000	46.00000	95.00000	213.0000	918.0000

Table 54 Expected frequencies in grouped variables – Conjoint question #1: employers' incentives and mental state/experienced feelings

Source: own calculations (Statistica 64, version 13.1)

In Table 54, the expected frequencies for the variable "mental state (experienced feelings)" and the variable "Conjoint question #1 (employers incentives)" are provided. As seen, the p-value is 0.311746 confirming that there is no significant association between both variables, assuming that other reasons than experienced feelings while traveling the primary transport mode are responsible choice of transport in case of offered incentives by the employer.

It can rather be assumed that the offered incentives in the sense of financial incentives or also gifts by the employer influence the choice of the means of transport. Feelings while traveling by the main means of transportation could also be related to the life situation.

Table 55 provides an overview of the options chosen by respondents in the hypothetical situation of incentives being offered to switch to environmentally friendly transport modes and mental state/experienced feelings (Te Brömmelstroet et al., 2021) during travel with primary transport mode. Of the 918 respondents, 213 decided to choose none of them/other, the 310 respondents experiencing pleasant feelings, most would switch to car/taxi sharing, followed by public transport. Of the minority experiencing unpleasant feelings, the majority would switch to public transport, followed by car as a passenger, this indicates that most of the respondents who experience pleasant feelings while traveling would first opt for car-sharing, while the respondents who experience unpleasant feelings primarily tend to use public transport. However, these results should be interpreted with caution, as the no-choice option was chosen by a large proportion of respondents. This could be because the options provided are not attractive or that the respondents do not want to do without their car.

Frequency Table: Conjoint Question #1 (employers´ incentives) and most experienced feelings (mental state) when traveling with primary transport mode							
Category Mental state (experienced feelings)	*Option #1* Car (as a passenger)	*Option #2* Car/Taxi sharing	*Option #3* Public transport	*Option #4* Active traveling	*Option #5* Combination of different transport modes	*Option #6* none of them/ other	Row Totals
Pleasant	46	81	70	15	34	64	310
Unpleasant	12	9	17	4	1	17	60
No choice/no comment	77	131	121	27	60	132	548
All groups	135	221	208	46	95	213	918

Table 55 Frequency table: Conjoint question #1 - employers´ incentives and experienced feelings (mental state)

Source: own calculations (Statistica 64, version 13.1)

In Table 56, the frequencies of Conjoint question #2 (non-availability of car) and experienced feelings/mental state (Te Brömmelstroet et al., 2021) are provided. The majority who experience pleasant feelings would switch to public transportation, followed by car/taxi sharing. In third place is the combination of different modes of transportation, followed by car as a passenger, and finally by active travel.

Frequency Table: Conjoint Question #2 (being in town and no car is available to return home) and mental state/experienced feelings							
Category Mental state (experienced feelings)	*Option #1* Car (as a passenger)	*Option #2* Car/Taxi sharing	*Option #3* Public transport	*Option #4* Active traveling	*Option #5* Combination of different transport modes	*Option #6* none of them/ other	Row Totals
Pleasant	38	50	51	29	46	96	310
Unpleasant	8	11	12	6	4	19	60
No choice/no comment	72	76	83	55	63	199	548
All groups	118	137	146	90	113	314	918

Table 56 Frequency Table: Conjoint question #2: no car available to return home and experienced feelings (mental state)

Source: own calculations (Statistica 64, version 13.1)

Respondents who experience uncomfortable feelings when traveling by their primary mode of transportation would switch to public transportation by majority, followed by car/taxi sharing, third is car as a passenger, followed by active travel, and last is combination of different modes of transportation. In total, 314 respondents preferred the "no choice/other" option. This leaves open the question of what mode of transportation would be chosen if the car was not available for the trip home. As can be seen, the first choice, regardless of experienced feelings, would be public transportation in such a situation. However, these results should be interpreted with caution, as more than one-third of respondents chose the no-choice option in both cases.

In the following, the chi-square results for mental state (experienced feelings) in combination with the conjoints are presented.

Table 57 provides the expected frequencies for the variable "mental state (experienced feelings)" and the variable "Conjoint question #2 (no car available to get home)". As seen, the p-value is 0.674895 confirming that there is no significant association between both variables, assuming that other reasons than experienced feelings are responsible choice of transport in case of the non-availability of the car to return home.

Pearson Chi-square: 7.52737, df=10, p=.674895							
Mental state /experienced feelings	*Option #1* Car (as a passenger)	*Option #2* Car/Taxi sharing	*Option #3* Public transport	*Option #4* Active traveling	*Option #5* Combination of different transport modes	*Option #6* none of them/ other	Row Totals
Pleasant	39.8475	46.2636	49.3028	30.39216	38.1590	106.0349	310.0000
Unpleasant	7.7124	8.9542	9.5425	5.88235	7.3856	20.5229	60.0000
No choice/no comment	70.4401	81.7821	87.1547	53.72549	67.4553	187.4423	548.0000
All groups	118.0000	137.0000	146.0000	90.00000	113.0000	314.0000	918.0000

Table 57 Expected frequencies in grouped variables – Conjoint question #2: no car available to get home and mental state/experienced feelings

Source: own calculations (Statistica 64, version 13.1)

It can be assumed that in such a situation there is no connection between the experienced feelings during the travel and the choice of the means of transport, since rather personal circumstances as well as external circumstances such as the distance to the next public transport or car-sharing or bike-sharing station, play a role, which means of transport is taken in such a case. It may be possible that car as a passenger is chosen if there is a social environment that can pick one up in such a case when one's own car is not available.

Individuals are differing in terms of personality, their values, lifestyle, motivation, and habits, attitudes and knowledge and resources (Engel et al., 1995; Van Acker et al., 2010). In the following life experiences concerning changes in job and life within the previous 24 months as well as emotional states during travel with the main transport modes is provided, representing the environmental influences and individual differences according to the EBM-model.

The Chi-square results for several categorical variables are provided in Table 58:

- conditions to switch/transport policy instruments in connection with mental state (experienced feelings) and life situation,
- life situation in connection with mental states (experienced feelings), sociodemographics and car aspects,
- mental state/experienced feelings while traveling with the current transport mode in connection with current transport mode, sociodemographics and car aspects.

Some significant correlations can be retrieved, and the following assumptions are made: for the two variables "changes in life situation within the last 24 months" and "mental state/experienced feelings" there is a significant correlation with p = 0.00000. It can be assumed that the psychological state during the commute is related to the change in a life situation, since changed life circumstances, such as changes in the private or professional sphere, have an influence on the feelings during the trip.

Variable 1	Variable 2	Pearson Chi-square	Df (degree of freedom)	p-value
Conditions to switch (transport policy instruments)	Mental state/experienced feelings	9.08204	12	0.695908
Conditions to switch (transport policy instruments)	Life situation	6.95758	12	0.860404
Life situation	Mental state/experienced feelings	121.603	4	0.000000
Life situation	Density area	27.5995	8	0.000557
Life situation	Employment	21.4319	12	0.044402
Life situation	Income	39.5953	10	0.000020
Life situation	Car ownership	10.6552	2	0.004856
Life situation	Plans to buy a car	31.8836	4	0.000002
Life Situation	Plans to sell the car	15.7821	4	0.003326
Life Situation	Preferred transport mode is car driving but current transport mode is public transport	8.23592	6	0.221324
Life Situation	Preferred transport mode is public transport, but current transport mode is car driving	12.4991	6	0.051716
Mental State/experienced	Preferred transport mode	7.15628	6	0.306636

Variable 1	Variable 2	Pearson Chi-square	Df (degree of freedom)	p-value
feelings	is car driving but current travel mode is public transport			
Mental State/experienced feelings	Preferred transport mode is public transport, but current transport mode is car driving	6.16124	6	0.405372
Mental State/experienced feelings	Density Area	20.7725	8	0.007777
Mental State/experienced feelings	Employment	13.5288	12	0.331801
Mental State/experienced feelings	Income	9.52827	10	0.482806
Mental State/experienced feelings	Car ownership	1.29332	2	0.523792
Mental State	Plans to buy a car	14.7995	2	0.000611
Mental State/experienced feelings	Plans to sell the car	6.56464	2	0.037541

Table 58: Expected frequencies in grouped variables

Source: own calculations (Statistica 64, version 13.1)

Another significant relationship exists between the two variables "life situation" and "density range" (p = 0.000557), where it can be assumed that changed life circumstances have an influence on the place of residence, such as a move. This is also true for living situation and employment (p=0.044402) as well as changes in living situation and income (p= 0.000020), as changing living circumstances can have a significant effect on employment and a change in income. Another significant relationship exists between life situation and car ownership (p=0.004856), it can be assumed that changed life circumstances have a relationship with car ownership. A significant relationship also exists between the intention to buy or sell a car and the respective life circumstances (with p=0.000002 and p=0.003326). Here, one could assume that private and professional changes go hand in hand with the considerations to buy or sell a car. Another significant relationship appears between the two variables "mental state/experienced feelings" and "plans to buy a car" (p= 0.000611) as well as "state of mind" and "plans to sell the car" (p= 0.037451) under the assumption that depending on the experienced feelings during the trip with the primary means of transport, the plan to buy or sell a car is considered

Summarized, it can be concluded that there is a significant correlation between changes in the last 24 months in the professional and private context and the place of residence, income, and considerations to buy or sell a car. This is also plausible, as changes in the private sphere, such as a death in the family, the birth of a child or even a move, have an impact on the place of residence, income, and considerations regarding the car. Changes in the professional context, such as a promotion or unemployment, can also be related. In addition, the significant correlation between changes in the life situation and mental state/experienced feelings during the commute is also understandable, depending on what kind of event happened. As for mental state, significant correlations were found between the density of the area and the intention to buy or sell the car. Depending on the location of the place of residence and the means of transport used for commuting to work, different mental/feelings states can be evoked. This also affects the intention to buy a car. For example, if commuting by public transportation is tedious for the commuter, he or she might consider buying a car.

4.4. Results on Attitudes and Personality and PLS-SEM Model

The remainder of this chapter concerns analyses of variances using ANOVA (Analysis of Variances) and SEM modelling.

ANOVA is a technique that examines the effect of an independent variable that is nominally scaled on a dependent variable that is metrically scaled. Analysis of variance is one of the most important analysis methods when it comes to the evaluation of experiments. The dependent variable is also referred to as the effect variable, the independent variables are referred to as factors, and the characteristics of the factors are referred to as factor levels or categories. ANOVA is a one-factor model, a univariate analysis of variance, because this model has only one dependent variable and one independent variable. To perform the analysis of variance, the means of the groups and the overall mean are needed, since this analysis analyzes the differences between the means. Since the variances around the means play a decisive role, a distinction is made between a systematic and stochastic component. For the test of statistical significance, the F-statistic is used. The F-test relates the explained variance (factors) and the unexplained variance (error terms). The null hypothesis states that there is a significant relationship between the two variables (Backhaus et al., 2018). Thus, ANOVA is a method used to statistically test the equality of mean values between groups using an F-test considering the degrees of freedom (df) used to calculate the estimates. The F-test performed is a so-called omnibus test, i.e. it tests whether there are differences between the groups, however, it does not test whether all groups distinguish from each other, the observations are expected to be independent of each other and their variances caused by the “noise variables” should be approximately the same in the groups (Backhaus et al., 2018).

The following table shows the one-way ANOVA results for the dependent “psychological” variables “and the independent variable (factor) “conditions to switch/transport policy instruments”. The latter is about whether people switch to environmentally friendly means of transport with the help of incentives such as or punishment through policy instruments. Explaining the “psychological” variables, risk-taking is about how risk is viewed as a challenge, disliking what is going to happen, personal view as being a risk seeker or risk avoider. Optimism/Pessimism is about if a person describes himself being how optimistic /pessimistic. "Attitude" represents the personal belief that environmentally friendly modes of transportation can reduce air pollution and meet travel needs, the moral obligation to drive less, and the perceived behavioral control of being able to switch to environmentally friendly modes of transportation at any time. "Subjective norm" represents the expectations of the social environment to switch to other modes of transport than the car, and the "feelings" represent the disturbance caused by traffic noise and the concern about the impact of car and freight traffic. “Car habits” and “motives” are for individual automotive and habitual car use. Personality is assessed with the BFI-10 scale (Rammstedt, 2007). “Risk-taking” is about how much risk is seen as a challenge, how much a person dislikes what will happen, and how much a person classifies him/herself as risk-taking or risk averse (Meertens & Lion, 2008). Through “optimism/pessimism”, a person describes his tendencies in general (Kemper et al., 2012).

Table 59 shows the effects of the independent variables (conditions to switch/transport policy instruments) on the various dependent variables. As seen, the independent variable "conditions to switch" is not correlated with the variables of the individual differences "attitudes, subjective norms, feelings, habits, car motives and personality”, since the respective p-values are above the significance level of $p = 0.05$. It can be concluded that incentives such as free public transport, increased park and ride facilities, increased frequency of public transport, or increased individual safety, as well as punishments in the sense of higher gasoline prices, reduction of parking space and introduction of a speed limit in the cities are not correlated with individual differences of attitudes, subjective norms, feelings regarding the individual impairment by traffic and noise. Likewise, incentives and punishments are not correlated with habitual car usage, the motives to use the car and not with personality.

A significant effect has been seen on the dependent variable "Risk-taking" (p=0.046096) and "Optimism/Pessimism" (p= 0.021001), and is statistically significant ($p < 0.05$), meaning that the mean values of these groups differ statistically significantly. However, the independent variable "Conditions to switch" has a significant effect on the two dependent variables "Risk-taking" (p=0.046096) and "Optimism/Pessimism" with p= 0.021001, meaning that part of the variance of the dependent variables "Risk-taking" and "Optimism/Pessimism" can be explained by the "Conditions to switch" (error variance).

Variable (dependent)	Effect (independent)	Value	F	Effect df	Error df	p-value
Attitudes (1-4)	Conditions to switch	0.972636	1.0543	24	3168.844	0.390148
Subjective Norm (1-2)	Conditions to switch	0.977537	1.7327	12	1820	0.054453
Feelings toward Environment	Conditions to switch	0.984814	1.1649	12	1820	0.303035
Habits	Conditions to switch	0.903283	0.9270	72	3536,746	0.651847
Car motives	Conditions to switch	0.919480	1.2735	60	4730.914	0.076628
Personality	Conditions to switch	0.925086	1.181	60	4730.914	0.161665
Risk-taking	Conditions to switch	0.960459	1.5358	24	3168.844	0.046096
Optimism/Pessimism	Conditions to switch	0.974150	2.00	12	1820	0.021001

Table 59: Multivariate tests of significance in grouped variables, sigma-restricted parameterization, effective hypothesis decompensation

Source: own calculations (Statistica 64, version 13.1)

Thus, there are differences among the means of the groups. This means that incentives and punishments, as explained above, are correlated with the individual's willingness to take risks as well as on the description of oneself as having a rather optimistic or pessimistic character. The p-value for risk-taking and optimism/pessimism is less than $p < 0.05$, which means that a non-parametric test should be performed to confirm the results of ANOVA. Levene's test is performed to verify that the main assumption of the ANOVA (i.e., homogeneity of variances) is met. This is a statistical test that checks for equality of variances and is based on the null hypothesis that the error variance of the dependent variable is the same across groups

(Backhaus et al., 2018).

Presented in Table 60 Levene's test shows a significant result for the dependent variable "risk avoidance" (Risktaking_3) with p=0.002030. This means that the variances in "conditions for switching" and "I consider myself a risk avoider" are not equal across groups and thus the homogeneity of variances is not met.

Dependent variable: Risk Tendency	Levene's Test for Homogeneity of Variances Effect: "Conditions to switch" Degrees of freedom for all F's: 6, 911			
	MS Effect	MS Error	F	p
RISKTAKING_1: I really dislike not knowing what is going to happen	0.967840	0.470321	2.057830	0.055784
RISKTAKING_2: I usually view risks as a challenge	0.236856	0.243507	0.972689	0.442469
RISKTAKING_3: I view myself as a risk avoider	0.887813	0.254304	3.491145	0.002030
RISKTAKING_4: I view myself as a risk seeker	0.325073	0.300436	1.082002	0.371292

Table 60 Levene`s test for homogeneity of variances, effect: conditions to switch (policy instruments), dependent variable: risk tendency

Source: own calculations (Statistica 64, version 13.1)

The Kruskal-Wallis test is a nonparametric approach and hence the nonparametric equivalent of one-way ANOVA. The test checks whether the independent samples come from the same population or from populations with a continuous distribution and the same median for the variable under test. The variable being tested must be ordinally scaled. In this test, sample values are assigned to ordered ranks. The null hypothesis of the Kruskal-Wallis test is that the medians are equal, which means that they come from the same population ranks (de Sá Marques, 2007).

Table 61 provides the mean ranks and the results" risk-taking_3 (here: risk avoidance)" showing no differences regarding the central tendencies of the groups (Chi-Square = 3.551426, p = .7371). As seen, the null hypothesis of median equality is confirmed.

Dependent Risk avoidance (3)	Median Test, Overall Median = 3.00000; Independent (grouping) variable: Conditions to switch Chi-Square = 3.551426 df = 6 p = ,7371							
	0	1	2	3	4	5	6	Total
<= Median: observed	553.0000	81.0000	19.00000	9.00000	15.00000	31.00000	5.00000	713.0000
expected	559.2157	77.6688	17.08715	9.32026	15.53377	30.29085	3.88344	
obs.-exp.	-6.2157	3.3312	1.91285	-0.32026	-0.53377	0.70915	1.11656	
> Median: observed	167.0000	19.0000	3.00000	3.00000	5.00000	8.00000	0.00000	205.0000
expected	160.7843	22.3312	4.91285	2.67974	4.46623	8.70915	1.11656	
obs.-exp.	6.2157	-3.3312	-1.91285	0.32026	0.53377	-0.70915	-1.11656	
Total: observed	720.0000	100.0000	22.00000	12.00000	20.00000	39.00000	5.00000	918.0000

Table 61: Kruskal Wallis (Median Test), dependent variable "risk-taking 3: I view myself as a risk avoider", independent grouping variable "conditions to switch (policy instruments)"
Source: own calculations (Statistica 64, version 13.1)

Table 62 provides the results of the Levene´s Test on the effect of “conditions to switch” and “optimism/pessimism” showing no significant results with p=0.911. This means that the variances in “conditions to switch” and “optimism and pessimism” are equal across the groups and thus the homogeneity of variances is met.

	Levene's Test for Homogeneity of Variances Effect: "Conditions to switch" Degrees of freedom for all F's: 6, 911			
	MS Effect	MS Error	F	p
OPTIMISM_1	1.018583	0.603033	1.689100	0.120474
PESSIMISM_1	0.404486	0.550331	0.734986	0.621518

Table 62 ANOVA Homogeneity of variances, dependent variable: optimism/pessimism, effect: conditions to switch (policy instruments)

Source: own calculations (Statistica 64, version 13.1)

Factor analysis is one of the methodological procedures designed to discover structures with the aim of discovering relationships between objects or variables. In comparison to the structure-testing methods, this method does not divide into dependent and independent variables. The factor analysis is used, if there are many variables to a question and the variables must be reduced, if for example many characteristics are to be led back to some central factors, which are then found in factors. These factors are a condensation of variables, but with a loss of information (Backhaus et al., 2018). In order not to lose so much information, the author decided to analyze each area (attitudes, subjective norms, feelings, motives, habits, risk-seeking, personality, and optimism/pessimism) separately.

Once the number of factors is given, correlations are calculated, giving a measure of the strength and direction of the relationships between the factors and the original variables, which are then referred to as factor loadings. The factor loadings contain standardized values, and the expressions are presented as deviations from the means. Factor loadings are a measure of the relationship between variables and factor is only valid, however, if the factors are independent of each other and there is a linear relationship. The analysis used here is a Principal Component Analysis (PCA), which means that as many factors as output variables are extracted in this PCA. The variance of the output variables can be fully reproduced by uncorrelated principal components. In PCA, there is a distinction in terms of commonalities, that is, how many factors are extracted, the extraction criterion is the Kaiser criterion, according to which the number of factors to be extracted is equal to the number of factors with eigenvalues greater than one. This criterion is used here. The PCA procedure is used to answer the question of how the variables can be summarized on one factor by one term. The Eigenvalues describe the contribution of the explanation of the variance of a factor with respect to the variance of all variables. High factor loadings are assumed from 0.5. The rotation of the coordinate cross helps with the interpretation, the factor loadings become higher with the rotated loading. An unrotated model should not be interpreted because using a rotated method changes the distribution of a variable's explained variance across factors. A high positive factor value indicates an above-average expression of an item on that factor, and a high negative value indicates a below-average expression of the item on that factor. For a factor analysis, the data must be metrically scaled, the number of cases must be at least greater than 50, the variables must be standardized, and the factor loadings must be > 0.5 (Backhaus et al., 2018, p. 365 ff.).The steps for the factor analysis are as follows: variables are selected for the factor analysis from the raw data input file, the correlation matrix is computed for the specific variables, the extraction is performed with the principal component method.

As seen in Table 63, for the factor analysis of the variable “Attitudes”, 918 cases were selected and accepted; correlation matrix was computed for four variables. The method for extraction used is principal components (a standard in the software Statistica), two factors were extracted, accounting for less and less variance overall. Varimax raw rotation performed showing high loadings for Attitude 4 (If I wanted to, I could always switch to public transport or other environmentally friendly means of transport) and Attitude 3 (It is the moral obligation to everyone to reduce car travel).

Attitudes Variable	Factor Loadings (Varimax raw) Extraction: Principal components	
	Factor 1	Factor 2
Attitude_1: Environmentally friendly transport modes reduce air pollution	0.595952	-0.428327
Attitude_2: Environmentally friendly transport modes can meet our travel demands	0.545247	0.453894
Attitude_3: It is the moral obligation to everyone to reduce car travel	-0.016426	0.809741
Attitude_4: If I wanted to, I could always switch to public transport or other environmentally friendly means of transport	0.744138	0.030602
Expl.Var	1.206464	1.046101
Prp.Totl	0.301616	0.261525

Table 63: Factor loadings (Varimax raw), variables: attitude

Source: own calculations (Statistica 64, version 13.1)

However, as seen from the introductory part to factor analysis and, in line with Backhaus (2018), Attitude 1 (environmentally friendly transport modes reduce air pollution) has a loading of 0.595952 which is above the suggested value of < 0.5 for interpretation. This is also seen for Attitude 2 (environmentally friendly transport modes can meet our travel demand) with a loading of 0.545247.

The two covering components could be found as follows:

- ⇒ Moral obligation of everyone to reduce car travel
- ⇒ Perceived behavioral control (if wanted, a switch to public transport or environmentally friendly transport is always possible

The factor analysis for the variables “Subjective Norms” and “Feelings” below shows high loading for Factor Feelings_1 (feeling affected by the noise generated by traffic) with a loading of 0.863281. To Statistica 64, loadings over 0.700000 are “significant”. In conformity with Backhaus (2018), loadings over 0.500000 can also be used, to Blöbaum et al. (1998), the formal validity of the factor loadings varies between 0.56 and 0.85 (Blöbaum et al., 1998) . Thus, the variable subjective norm (people who are important to me usually support my use of environmentally friendly transport modes) with a loading of 0.681543 and Subjective norm 2 (people who are important to me expect me to use environmentally friendly transport modes to meet my travel needs) with a loading of 0.688864 could also be considered. The loading of Feeling 2 (I am concerned about the environmental impact of car and freight traffic) with a loading of 0.500221 is very low but > 0.5 as suggested by Backhaus (2018).

Subjective Norm and Feelings	Factor Loadings (Varimax raw) Extraction: Principal components	
Variable	Factor 1	Factor 2
Subjective Norm_1: People who are important to me usually support my use of environmentally friendly transport modes;	0.681543	0.127027
Subjective Norm_2: People who are important to me expect me to use environmentally friendly transport modes to meet my travel needs.	0.688864	0.083195
Feelings 1: I feel affected by the noise generated by traffic	0.113515	0.863281
Feelings 2: I am concerned about the environmental impact of car and freight traffic	-0.472522	0.500221
Expl.Var	1.175198	1.018533
Prp.Totl	0.293800	0.254633

Table 64: Factor loadings (Varimax raw), variables: subjective norms, feelings

Source: own calculations (Statistica 64, version 13.1)

The following four components could be found:

- ⇒ The social Norm (support of the social environment) is responsible of the usage of environmentally friendly transport
- ⇒ The social norm (expectation of the social environment) is responsible of the usage of environmentally friendly transport
- ⇒ Feelings of affection through noise generated by traffic
- ⇒ Feelings of concern about environmental impact of car and freight traffic

Table 65 shows the results for the variable “habitual car usage” with Factor loadings. From 918 cases, 667 valid cases were accepted, the correlation matrix was computed for 12 variables, the method is principal components, log (10) determinant of correlation matrix:

-.13571, two factors were extracted, the Eigenvalues are 1.5275 and 1.25436, Factor rotation is Varimax raw. As seen, high loadings are seen for HabitSRHI_2 (no matter to me which type of car I drive) with a loading of 0.680115 and a negative loading for HabitSRHI 5 (shows who I am and what I am) with -0.580808, also a negative loading of HabitSRHI-9 (know of a dream car I would love to possess).

Habital car usage: For me, the car has…. Variable	Factor Loadings (Varimax raw) Extraction: Principal components Factor 1	 Factor 2
HabitSRHI_1: Instrumental functions	-0.205240	0.257914
HabitSRHI_2: Not matter to me, which type of car I drive	0.050713	0.680115
HabitSRHI_3: Just a car to travel from A to B	-0.403203	0.283860
HabitSRHI_4: Status and prestige	0.111358	0.424778
HabitSRHI_5: Shows who I am and what I am	-0.580808	-0.132696
HabitSRHI_6: I am jealous if someone has a nice car	0.205890	0.030826
HabitSRHI_7: Love driving	-0.317055	0.388373
HabitSRHI_8: Feel free and independent	0.160293	0.347065
HabitSRHI_9: Know of a dream car I would love to possess	-0.559360	-0.083754
HabitSRHI_110: Like to drive just for fun	0.255495	0.463135
HabitSRHI_1111: I do frequently	0.033469	-0.153139
HabitSRHI_112: I do automatically	0.590815	0.051621
Expl.Var	1.453958	1.327560
Prp.Totl	0.121163	0.110630

Table 65: Factor loadings (Varimax raw) for the variables “habitual car usage”

Source: own calculations (Statistica 64, version 13.1)

Based on the differentiation of the use of the car on the basis of based on different functions (symbolic and affective function, instrumental function and independence according to Steg (Steg, 2005), as well as habitual car usage, a sorting was also made here. The following four covering components could be found:

- ⇒ HabitsSRHI_2: Instrumental functions (type of car is not important)
- ⇒ HabitsSRHI_5: Symbolic and affective functions (shows who I am and what I am)

(negative loading)

⇒ HabitSRHI_9: Symbolic and affective functions (know of a dream car I would love to possess) – negative loading,

⇒ HabitSRHI_112: instrumental functions (I do automatically)

Motives using the car: Using my car is something I… Variable	Factor Loadings (Varimax raw) Extraction: Principal components		
	Factor 1	Factor 2	Factor 3
CARMOTIVES_1: do without having to consciously remember	0.490862	0.445623	-0.291426
CARMOTIVES_2: makes me feel weird if I do not do it	0.196040	0.483763	-0.280832
CARMOTIVES_3: I do without thinking	-0.393663	0.454142	-0.047498
CARMOTIVES_4: would require effort not to do it	0.278889	0.217299	0.007806
CARMOTIVES_5: belongs to my daily, weekly, monthly routine	**0.785516**	-0.074082	0.255194
CARMOTIVES_6: I start doing before I realize I am doing it	**0.834998**	0.048957	-0.068952
CARMOTIVES_7: I would find hard not to do so	0.067192	**0.663179**	0.147873
CARMOTIVES_8: I have no need to think about doing	-0.049481	0.394559	**0.607035**
CARMOTIVES_9: that is typically me	-0.063247	**0.717301**	0.164220
CARMOTIVES_10: I have been doing for a long time	0.215959	-0.005462	**0.671089**
Expl.Var	1.883986	1.803989	1.103678
Prp.Totl	0.188399	0.180399	0.110368

Table 66: Factor loadings (Varimax raw) for the variables “Car motives”

Source: own calculations (Statistica 64, version 13.1)

Table 66 provides the results of Factor loadings “Car motives”. 918 cases were selected, and all were accepted, the correlation matrix was computed for 10 variables. Maximum no of factors selected: 10. Three factors were extracted. High loadings are seen for the variable Carmotives_5 (belongs to my daily, weekly, monthly routine) with a loading of 0.785516 and Carmotives_6 (I start doing bevor I realize I am doing it) with even a higher loading of 0.834998. Also, high loadings are seen for carmotives_7 (I would find hard not to do so) with a loading of 0.663179, carmotives_8 (I have no need to think about) with a loading of 0.607035, carmotives_9 (that is typically me) with a loading of 0.717301 and carmotives_10 (I have been doing for a long time) with a loading of 0.671089. As explained earlier, in line with Backhaus (2018) loadings above 0.5000000 can be taken into consideration.

The factors extracted are summarized as follows:

⇒ Car motive 5: using the car as a routine (Routine –habitual car usage)

⇒ Car motive 6: unconscious car usage (Unconsciousness –habitual car usage)

⇒ Car motives 7: difficult to give up (Car Personality) (symbolic and affective motives)

⇒ Car motives 8: have no need to think about (Unconsciousness –habitual car usage)

⇒ Car motive 9: is typically me (“Car Personality) (symbolic and affective motives)

Personality (Big Five-10) I see myself as someone who is… Variable	Factor Loadings (Varimax raw) Extraction: Principal components		
	Factor 1	Factor 2	Factor 3
PERSONALITY_1: Reserved	0.150245	-0.022570	**0.606681**
PERSONALITY_2: Generally trusting	0.179676	-0.174023	**-0.600063**
PERSONALITY_3: Tends to be lazy	0.260977	**0.644105**	-0.106531
PERSONALITY_4: Is relaxed	0.020272	**0.606639**	-0.015395
PERSONALITY_5: Handles stress well	**-0.626231**	0.145720	-0.179813
PERSONALITY_6: Is outgoing, social	-0.195649	-0.364308	0.482084
PERSONALITY_7: Tends to find fault with others	**0.753447**	0.095556	0.005151
PERSONALITY_8: Does a thorough job	**-0.808484**	-0.103146	0.151856
PERSONALITY_9: Gets nervous easily	0.009427	**0.649386**	0.041724

PERSONALITY_10: Has an active imagination	-0.102153	**0.528741**	0.298839
Expl.Var	1.785673	1.688671	1.118594
Prp.Totl	0.178567	0.168867	0.111859

Table 67: Factor Loadings „Personality Big Five-10"

Source: own calculations (Statistica 64, version 13.1)

Table 67 provides the results of Factor loadings "Personality". 918 cases were selected, and all were accepted, the correlation matrix was computed for 10 variables. The maximum number of factors selected are 10. Three factors were extracted. Through factor analysis, the following nine covering components could be found and a further classification is made on the basis of the Big Five criteria (Rammstedt et al., 2013):

⇒ Personality describing him/herself as "reserved" (1) (Extraversion)

⇒ Personality with the tendency to be generally trusting (2) (negative factor loading) (Agreeableness)

⇒ Personality with the tendency to be lazy (3) (Conscientiousness)

⇒ Relaxed Personality (4) (Conscientiousness)

⇒ Personality handling stress well (5) (Neuroticism)

⇒ Personality with the tendency to find faults with others (7) (Agreeableness)

⇒ Personality doing a thorough job (negative factor loading) (8) (Conscientiousness)

⇒ Personality getting nervous easily (9) (N= Neuroticism)

⇒ Personality with an active imagination (10) (O = Openness)

Summarized, high factor loadings could be found all Big Five criteria Extraversion (+), Agreeableness (+/-), Conscientiousness (+), Neuroticism (+) and Openness (+).

Table 68 provides the results of Factor loadings "Risk Tendencies and Optimism/Pessimism". Two factors were extracted. For Risk-taking 1 (disliking not knowing what is going to happen, the factor loading is high with 0.730673, as well as for Risk-taking 3 (viewing oneself as risk avoider with factor loading 0.694813 followed by Risktaking_4 (viewing oneself as risk seeker) with factor loading 0.609524. For the category optimism/pessimism there are high factor loadings seen for optimism with a loading of 0.966066 and pessimism with a negative loading of -0.970070.

Through factor analysis, five components could be found:

⇒ It is disliked, not knowing what happens

⇒ Risk avoidance

⇒ Risk seeking

⇒ Viewing himself/herself as being optimistic

⇒ Viewing himself/herself as being pessimistic (negative factor loading).

Risk Tendencies and Optimism/Pessimism I view myself … Variable	Factor Loadings (Varimax raw) Extraction: Principal components Factor 1	 Factor 2
RISKTAKING_1: Dislike not knowing what is going to happen	-0.040470	**0.730673**
RISKTAKING_2: Usually views risk as a challenge	0.056299	-0.451691
RISKTAKING_3: View myself as risk avoider	0.046047	**0.694813**
RISKTAKING_4: View myself as risk seeker	0.082635	**0.609524**
OPTIMISM_1: How optimistic are you in general?	**0.966066**	0.032257
PESSIMISM_1: How pessimistic are you in general	**-0.970070**	0.015348
Expl.Var	1.888076	1.593469
Prp.Totl	0.314679	0.265578

Table 68: Factor loadings (Varimax raw) for the variables risk-taking and optimism/pessimism

Source: own calculations (Statistica 64, version 13.1)

In the following the path diagram as well as the path estimates of the model are explained and discussed. First, the respective indicators (yellow rectangles) of the measurement model are explained: the indicator "Lifesit" represents the changes in life circumstances and job situation within the last 24 months. "CARSHARING", for respondents' experiences with carsharing modes, and "Mental state" refers to respondents' experienced feelings (mental state) while traveling with primary mode of transportation. “Conditions” is the indicator for transport policy instruments (punishment in terms of higher cost, less convenience, and less enjoyment) and in terms of incentives (free public transportation, increase in safety and convenience). "DRIVLIC" refers for the possession of a driver's license. The indicator "CBCA-1" represents Conjoint question #1, providing a hypothetical situation of an employer offering various incentives to switch to other modes of transportation, such as carpooling, car/taxi sharing, public transportation, active travel (bicycling/sharing and walking), and combining different modes of transportation. The indicator "CBCA-2" is Conjoint question #2, providing a hypothetical situation of being in the city and no car is available to get home. In both hypothetical situations, the respondents could choose between five transport modes options (car (as a passenger), car/taxi sharing, public transport mode, active traveling modes (inclusive sharing), combination of different transport modes and the option “no choice/none of them”. „Timecar" is the dependent variable in this model representing the aggregated results of the percentage of time spent traveling by car, the actual transport behavior. All other variables turned out to be useless for the model due to collinearity reasons.

The circles of the latent variable CBCA_1 (conjoint question #1: employers incentives) and the latent variable CBCA_2 (conjoint question #2: no car available to get home) show the p-values indicating how much the variance of the latent variable is explained by the other variables, the arrows are the path coefficients that explain “how strong the effect of a variable is on another variable” (Wong, 2013, p. 17).

As seen, the p-values of CBCA_1 (employer´s incentives) with p=0.024, the p-value of CBCA_2 (no car available to get home) with p= 0.009 and the p-value of the latent variable “timecar” with p=0.091 representing the actual behavior are significant. As obvious, the indicators "mental state/experienced feelings", "car sharing experience", "conditions to switch (transport policy instruments)", "gender" and "driver’s license" have a significant effect on the latent variable (CBCA_1): choice of transport mode under the hypothetical situation "employers’ incentives". The significant effect of the same variables is also evident on the latent variable CBCA_2: "non-availability of the car to get home". As also suspected, the choice of the means of transport under both hypothetical situations also has a direct effect on the behavior.

Figure 48 shows the Partial Least Square-SEM (PLS-SEM) path diagram. The overall structure of a model is evaluated using different quality criteria. The Chi-square tests the validity of a model using a likelihood ratio test H0: the model-theoretic variance-covariance matrix corresponds to the true values of the population, H1: the model-theoretic variance-covariance matrix corresponds to an arbitrarily defined matrix (Backhaus et al., 2018). The Smart PLS V.3 Software provides goodness-of-fit measures, the Standardized Root Mean Square (SRMR), the Chi-square and the rmsTheta. The SRMR for the model is 0.066, which is below the level of 0.08, “which is less than the threshold level below 0.08” (Esfandiar et al., 2021, p. 310) indicated by Henseler et al. (2014) (Henseler et al., 2015 as cited in Esfandiar et al. (2014)). This was also stated by other authors (Alshurideh et al., 2021), that SRMR values below 0.08 and rmsTheta values lower than 0.12 are considered as good model fit measures (Alshurideh et al., 2021). rmsTheta is 0.105 and Chi-square is 205.730 showing a good fit.

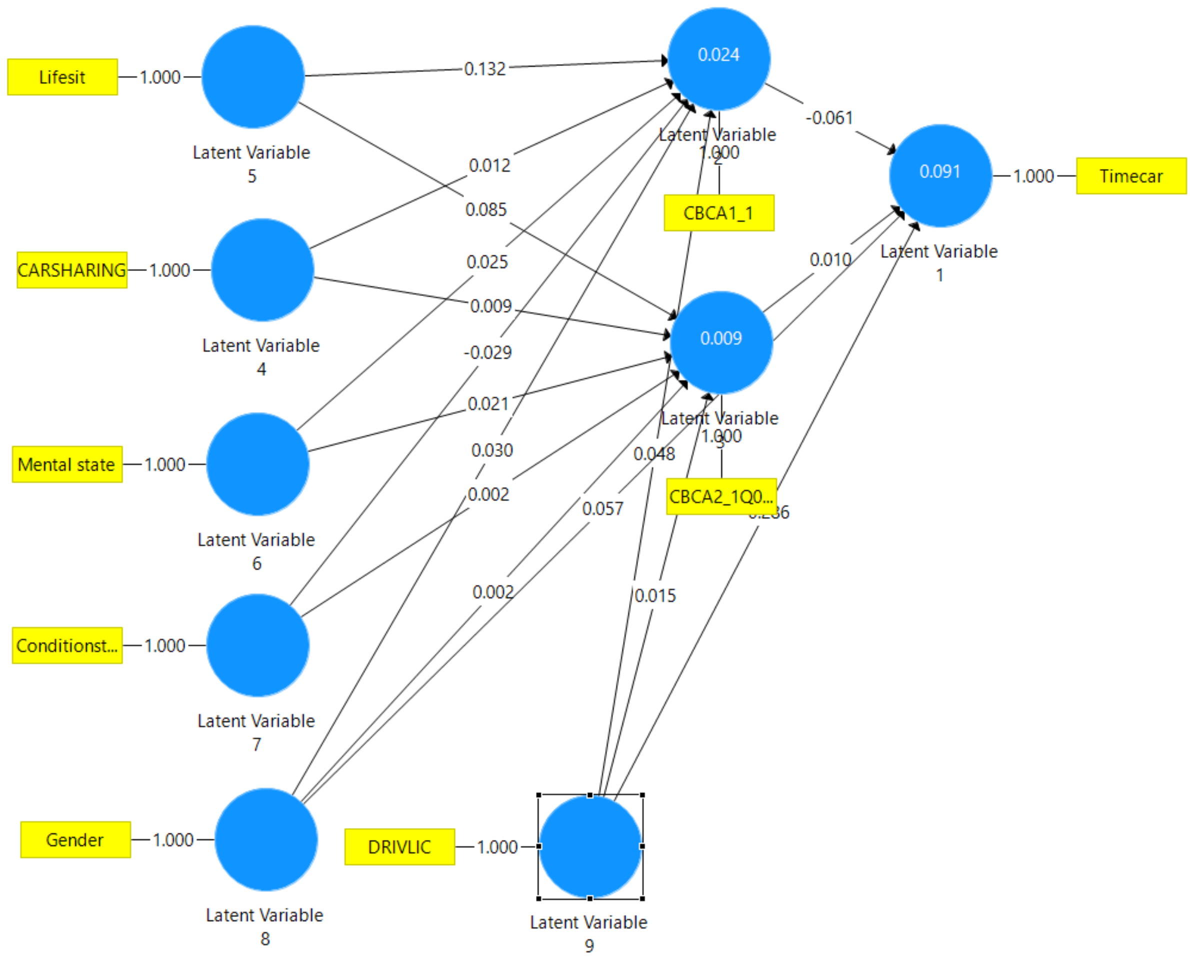

Figure 48 SEM Path diagram

Source: own calculations (SmartPLS 3.0)

The following table provides the path estimates of the above model. The main findings will be described in Table 69.

sPath estimates of the model (p-values)	Latent Variable 1: Actual travel behavior	Latent Variable 2: CBCA 1 (employers´ incentives)	Latent Variable 3: CBCA 2 (no car available to get home)
Latent Variable 1 = actual travel behavior			
Latent Variable 2 = employers´ incentives	**-0.061**		
Latent Variable 3 = no car available to get home	**0.01**		
Latent Variable 4 = experience with car-sharing		**0.012**	**0.009**
Latent Variable 5 = life circumstances and job situation (previous 24 months)		0.132	0.085
Latent Variable 6 = mental state/experienced feelings (while traveling with current transport mode)		**0.025**	**0.021**
Latent Variable 7 = conditions to switch (punishment and incentives)		**-0.029**	**0.002**
Latent Variable 8 = gender	0.057	**0.03**	**0.002**
Latent Variable 9 = drivers´ license	-0.286	**0.048**	**0.015**

Table 69 Path estimates of the model (significant values are in bold)

Source: own calculations (SmartPLS 3.0)

The analysis is focusing on the environmental circumstances and individual differences based on the EBM framework. The results indicate significant relationships and the main findings in context with the research objective and the hypothesis are as follows:

Mental state/experienced feelings while traveling with current transport mode has a significant effect on the choice of transport mode if an employer offers incentives (CBCA 1) with p = 0.025. The significant relations suggest, that experiencing feelings while traveling with their primary transport mode are influenced in case of offered incentives. The results presented in the frequency tables show that most respondents with pleasant feelings would primarily switch to car-sharing and public transportation, followed by riding in a car as a passenger. Respondents experiencing unpleasant feelings would primarily switch to public transportation and riding as a passenger in a car, given the appropriate incentives.

Mental state/experienced feelings while traveling with current transport mode has a significant effect on the choice of transport mode if no car is available to get home (CBCA 2) with p = 0.021. This can be seen from the frequency table. that the majority experiencing pleasant feelings traveling with their primary mode of transport would switch to public transport and car/taxi sharing, most of the respondents experiencing unpleasant feelings would opt public transport and car/taxi sharing in to get home, if there is no car available.

A significant effect was seen from driver’s license on the choice of transport mode, if employers offer incentives to switch to environmentally friendly modes of transportation (p=0.048). This can be seen in the frequency table that most of the respondents possessing a driver’s license would switch to car/taxi sharing and public transport and the respondents without a driver’s license to public transport first, followed by car/taxi sharing.

Further, a significant effect was seen from having a driver´s license on the choice of transport if no car is available to return home (p=0.015). Not having a driver's license automatically leads to having to take other means of transportation to get home at all. As seen from the tables the majority of car drivers would switch to car/taxi sharing first, followed by public transport and the respondents without a drivers´ license to public transport first and car/taxi sharing.

Car-sharing experience has a significant impact on mode choice when an employer offers incentives (CBCA 1 with p = 0.012). From the frequency table, it can be seen that regardless of whether a respondent has carsharing experience or not, most respondents without experience would switch to car/taxi sharing, followed by public transportation. Respondents with carsharing experience would choose car/taxi sharing first, followed by public transportation.

Car-sharing experience has a significant effect on the choice of transport mode if there would be no car available to return home (CBCA 2 with p = 0.009). As seen, respondents with no car-sharing experience would switch to public transportation first, followed by car/taxi sharing, the respondents with car-sharing experience would prefer car-sharing, followed by public transportation.

Transport policy instruments in terms of punishment and incentives have a significant effect if employers offer incentives to switch to environmentally friendly transport modes (CBCA 1) with p= 0.029. This is confirmed by the results as seen in Table 20, which shows that most respondents would switch to car/taxi sharing first and then to public transport if the cost increases. In the case of punitive policy instruments related to convenience, respondents would choose car/taxi sharing first, followed by public transportation if incentives through the employer are offered.

Transport policy instruments in terms of punishment and incentives have a significant effect if no car is available to get home with p=0.002. This is confirmed by the results seen in the frequency Table 21. In case of increasing costs, the majority of respondents would switch to public transport, followed by car-sharing. If policy instruments are introduced that reduce convenience, most respondents would switch to public transport, followed by car/taxi sharing.

A significant effect of gender on the choice of transport mode was found if the employer offered incentives to switch to environmentally friendly means of transport (p= 0.03). This can also be seen in Table 22: male respondents would choose car/taxi sharing followed by public transportation, and female respondents would choose public transportation first followed by car/taxi sharing if the employer offered incentives to switch to other modes of transportation.

A significant effect was seen from gender to transport mode choice if no car is available to get home with p-value 0.002. Also illustrated in Table 23, male respondents would choose car/taxi sharing followed by public transport and females public transport first followed by car as passenger if there would be no car available to return home.

A significant effect was found for employer incentives (CBCA_1) on actual travel behavior (p=-0.061). As shown in Table 26, respondents would choose other modes of transportation, especially car/taxi sharing and public transportation, if there are incentives from the employer.

A significant effect has been seen between the non-availability of the car to get home (CBCA 2) and actual travel behavior (p=0.01). As seen in Table 27, the majority would choose car-sharing and public transportation when the car is not available to get home.

In the following, the non-significant effects are outlined as follows: Changes at work and in life within the past 24 months have no significant effect (p = 0.132) on transport mode choice when incentives are offered by the employer to encourage switching to modes of transportation other than one's own car. They also have no significant effect on mode choice when the car is not available for home travel (p = 0.085). Furthermore, no significant effects were found between driver's license and actual transportation behavior (with p=-0.286) and between gender and actual transportation behavior (with p=0.057).

CONCLUSIONS

The objective of this thesis was to investigate the extent of respondents' statements about a hypothetical situation and how these correspond to actual travel behavior. This goal was achieved by embedding the thesis in the context of climate change, the rising demands and need for more sustainability, the increasing possibilities of sustainable mobility, and a solid theoretical foundation of how people make decisions. Thus, the factors influencing the choice of means of transport and current travel behavior have been investigated.

This conclusion begins with a summary of the previous chapters, discusses the results regarding the hypotheses that were formulated, and discusses the approach of the study itself. In addition, actual suggestions are made as to which measures could be used to accelerate the adoption of sustainable mobility methods.

To achieve this goal, an introduction was first given to the historical development of motorized mobility and the car itself, and the consequences of ever-increasing individual transport in the European Union and especially in Poland. As it is well known, the consequences of mass mobility have been, and remain, accidents, noise, and increased emissions, which are currently being tried to be solved at national and European levels by a variety of holistic concepts. Further, different sustainability concepts were presented, which can be traced back to the first formulations in terms of sustainability in the 18th century and concluded that sustainable action is only possible if economic, social, and the environment are equally considered. As the thesis deals with mobility behavior, the development of the topic of “Sustainable Mobility” was again looked at historically and presented. Further it describes how different academic disciplines developed and changed over the years, as it became more and more clear over time that sustainability in transportation, in particular, affects several areas: the development of new technologies, investments in public transport, land use planning and last but not least the behavior of transportation users (Holden, 2014).

At the European level, many concepts already exist, such as the interconnection of different transport routes, intending to reduce emissions, in Europe by 2050. To achieve this goal, the participation of different interest groups is required, as they differ from each other in terms of their motives. Environmental and sustainability considerations go hand in hand with the development of innovative mobility concepts and the development of sustainable technologies.

Thus, the development of innovative concepts and the use of newer technologies, and the Europe-wide networking of transport routes must be promoted. Furthermore, the focus on other modes of transport and their opportunities than the own car, such as conventional travel by bicycle, walking, sharing service, or mobility as a service, which is a combination of different modes of transport, continued a presentation of newer innovative achievements such as autonomous driving by car or autonomous public transport.

However, all concepts and solutions that have been presented or already implemented on a national and European level are of little use if it is not understood how people make decisions and which factors influence the decision process to switch to other modes of transport than the car, for example. This problem has been addressed by various scientists who have developed different theories, as the next chapter then showed.

Based on the principle of Homo Oeconomicus, who strives for utility maximization, the first distinction between normative and descriptive decision processes followed, with the focus in this paper on descriptive decision processes. First, the main utility theories are presented. In the further course, further assumptions are described, which describe those decisions are based on heuristics, are made under emotions, or are also made unconsciously, for example, the use of the car is subject to a habitual process. To this end, several well-known socio-cognitive models have been presented that attempt to explain how decisions are made, including the Theory of Reasoned Action (TRA), the further development of the TRA, namely the TPB, and the Engel-Blackwell-Miniard Model (EBM), which has been used as the theoretical basis in this thesis. The reason of using the EBM model is because this model combines the cognitive and the decision-making process with the variables that influence the decision-making process and for the author, it represents a holistic approach to achieving the goal of the actual work, if the statements, made by respondents reflect actual travel behavior. According to the author, this theoretical model provides a holistic framework: how information is captured, processed, and what individual factors and environmental factors influence the decision-making process, which in turn occurs in several stages.

Other models focusing on habits and feelings, norms, and social behavior have also been presented, since driving in particular is a habitual process that occurs automatically (Verplanken & Aarts, 1999). Although the Theory of Interpersonal Behavior (TIB) by Triandis (Triandis, 1977) was shortlisted as a theoretical foundation, as it also takes into account internal and external factors, the author missed the area of information processing processes triggered by stimuli and the representation of all areas mentioned in the EBM model in a holistic concept in all theoretical models presented.

As stated, innovative solutions are being sought at the national and EU level to promote sustainability, which were described at the beginning. To this end, different models have been presented at the theoretical level that attempt to explain how the acceptance of innovations occurs. Other researchers have brought the areas of emotions and feelings into their model, which try to explain current behavior, such as the Value-based Adoption Model (VAM) of Kim et al. (Kim et al., 2007) or the Risk as Feelings Theory (Loewenstein, 2000; Loewenstein et al., 2001).

With the knowledge that emotions and feelings play a major role in the context of actual behavior, a brief description of different psychological views that attempt to explain behavior was given in the same chapter with the conclusion that the models describing cognitive processes are the models that are most widely used (Zimbardo 1992). According to the author, these cognitive processes are covered holistically in the EBM model (1995). The steps in the information process are directly linked to the decision process and the decision process and the actual choice is equally influenced by the individual and environmental factors. Consequently, which behavior is then executed depends on the individual motives. For this reason, Maslow's hierarchy model was presented, since personal factors play a role in whether a choice can be made at all, according to Maslow, basic needs must first be satisfied before one can turn to the next higher needs (Maslow, 1943). Since emotional states also play a role in the individual factors, a focus was placed on mental processes/experienced feelings during travel, which was presented in this chapter using the Flow Model (Csikszentmihalyi, 2014) as a theoretical foundation, and the experienced feelings/mental states as described in te Brömmelstroet et al, 2021 using original designs by Csikszentmihalyi (Csikszentmihalyi, 1977 as cited in Brömmelstroet et al., 2021).

The following part of this chapter describes the Rubicon model explaining why volitional aspects are also important, and that motives and goals lead to outcomes and decisions, which the author believes is important because choosing a mode of transportation other than the one used to be also an act of volitional decision-making. Moreover, whether the choice of a different mode of transportation is considered depends on the individual personality. Therefore, the focus on the Big Five, Risk Seeking, and Optimism/Pessimism as personality factors were laid in the same chapter. In the author's opinion, the theories presented in the context of the current problems of mass mobility formed an important basis for the development of the following summarized methodological approach.

The third chapter “Methodology” presents the different variants of conjoint analysis and showed the different advantages and disadvantages, explained different modeling and estimation strategies and techniques, how the study design looks like and how the data was collected. The reason for choosing a conjoint analysis was that different means of transportation could be presented with different characteristics, among which the respondents could then choose a means of transportation under a hypothetical situation, which would be equivalent to a "real situation". Choice-Based Conjoint Analysis was deliberately chosen to also provide respondents with the option of not choosing, to counteract the risk of false statements or abandonment of the survey. In the further course, the different modeling techniques such as Logit Models, Structural Equation Modeling methods, Hierarchical Bayes Estimation, as well as the Multi-Nested Generalized Extreme Value (GEV) Model were presented and discussed in detail, whereby then, after consideration, Structural Equation Modeling was chosen, since it has often been successfully used in the marketing field (Wong 2013) or also in the transportation field (Kang et al., 2019; Liang et al., 2019). Another reason for choosing Structural Equation Modelling was also the "appropriate " theoretical foundation of the EBM model because it has been used as a theoretical foundation for studies in the tourism sector (Hsu et al., 2012) which could be linked to mobility in general in the opinion of the author. One of the disadvantages of this method is, that „arrows are always single-headed, it cannot model undirected correlation“ (Wong, 2013, p. 3). However, he further noted, that this technique has been used in many other scientific fields by other authors as well (Wong 2013).

The questionnaire was developed using the LimeSurvey tool Version 3.17.0+190402 (LimeSurvey, 2018), a open source tool that presented itself to the author as very user-friendly. The questionnaire consisted of 37 questions (sociodemographic data, actual travel status and plans, life circumstances, experienced feelings during travel and personality aspects, habitual car behavior and car motives, reflecting the „environmental influences and individual differences“ in the EBM model (Engel et al., 1995). The time for completion of the questionnaire was calculated with approx. 10-15 minutes. This is a very comprehensive questionnaire from today's point of view, but it covers many aspects of current travel behavior, individual and environmental aspects, as well as two hypothetical situations that seem very close to reality from the author's point of view. The questionnaire was made available online for completion, and further tools were implemented to ensure complete completion of the questionnaire and to increase the response rate, which in the end proved to be purposeful. The survey was conducted in Poland at the end of 2021 to the beginning of 2022, i.e., both in a period of pandemic and in a season, which should be considered when interpreting the results obtained.

In the survey, 918 people from Poland participated, the results are to be interpreted from the point of view of predominantly 31–50-year-olds, of which about half are married and half unmarried and gender was equally represented. It is difficult to make a statement about the monthly income because more than half of the respondents did not give any information about it, but most of the respondents who gave information about it, earn more than 7000 PLN per month. Of the respondents, the majority have a middle school degree and among the academics most have a master's degree, more than half of the respondents are employed full-time. Overwhelmingly, there are no plans to sell the car or buy one within the near future. What was also interesting is that few of the respondents have made use of sharing offers so far. As far as the monthly travel costs are concerned, almost no information was given on this. Most of the respondents use the car, followed by other modes of transport for daily travel. Cost and convenience reasons are predominantly the reason for using the currently chosen mode of transport. Should policy instruments make it more difficult to use the car, in the form of increased cost or restriction of convenience, most would switch to other modes because of rising costs. The conjoint results indicate that through employer incentives, many would switch to car/taxi sharing and public transport, and in the case of car unavailability, to public transport and car/taxi sharing. In a further study, it could be investigated which forms of incentives, would be responsible for the switch to derive differentiated measures.

However, these results should be interpreted with caution, as many chose the no-choice option. This could lead to the question of whether a different conjoint method would not have led to more differentiated results. The choice of sharing methods could be interpreted as an indication that more needs to be done here by policymaker. Only these changes can lead to an increase in choice for this mode compared to the dominant private car. The analysis of the correlation between two variables showed that there are significant correlations between respectively income, monthly trip, car ownership, plans regarding a car purchase and car sale and benefits for a means of transport other than the preferred one, individual living situation and transport policy instruments. Again, cost followed by convenience aspects primarily play a role in this relationship. Thus, the respective income and cost and convenience reasons are the main factor for a change in transportation behavior there. Furthermore, the correlation between the respective living situation and the variables experienced feelings, density area, employment, income, car ownership and intentions to sell or buy the car was analyzed and a significant correlation was found, also between mental state and density area and intentions to buy or sell the car. The factor analysis of the psychological variables (attitudes, norms, feelings, car motives, car habits, risk-tendencies, personality, optimism/pessimism) was conducted with the purpose of extracting factors that have commonalities. No significant correlation was found for any of the extracted factors. The only "psychological variable" which could be used was the indicator "mental state/experienced feelings". All other psychological variables showed no significant effect on transport behavior. In this research design, the other "psychological variables" did not show any influence on choice behavior, which raises the question of whether a different method would have yielded the same results.

In the following course of this chapter, the hypotheses as presented in the introduction will be confirmed or rejected and discussed further. The reflection is followed by suggestions for employers and transport policy, which when implemented could help to drive the shift to environmentally friendly modes of transport in the interests of sustainability. In addition, other potential areas of research identified as part of this thesis are highlighted.

	Hypotheses	Results
H 1	Changes in life circumstances and job situation within the previous 24 months have a significant effect on transportation behavior	rejected
H 1a	Changes in life circumstances and job situation within the previous 24 months have a significant effect on transport mode choice if employers offer incentives to switch to environmentally friendly transport modes	rejected
H 1b	Changes in life circumstances and job situation within the previous 24 months have a significant effect on transport mode choice if no car is available to get home	rejected

Table 70 Hypotheses life circumstances and job situation and travel behavior

Source: own illustration

As seen in Table 70, the hypotheses could not be confirmed; no significant effect was found. Changed life circumstances, such as death in the family, relocation or also changed working conditions, which came within the last 24 months, have no influence on the choice of the means of transport. With regard to the significant effect that was not found, the author believes that the fundamental question of why no effect was found in this study should be investigated, since some researchers have already found an effect of relocation on travel behavior (Koopmans & Oosterhaven, 2011; Zarabi et al., 2019). It can be assumed that the habit of relying on previously used means of transport plays a role here, even if the personal and occupational situation changes.

	Hypotheses	Results
H 2	Emotions such as mental states/experienced feelings while traveling with the current mode of transportation have a significant effect on transport behavior.	confirmed
H 2a	Emotions such as mental state/experienced feelings while traveling with the current mode of transportation have a significant effect on transport mode choice if employers offer incentives to switch to environmentally friendly transport modes.	confirmed
H 2b	Emotions such as mental state and experienced feelings while traveling with current mode of transportation have a significant effect on transport mode choice if no car is available to get home.	confirmed

Table 71 Hypotheses mental states/experienced feelings and transport behavior

Source: own illustration

The above illustrated hypotheses (Table 71) are confirmed since a significant effect was demonstrated. As can be seen from the results, experienced feelings have an influence on the choice of the means of transport if the employer offers incentives to switch to environmentally friendly means of transport. It can be assumed that the employer's contribution to the travel costs, for example, has an influence on the feeling, such as in the form of relief, since the costs of travel no longer must be shouldered alone. As also confirmed, experienced feelings during travel have a significant effect on the choice of means of transportation when the own car is not available. The assumption suggests itself that in such a case the means of transport with which one associates the most pleasant feelings is then chosen. On the other hand, however, other feelings could also arise if there is a particularly high dependence on one's own car, which is then not available, such as fear or worry of not getting home as usual, such as fear of new or also bad experiences with other modes of transport. However, the hypothesis that feelings influence the choice of means of transport must be fundamentally questioned, since in the author's opinion the question would first have to be answered as to whether the feelings experienced are caused by the means of transport used or are attributable to other causes, be it one's life circumstances, one's personality structure or also other reasons such as the subjectively perceived threat posed by climate change. In addition, feelings change over time and, in the author's opinion, are only a snapshot in time.

	Hypotheses	Results
H 3	Drivers´ issues such as the possession of a driver’s license and car-sharing experience have a significant effect on transport behavior.	confirmed
H 3a	Having a driver´s license has a significant effect on transport mode choice if employers offer incentives to switch to environmentally friendly transport modes.	confirmed
H 3b	Having a driver’s license has a significant effect on transport mode choice if no car is available to get home.	confirmed
H 3c	Carsharing experience has a significant effect on transport mode choice if employers offer incentives to switch to environmentally friendly transport modes.	confirmed
H3d	Carsharing experience has a significant effect on the transport mode choice if no car is available to get home.	confirmed

Table 72 Hypotheses drivers’ issues and transport behavior

Source: own illustration

As seen in Table 72, the above hypotheses are confirmed as a significant effect could be seen for the possession of a driver’s license on employers’ incentives on transport mode choice and the non-availability of the car to get home. The frequency Table 24 and Table 25 show that most of the respondents with a driver's license would primarily choose car/taxi sharing and those without a driver's license would primarily choose public transportation in both cases. It is concluded that the respondents would find it easier to make the switch to similar transport modes (in case of car self-driven to car/taxi sharing). As far as the carsharing experience is concerned, a significant correlation was also seen here with incentives from employers as well as the unavailability of the car. In the case of employer incentives, most respondents would opt for car/taxi sharing, regardless of experience. It can be assumed that cost-sharing by the employer of the travel costs offers the greatest incentive. In case of unavailability of the car, most respondents with car sharing experience would switch to car/taxi sharing and those without to public transport. This may be because in such a case, people prefer to switch to means of transport with which they feel more familiar.

	Hypotheses	Results
H 4	Gender has a significant effect on transport behavior.	confirmed
H 4a	Gender has a significant effect on transport mode choice if employers offer incentives to switch to environmentally friendly transport modes.	confirmed
H 4b	Gender has a significant effect on transport mode choice if no car is available to get home.	confirmed

Table 73 Hypotheses gender and transport behavior

Source: own illustration

Table 73 shows that these hypotheses were confirmed, as gender has a significant effect on travel behavior, in case of incentives by the employer or even if the own car is not available. In both cases, the first choice for females would be public transport and for male’s car/taxi sharing. Thus, one could assume that females see the cost aspect or also safety aspects (they do not know the people who ride with them in the car) as the reason for choosing public transport as the first choice.

As seen in Table 74, the hypotheses that transportation policy instruments have a significant effect on the choice of transportation in the case of employer incentives and the unavailability of the car were confirmed. Thus, respondents would switch to other means of transportation in the face of rising costs in terms of gasoline and parking and cuts in convenience in terms of fewer parking spaces. In the author's opinion, the logical consequence is that if a car is unavailable, respondents would generally switch to other means of transportation if there were no possibility of being picked up by another person. Therefore, if the possibility of being picked up were to be excluded, virtually every transport policy instrument would have an effect, since mobility must be guaranteed today.

	Hypotheses	Results
H 5	Transport policy instruments have a significant effect on transport behavior.	confirmed
H 5a	Transport policy instruments have a significant effect on transport behavior if employers offer incentives to switch to environmentally friendly transport modes.	confirmed
H 5b	Transport policy instruments have a significant effect on transport behavior if no car is available to get home.	confirmed

Table 74 Hypotheses transport policy instruments and transport behavior

Source: own illustration

As can be seen from Table 75, employer incentives in the sense of a contribution to travel costs or even the provision of an environmentally friendly means of transport influence travel behavior. If there is no car available, there is no other option than to use other means of transport to get home, unless it is possible to cover the distance on foot. Possession of a driver's license has shown a significant effect on transportation behavior. According to the author, the barrier to switching to other modes of transportation is greater if one possesses a driver's license and a car is available.

	Hypotheses	Results
H 6	Employers´ incentives have a significant effect on actual transport behavior.	confirmed
H 7	The non-availability of the car to get home has a significant effect on actual transport behavior.	confirmed
H 8	Having a driver’s license has a significant effect on actual transport behavior.	confirmed

Table 75 Hypotheses of the two hypothetical situations, gender, and transport behavior

Source: own illustration

In the further course, reflections on the significant results obtained are made and further fields of research from the author's point of view are pointed out. It is started with the results that mental states or experienced feelings during travel influence transportation behavior.

According to the view of the author, the findings that mental states/experienced feelings have a significant effect on travel behavior should be seen as an opportunity for transport policy makers to develop tools aimed at creating positive feelings during travel. This is explained using the example of the mental state "flow" as follows: flow is a feeling of well-being and describes a state in which time is forgotten (Csikszentmihalyi, 2014). If transport policy instruments were aimed at making travel as pleasant as possible, so that transportation mode user experiences a feeling of well-being and flow, this would be the first step towards switching to transport-friendly modes. This is also justified by the results, as the respondents chose time, cost, and convenience reasons as the most important reasons why they do not use the preferred mode of transport. The argumentation would be as follows: if environmentally friendly modes of transport are designed so attractively that a flow feeling is created, the time factor no longer plays a role, because time is perceived and evaluated differently in flow than when one is stuck in a traffic jam by car. The cost reasons could be countered by appropriate public advertising measures that the threat of climate change is associated with negatively experienced feelings and, in the long run, with much higher costs for the individual. Therefore, it would be advantageous if politicians and employers jointly search for solutions as to how environmentally friendly means of transport must be designed to create a positive feeling, flow, and well-being, since, according to the author, the emotional state on the way to and from work has an important influence on the mental state at the workplace. This would again be a possible research question to investigate.

Concerning the significant effect of car-sharing experience and driving license ownership on traffic behavior, it would be worth considering what incentives could be created politically and on the part of employers to ensure that people not only use their own car as their sole means of transport but also make it available to the general public, e.g., in the context of car-sharing, to protect the environment. To make individual driving less attractive, a transport policy measure would be, for example, regular checks of driving ability (like the TÜV in Germany) for driving license holders. If drivers switch to carsharing, these costs could be covered by the government. Employers also could pay a share of the carsharing costs, provide suitable parking spaces, and both sides could reduce the supply of parking spaces for single drivers, aiming for a win-win effect.

Transport policy instruments such as increasing parking fees, reducing parking capacities or even higher gasoline prices could create the basis for employers to be more committed to offering incentives such as contributing to travel costs or even providing a bicycle or creating park-and-ride parking spaces on their company premises. Regarding punishments in the form of higher costs for gasoline and parking, the author believes that it would be more appropriate to regularly check the driver's license fitness and offer regular traffic training courses mandatory, which must be paid for by drivers, as this would also contribute to increased safety on the road. This punitive measure would turn into an incentive if the training were paid for by the employer when the employee switches to other modes of transport than using his or her own car. In summary, policymakers could work with employers to develop tools that are not just punitive measures on the part of policymakers, but also incentive measures on the part of employers. However, it would have to be considered that simultaneous incentives on the part of the employer and the part of the transport policy could mutually cancel out the respective measures, so that the measures would not be of any use.

Regarding the obtained results, further fields of research could be identified. For the measurement and analysis of feelings during travel, instead of Csikszentmihalyi´s (2014) eight mental states used by Te Brömmelstroet et al. (2021), Sierpinski's (2016) developed HWB index for measuring well-being could be considered. Another possibility would also be to record experienced feelings during travel not only at a single time as conducted here but in the form of a diary since feelings change during the day (Csikszentmihalyi, 2014). For example, Csikszentmihalyi and Larson (Csikszentmihalyi, 2014; Larson & Csikszentmihaly, 1983) conducted a survey using the Experience Sampling Method (Larson & Csikszentmihaly, 1983) proofing this method as useful. Since a significant correlation was found between the feelings and employer incentives, as well as the unavailability of the car, a further study could find out how the feelings change over time due to the incentives or also how longer unavailability of the own car and consequently, the use of other modes of transport affects the feelings during travel.

To counter convenience reasons for switching to other means of transport, transport policies and employer's approach could be focused on social values and responsibility towards the environment, which could be another research opportunity. The results obtained would help those in charge to design their means of transport and create values that generate positive feelings such as flow, well-being, and pride that by changing behavior a contribution is made to save the environment.

The remainder of this concluding chapter summarizes and reflects the approach chosen. As mentioned, the first chapter focused on the challenges of modern cities. Not only bad air but also noise is a burden for people and the environment. Different efforts on the part of politics were presented on how to achieve sustainability, however, this has to be done not only on a national level, but also on an international level in order to stop climate change. Existing environmentally friendly transport concepts should be used to a greater extent and the acceptance of new innovative solutions should be promoted to facilitate the switch. To this end, society must be more closely involved. From the theoretical part of the chapter, many models try to explain behavior. From the author's point of view, the choice of the EBM model was suitable for the research question, since it considers individual, situational, and environmental aspects, and at the same time depicts the process of information processing. An important contribution to human behavior are the different psychological theories, including the flow concept, which was treated in depth. From today's point of view, the author would no longer categorize the eight mental states into pleasant feelings, and unpleasant feelings, but rather analyze each state in terms of choice behavior. Regarding the choice-based conjoint analysis, the question would be whether another form of conjoint analysis would have been more appropriate to limit the multitude of no-choice options. Regarding the Estimation Techniques, the question would be whether a different approach would have led to different results since no other psychological variables were used except for the mental states /experienced feelings variables.

In closing, the question could be posed to policy makers, society per se, each individual, and researchers, how sustainable mobility can be implemented and linked to well-being, how old habits can be broken, by raising awareness regarding experienced feelings when traveling, i.e., how can sustainable mobility be ensured, considering time, cost, comfort, and emotional aspects?

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ABC of psychology	A = antecedent conditions that precede the behavior, B=behavioral response, C = consequences that follow
ACA	Adaptive Conjoint Analysis
ACBC	Adaptive Choice-Based Conjoint Analysis
ACEA	EuropeanAutomobile Manufacturers´Association
AFV	Alternative fueled vehicles
ANOVA	Analysis of Variances
AT	Autonomous taxi
AV	Autonomous vehicles
BCA	Bridging Conjoint Analysis
BEV	Battery electric vehicles
BFI	Big Five Inventory
BFI-10	Big Five Inventory-10 items
BMVI	Bundesministerium für Verkehr und digitale Infrastruktur
BMW (BMW 2019)	Bayerische Motorenwerke
BMWi	Bundesministerium für Wirtschaft und Technologie
BMZ	Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung
BYO	Build your own section
CAST	City Automated Transport System
CAPI	Computer Assistant Personal Interviewing
CATI	Computer Assistant Telephone Interviewing
CAWI	Computer Assistant Web Interviewing
CBCA	Choice-Based Conjoint Analysis
CB-SEM	covariance-based SEM

CEP	Polish: Centraina Ewidencja Pojazdow (English: Courier, Express and Parcel)
CH_4	Methane
CM	Conjoint Measurement
CNG	Compressed natural gas
CNS	Central Nervous System
CO_2	Carbon dioxide
CORDIS	Community Research and Development Information Service
COVID-19	Coronavirus disease 2019
CPT	Cumulative Prospect Theory
dB	decibels
DC	Discrete Choice
DCE	Discrete Choice Experiments
Destatis	Deutsches Statistik-Informationssystem
DP	Digital Piracy
DPM	Dirichlet Process Mixture
DPP	Dirichlet Process Prior
e.g.	Exempli gratia
e-bike	Electric bicycle
EBM	Engel-Blackwell-Miniard model
EC	European Commission
EEA	European Environment Agency
EFA	Exploratory Factor Analysis
EKB	Engel/Kollat/Blackwell model
EPOMM	European Platform on Mobility Management
ESM	Experience Sampling Method
EU	Coronavirus Disease 2019
EU	Expected Utility
Eurostat	Statistical Office of the European Communities
EV	Electric Vehicles

FCV	Fuel cell vehicles
GEV	Generalized Extreme Value
GSCA	Generalized Structured Component Analysis
GTAI	Germany Trade and Invest
GUS	Główny Urząd Statystyczny/ CSO Central Statistical Office (English)
H2	Hydrogen
HB	Hierarchical Bayesian
HCM	Hybrid Conjoint Measurement
HIT-CBC	Hybrid Individualized Two-level Choice-Based Conjoint
HPA	hypothalamic-pituitary-adrenal
HWB	Hybrid well-being (index)
IAO	Fraunhofer Institut für Arbeitswirtschaft und Organisation
IDT	Innovation Diffusion Theory
IT	Information Technology
KGP	Komenda Główna Policji (Police Headquarter)
kWh	Kilowatt hours
LCA	Limit Conjoint Analysis
LCM	Latent Class Model
LNG	Liquified natural gas
MaaS	Mobility as a Service
MNL	Multinomial Logistic model
MNP	Multinomial Probit
M-S-R	Model of reality (Stimulus-Response)
NAM	Norm Activation Model
NAM	Norm Activation Model
NEO	Neuroticism-Extraversion-Openness
NEO-FFI	Neuroticism-Extraversion-Openness-Five Factor Inventory

NEO-PI-R	Neuroticism-Extraversion-Openness Personality Inventory-Revised
NEP	New Ecological Paradigm
NEPA	National Environmental Policy Act
NEUSREL	nonlinear universal structural relational modeling
NH3	Ammonia
NHTSA	National Highway Traffic Safety Administration
NLE	number-of-levels effect
NMVOC2	Non-methane volatile organic compounds
Nox	Nitrogen oxides
OECD	Organisation for Economic Co-operation and Development
P2P	Peer-to-peer (carsharing)
PAG	periaqueductal grey
PBC	Perceived Behavioral Control
PHEV	Plug-in hybrid electric vehicles
PLS	partial least square
PLS-SEM	Partial Least Square Structural Equation Modeling
PM (Air quality value next to ozone…	particulate matter
PN	Personal Norms
PT	Prospect Theory
PT	Public Transport, Public Transportation
PZPM	Polski Zwiazek Przemyslu (Check Polish)
RDU	Rank-Dependent Utility
RP	Revealed Preferences
RPS	Risk Propensity Scale
RUT	Random Utility Theory
SAE	Society of Automotive Engineers
SDGs	Sustainable Development Goals
SDPB	Self-driving public buses

SPAD	Signal passed at danger
SE	self-explicated preference measurement phases
SEM	Structural Equation Modeling
SEU	Subjective Expected Utility
SmartPLS V.3	Smart Part Least Square Version 3
SN	Subjective Norm
SNS	Sympathetic Nervous System
SO_2	Sulphur dioxide
SoE	State of Environment (Report)
SOP	Scale Optimism-Pessimism
SP	Stated Preferences
SPAD	Signal passed at danger
S-R	Stimulus-Response
SUMP	Sustainable Urban Mobility Plan
TAM	Technology Acceptance Model
TCA	Traditional Conjoint Analysis
TENT-T	Trans-European Transport Network
TIB	Theory of Interpersonal Behavior
TPB	Theory of Planned Behavior
TRA	Theory of Reasoned Action
TÜV	Technischer Überwachungs Verein
UN	United Nations
UN	United Nations
UTAUT	Unified Theory of Acceptance and Use of Technology
UTK	Urząd Transportu Kolejowego (Office of Rail Transport)
VAM	Value Added Model
VBN	Value Belief Norm Theory
VDA	Verband deutscher Automobilhersteller
VDV	Verband Deutscher Verkehrsunternehmen
WHO	World Health Organization.

WTP	Willingness-to-Pay

APPENDIX QUESTIONNAIRE ENGLISH

Przyzwyczajenia i zwyczaje transportowe mieszkańców Polski

Breaking Rules of Travel Behavior - Survey

Welcome to our Survey!

Thank you very much for taking the time to participate in our survey. With this survey we try to find out what has to be done also from the government side, so that people can travel in an environmentally friendly way in the future, without completely giving up convenience - taking into account the respective personal wishes and needs.

We therefore kindly ask you to answer all the following questions completely and as best as you can. The survey will take no longer than 15 minutes.

Warm regards

Your Survey team

There are 37 questions in this survey.

Please select your age group *

Choose one of the following answers
Please choose **only one** of the following:

- younger than 18 years
- 18 - 30 years
- 31 - 50 years
- 51 - 65 years
- older than 65 years

Please select your gender *

Choose one of the following answers
Please choose **only one** of the following:

- female
- male
- other

Marital Status *

Choose one of the following answers
Please choose **only one** of the following:

- married
- not married
- divorced
- widowed
- other

How many people live in your household including yourself ? (Please type in the number) *

Your answer must be at most 10
Only an integer value may be entered in this field.
Please write your answer here:

How many people in your household including yourself are 18 years or older? (Please type in the number) *

Only answer this question if the following conditions are met:
Answer was greater than '0' at question '4 [NOHOUSEHOLD]' (How many people live in your household including yourself ? (Please type in the number))

Your answer must be between 0 and 10
Only an integer value may be entered in this field.
Please write your answer here:

This question is about your living situation:
In what type of home do you live? *

Choose one of the following answers
Please choose **only one** of the following:

- own house
- rented house
- own apartment
- rented apartment
- other/no comment

Where do you live? *

❶ Choose one of the following answers
Please choose **only one** of the following:

- ◯ town (below 5000 inhabitants)
- ◯ town (below 100.000 inhabitants)
- ◯ town (100.000 - 250.000 inhabitants)
- ◯ town (250.000 - 500.000 inhabitants)
- ◯ city (above 500.000 inhabitants)
- ◯ other/no comment

Please choose your highest school leaving certificate *

❶ Choose one of the following answers
Please choose **only one** of the following:

- ◯ Primary School
- ◯ Middle School
- ◯ Gymnasium
- ◯ Bachelor
- ◯ Master
- ◯ PhD
- ◯ other

Employment/Educational Status *

❶ Choose one of the following answers
Please choose **only one** of the following:

- ◯ Yes, full time (including self-employment)
- ◯ Yes, part time
- ◯ I still go to school
- ◯ Student
- ◯ Working Student
- ◯ Retired
- ◯ other

What is the average income per month in your household?
(monthly net income after deduction of mortgage loan, alimony e.g.)

❶ Choose one of the following answers
Please choose **only one** of the following:

- ◯ < 1000 Złoty
- ◯ 1000 - 2999 Złoty
- ◯ 3000 - 4999 Złoty
- ◯ 5000 - 7000 Złoty
- ◯ > 7000 Złoty
- ◯ other

Within the previous 24 months:

❶ Check all that apply
Please choose **all** that apply:

- ☐ I got married
- ☐ I got divorced
- ☐ I had a childbirth in my household
- ☐ I had a deathcase in my household
- ☐ I moved to a more urbanized area
- ☐ I moved to a less urbanized area
- ☐ I started working in a new place
- ☐ I stopped working (eg. retirement)
- ☐ I got promoted
- ☐ none of them/no comment

This question concerns your attitude towards environmentally friendly modes of transport *

Please choose the appropriate response for each item:

	I strongly agree	I agree	I neither agree nor disagree	I disagree	I strongly disagree
Environmental friendly transport modes reduces air pollution	◯	◯	◯	◯	◯
Commuting by environmental friendly transport modes can meet our travel demands	◯	◯	◯	◯	◯
It is the moral obligation to everyone to reduce car travel	◯	◯	◯	◯	◯
If I wanted to, I could always switch to public transport or other enviromentally friendly means of transport	◯	◯	◯	◯	◯

The following questions are about the expectations of those close to you (family, friends, colleagues, or key opinion leaders) about your daily travel behavior *

Please choose the appropriate response for each item:

	Never	Rarely	Sometimes	Often	Always
People who are important to me usually support my use of environmental friendly transport modes	◯	◯	◯	◯	◯
People who are important to me expect me to use environmental friendly transport modes to meet my travel needs	◯	◯	◯	◯	◯

The following questions are about your feelings concerning traffic and its environmental impact *

Please choose the appropriate response for each item:

	I strongly agree	I agree	I neither agree nor disagree	I disagree	I strongly disagree
I feel affected by the noise generated by car traffic	◯	◯	◯	◯	◯
I am concerned about the environmental impact of car and freight traffic	◯	◯	◯	◯	◯

Which of the feelings listed below are most likely apply to you when you travel by your main mode of transportation? *

❶ Check all that apply

❶ Please select from 1 to 3 answers.

Please choose **all** that apply:

☐ Anxiety
☐ Worry
☐ Apathy
☐ Boredom
☐ Relaxation
☐ Control
☐ Flow
☐ Arousal
☐ I don´t know/no comment

Do you have a driver´s license? *

Please choose **only one** of the following:

◯ Yes
◯ No

Do you own a car? *

Please choose **only one** of the following:

◯ Yes
◯ No

How many cars are in your household? Please enter the number of cars in your household *

Only an integer value may be entered in this field.

Please write your answer here:

Does your household possess a hybrid or electric car?

Please choose **only one** of the following:

- Yes
- No

This question is about finding out about your attitude towards cars *

Please choose the appropriate response for each item:

	I strongly agree	I agree	I neither agree nor disagree	I disagree	I strongly disagree
For me, the car has instrumental functions only					
It does not matter to me which type of car I drive					
I only have a car to travel from A to B					
A car provides me status and prestige					
My car shows who and what I am					
I maybe jealous of someone with a nice car					
I love driving					
I feel free and independent if I drive					
I know of a dream car that I would love to possess					
I like to drive just for the fun					

Using my car is something....

(only to be completed, if you are a car owner)

Please choose the appropriate response for each item:

	I strongly agree	I agree	I neither agree nor disagree	I disagree	I strongly disagree
I do frequently					
I do automatically					
I do without having to consciously remember					
that makes me feel weird if do not not do it					
I do without thinking					
that would require effort not to do it					
that belongs to my (daily, weekly, monthly) routine					
I start doing before I realize I´m doing it					
I would find hard not to do					
I have no need to think about doing					
that´s typically "me"					
I have been doing for a long time					

This question is about how far the nearest public transport is from your home.

What is the distance to your next public transport stop (e.g. train, metro, tram, bus)? *

Choose one of the following answers

Please choose **only one** of the following:

- less than 400 meters
- more than 400 meters

How many kilometers (estimated) do you travel a typical study/work day?
Please estimate the number of kilometers, fields that do not apply remain empty *

Only numbers may be entered in this field.
Please write your answer here:

The following question is about your daily travel time using your primary mode of transportation.
On a typical study/work day, how long do you travel using your primary mode of transportation?
Please select only the mode of transportation you normally use.

Please choose the appropriate response for each item:

	0 to 15 minutes	more than 15 minutes but less than 30 minutes	more than 30 minutes but less than 60 minutes	more than 60 minutes but less than 120 minutes	more than 120 minutes
Car (self-driven)	○	○	○	○	○
Car (as passenger)	○	○	○	○	○
Car Sharing	○	○	○	○	○
Taxi/Taxi Sharing	○	○	○	○	○
Bus/Tram/Metro	○	○	○	○	○
Railway	○	○	○	○	○
Cycling	○	○	○	○	○
Walking	○	○	○	○	○
Other (e.g. Scooter)	○	○	○	○	○

This section is about your plans of buying or selling a car *

Please choose the appropriate response for each item:

	Yes	Uncertain	No
In the next 12 months: Are you planning to buy a car?	○	○	○
In the next 12 months: Are you planning to sell your car?	○	○	○

Have you ever taken part in car/taxi sharing (e.g. Panek, Traficar, 4mobility, Uber, Lyft, Bolt)? *

Please choose **only one** of the following:

- ○ Yes
- ○ No

Have you ever taken part in Bike Sharing (municipal bike system, e.g. Nextbike Polska, Jakub Giza) ? *

Please choose **only one** of the following:

- ○ Yes
- ○ No

Please estimate how much money you spend on average EACH MONTH on transportation (e.g. leasing, expenses for fuel, insurance, tax, maintenance, repairs and replacements, loss of value, parking costs)

Choose one of the following answers
Please choose **only one** of the following:

- ○ < 300 Złotych
- ○ 300 - 600 Złotych
- ○ 601 - 1000 Złotych
- ○ 1001 - 1500 Złotych
- ○ 1501 - 2000 Złotych
- ○ I don´t know/no comment

If your *preferred* travel mode is car driving but your *current* travel mode is Public Transportation, what are the reasons? Please select up to 3 most important ones, or leave this page empty

Check all that apply
Please select at most 3 answers
Please choose **all** that apply:

- [ ] Time
- [ ] Costs
- [ ] Convenience
- [ ] Directness
- [ ] Punctuality
- [ ] Emotional Aspects (Joy, Status, Independency, Freedom)
- [ ] Environment
- [ ] Parking
- [ ] Lack of other possibilities

If your *preferred* travel mode is Public Transportation but your *current* travel mode is car driving, what are the reasons? Please select the 3 most important ones. Please select up to 3 most important ones, or leave this page empty

Check all that apply
Please select at most 3 answers
Please choose **all** that apply:

- [ ] Time
- [ ] Costs
- [ ] Convenience
- [ ] Directness
- [ ] Punctuality
- [ ] Emotional Aspects (Joy, Status, Independency, Freedom)
- [ ] Environment
- [ ] Parking
- [ ] Lack of other possibilities

If you are a car driver:

Under which conditions would you switch to environmental friendly means of transportation? Please select at most 3 answers.

(If this question does not concern you, please leave this page empty)

Please select at most 3 answers
Please choose **all** that apply:

- [ ] Increase gasoline price
- [ ] Less parking space
- [ ] Increased parking fee
- [ ] Speed limit of 30 km/h in inner cities
- [ ] Free public transportation
- [ ] Increase in frequency of public transportation
- [ ] Strengthening of safety through escorts / video surveillance
- [ ] Expansion of park and ride/bike and ride
- [ ] Increase of flexible sharing services
- [ ] Integrated public transport system: uniform ticketing and passenger information system, timetable coordination

Please imagine the following situation: You are in town (e.g., doctor's appointment, shopping, meeting with friends, etc.) under normal weather conditions. Your car (if you own one) is not available to take you home.

Which of the following would be most convenient for you?

Please select the option that most appeals to you, if none of the options appeal or apply to you, please select "none of them/other" *

❶ Please select one answer

Please choose the appropriate response for each item:

	Option 1: Car (as a Passenger)	Option 2: Car/Taxi Sharing	Option 3: Public Transport (Bus, Tram, Metro, Train)	Option 4: Cycling/E-Scooter (Sharing), Walking	Option 5: Combination of different transport modes (Car / Taxi (sharing), Bus, Tram, Metro, Train, Cycling, Walking, E-Scooter)	none of them/other
	Your access/waiting time is 15 - 20 minutes	Your access/ waiting time (sharing point) is 5 - 10 minutes	Your access/waiting time (at the station) is 5 - 10 minutes	Your access/ waiting time (in case of sharing) is 5 - 10 minutes	Your access/waiting time (to the nearest sharing point/station) is 5 - 10 minutes	
	Your travel time is 25-30 minutes	Your travel time is 30 - 35 minutes	Your travel time is 30 - 35 minutes	Your travel time is 35 - 40 minutes	Your travel time is 30 - 35 minutes	
	Your walking distance to your home is less than 50 meters	Your walking distance from drop off to your home is less than 200 meters	Your walking distance from station to your house is less than 400 meters	Your walking distance to your home is 5 meters	Your walking distance to your home is 5 - 10 meters	
	You are travelling with a maximum of 2 passengers	You are travelling with less than 3 passengers	You are travelling with more than 2 passengers	You are travelling alone	The number of passengers travelling with you depends on your choice of transport	
	You pay 20 % more than with your current travel mode	You pay 30 % less than with your current transport mode	You pay 50 % less than with your current travel mode	You pay less than 95% with your current travel cost	You pay 25% less than with your current transport mode	
My choice:	○	○	○	○	○	○

Imagine you are employed or self-employed. Your employer/client offers you different options if you use other means of transportation than your own car.

Please select the option you would choose. If none of the options suit you or apply to you, please select "no option/other". *

Please choose the appropriate response for each item:

	Option 1: Car (as a Passenger)	Option 2: Car/Taxi Sharing	Option 3: Public Transport (Bus, Tram, Metro, Train)	Option 4: Cycling/E-Scooter (Sharing), Walking	Option 5: Combination of different transport modes (Car/Taxi (sharing), Bus, Tram, Metro, Train, Cycling, Walking, E-Scooter)	none of them/other
	Your access/waiting time is 15 - 20 minutes	Your access / waiting time (sharing point) is 5 - 10 minutes	Your access/waiting time (at the station) is 5 - 10 minutes	Your access/ waiting time (in case of sharing) is 5 - 10 minutes	Your access/waiting time (to the nearest sharing point/station) is 5 - 10 minutes	
	Your travel time is 25-30 minutes	Your travel time is 30 - 35 minutes	Your travel time is 30 - 35 minutes	Your travel time is 35 - 40 minutes	Your travel time is 30 - 35 minutes	
	Your walking distance to your workplace is less than 50 meters	Your walking distance to your work place is less than 200 meters	Your walking distance from station to your house is less than 400 meters	Your walking distance to your workplace is 5 meters	Your walking distance to your workplace is 5 - 10 meters	
	You are travelling with a maximum of 2 passengers	You are travelling with less than 4 passengers	You are travelling with more than 2 passengers	You are travelling alone	The number of passengers travelling with you depends on your choice of transport	
	Your employer/client pays 20% of the transportation costs	Your employer / client pays 30% of the transportation costs	You pay 50 % less than with your current travel mode	Your employer/client rewards you with a new E-Bike or E-Scooter	Your employer/client pays 50% of the transportation costs and rewards you with a conventional Bike or Scooter	
My choice:	○	○	○	○	○	○

How well do the following statements describe your personality?
I see myself as someone who.... *
Please choose the appropriate response for each item:

	I strongly agree	I agree	I neither agree nor disagree	I disagree	I strongly disagree
... is reserved	○	○	○	○	○
... is generally trusting	○	○	○	○	○
... tends to be lazy	○	○	○	○	○
... is relaxed, handles stress well	○	○	○	○	○
... has few artistic interests	○	○	○	○	○
... is outgoing, sociable	○	○	○	○	○
... tends to find fault with others	○	○	○	○	○
... does a thorough job	○	○	○	○	○
... gets nervous easily	○	○	○	○	○
... has an active imagination	○	○	○	○	○

How well do the following statements describe your risk-taking tendencies?

*

Please choose the appropriate response for each item:

	I strongly agree	I agree	I neither agree nor disagree	I disagree	I strongly disagree
I really dislike not knowing what is going to happen	○	○	○	○	○
I usually view risks as a challenge	○	○	○	○	○
I view myself as a risk avoider	○	○	○	○	○
I view myself as a risk seeker	○	○	○	○	○

This question deals with optimism.
Optimists are people who look to the future with confidence and who mostly expect good things to happen. How would you describe yourself? *
Please choose the appropriate response for each item:

	1 not at all optimistic	2	3	4 neutral	5	6	7 very optimistic
How optimistic are you in general?	○	○	○	○	○	○	○

This question is about pessimism.
Pessimists are people who are full of doubt when they look to the future and who mostly expect bad things to happen. *
Please choose the appropriate response for each item:

	1 not at all pessimistic	2	3	4 neutral	5	6	7 very pessimistic
How pessimistic are you in general?	○	○	○	○	○	○	○

Many thanks for your participation we hope that you enjoyed it.

You are very welcome to share your suggestions and questions with us at the given email address "Transportation2021@online.de".

APPENDIX QUESTIONNAIRE POLISH

Przyzwyczajenia i zwyczaje transportowe mieszkańców Polski

Szanowni Państwo,

Bardzo dziękuję za poświęcenie czasu na wzięcie udziału w ankiecie. Staram się dzięki niej dowiedzieć, co należy robić, aby w przyszłości ludzie mogli podróżować w sposób przyjazny dla środowiska, bez całkowitej rezygnacji z wygody - uwzględniając przy tym indywidualne życzenia i potrzeby.

Dlatego też proszę o udzielenie wyczerpujących i możliwie jak najlepszych odpowiedzi na wszystkie poniższe pytania. Ankieta potrwa nie dłużej niż 15 minut.

Dziękuję bardzo!

W tej ankiecie jest 37 pytań.

Proszę wskazać swoją grupę wiekową *

Proszę wybrać jedną z następujących odpowiedzi
Proszę wybrać jedną odpowiedź z poniższych:

- poniżej 18 roku życia
- 18 - 30 lat
- 31 - 50 lat
- 51 - 65 lat
- w wieku powyżej 65 lat

Proszę wskazać swoją płeć *

Proszę wybrać jedną z następujących odpowiedzi
Proszę wybrać jedną odpowiedź z poniższych:

- kobieta
- mężczyzna
- inne

Stan cywilny *

Proszę wybrać jedną z następujących odpowiedzi
Proszę wybrać jedną odpowiedź z poniższych:

- zamężna/żonaty
- stanu wolnego
- rozwiedziony/rozwiedziona
- wdowiec/wdowa
- inne

Ile osób mieszka w Pana(i) gospodarstwie domowym łącznie z Panem(ią)? (Proszę wpisać liczbę) *

Odpowiedź musi wynieść co najwyżej 10
Do tego pola można wprowadzić tylko liczbę całkowitą.
Proszę wpisać odpowiedź tutaj:

Ile osób łącznie z Panem/Panią ma 18 lat lub więcej w Pana/Pani gospodarstwie domowym? (Proszę wpisać liczbę) *

Pozwól na udzielanie odpowiedzi, gdy spełnione są warunki:
Odpowiedź była większa niż '0' w pytaniu '4 [NOHOUSEHOLD]' (Ile osób mieszka w Pana(i) gospodarstwie domowym łącznie z Panem(ią)? (Proszę wpisać liczbę))

Odpowiedź musi mieścić się między 0 a 10
Do tego pola można wprowadzić tylko liczbę całkowitą.
Proszę wpisać odpowiedź tutaj:

To pytanie dotyczy Twojej sytuacji życiowej: W jakiego typu domu Pan/Pani mieszka? *

Proszę wybrać jedną z następujących odpowiedzi
Proszę wybrać jedną odpowiedź z poniższych:

- własny dom
- wynajęty dom
- własne mieszkanie
- wynajęte mieszkanie
- inne

a

Gdzie Pani/Pan mieszka? *

❶ Proszę wybrać jedną z następujących odpowiedzi
Proszę wybrać jedną odpowiedź z poniższych:

- ◯ miasto/wieś (mniej niż 5000 mieszkańców)
- ◯ miasto (mniej niż 100.000 mieszkańców)
- ◯ miasto (100.000 - 250.000 mieszkańców)
- ◯ miasto (250.000 - 500.000 mieszkańców)
- ◯ miasto (ponad 500.000 mieszkańców)
- ◯ inne

Jaki jest Pani/a poziom wykształcenia? *

❶ Proszę wybrać jedną z następujących odpowiedzi
Proszę wybrać jedną odpowiedź z poniższych:

- ◯ Podstawowe
- ◯ Średnie
- ◯ Gimnazjum
- ◯ Wyższe licencjackie/inżynierskie
- ◯ Wyższe magisterskie
- ◯ Doktorat
- ◯ inne

Status zatrudnienia/wykształcenia. Czy jest Pan/i osobą pracującą? *

❶ Proszę wybrać jedną z następujących odpowiedzi
Proszę wybrać jedną odpowiedź z poniższych:

- ◯ Tak, w pełnym wymiarze godzin (w tym samozatrudnienie)
- ◯ Tak, w niepełnym wymiarze godzin
- ◯ Uczęszczam do szkoły
- ◯ Student
- ◯ Pracujący Student
- ◯ Emeryt
- ◯ inne

Jaki jest średni miesięczny dochód w Pana(i) gospodarstwie domowym? (miesięczny dochód netto po odliczeniu kredytu hipotecznego, np. alimentów)

❶ Proszę wybrać jedną z następujących odpowiedzi
Proszę wybrać jedną odpowiedź z poniższych:

- ◯ < 1000 Złotych
- ◯ 1000 - 2999 Złotych
- ◯ 3000 - 4999 Złotych
- ◯ 5000 - 7000 Złotych
- ◯ > 7000 Złotych
- ◯ inne

W ciągu ostatnich 24 miesięcy:

❶ Proszę zaznaczyć właściwe odpowiedzi
Proszę wybrać wszystkie, które pasują

- ☐ Wyszłam za mąż/Ożeniłem się
- ☐ Rozwiodłem/am się
- ☐ W moim gospodarstwie domowym urodziło się dziecko
- ☐ Ktoś w moim gospodarstwie domowym umarł
- ☐ Przeprowadziłem/am się do bardziej zurbanizowanego obszaru
- ☐ Przeprowadziłem/am się do mniej zurbanizowanego obszaru
- ☐ Zaczęłam/zacząłem pracować w nowym miejscu
- ☐ Przestałem/am pracować (np. emerytura)
- ☐ Dostałem/am awans
- ☐ Żadne z powyższych

To pytanie dotyczy Pani/a stosunku do przyjaznych dla środowiska środków transportu *

Proszę wybrać odpowiednią odpowiedź przy każdej pozycji:

	Zdecydowanie się zgadzam	Zgadzam się	Ani się zgadzam, ani nie zgadzam	Nie zgadzam się	Zdecydowanie się nie zgadzam
Uważam, że przyjazne dla środowiska środki transportu zmniejszają zanieczyszczenie powietrza	◯	◯	◯	◯	◯
Uważam, że dojazdy przyjaznymi dla środowiska środkami transportu mogą zaspokoić nasze codzienne zapotrzebowanie na podróże	◯	◯	◯	◯	◯
Moralnym obowiązkiem każdego człowieka jest ograniczenie podróży samochodem	◯	◯	◯	◯	◯
Gdybym chciał, zawsze mógłbym przesiąść się do transportu publicznego lub innych przyjaznych środowisku środków transportu	◯	◯	◯	◯	◯

Poniższe pytania dotyczą oczekiwań osób z najbliższego otoczenia (rodziny, przyjaciół, współpracowników lub kluczowych liderów opinii) wobec Pana(i) codziennych zachowań związanych z podróżowaniem *

Proszę wybrać odpowiednią odpowiedź przy każdej pozycji:

	Nigdy	Rzadko	Czasami	Często	Zawsze
Osoby, które są dla mnie ważne, zazwyczaj popierają korzystanie przeze mnie z przyjaznych dla środowiska środków transportu	◯	◯	◯	◯	◯
Ludzie, którzy są dla mnie ważni, oczekują, że będę korzystał z przyjaznych dla środowiska środków transportu, aby zaspokoić swoje potrzeby w zakresie podróży	◯	◯	◯	◯	◯

Poniższe pytania dotyczą Pani/a odczuć związanych z ruchem drogowym i jego wpływem na środowisko *

Proszę wybrać odpowiednią odpowiedź przy każdej pozycji:

	Zdecydowanie się zgadzam	Zgadzam się	Ani się zgadzam, ani nie zgadzam	Nie zgadzam się	Zdecydowanie się nie zgadzam
Czuję się dotknięty hałasem generowanym przez ruch samochodowy	◯	◯	◯	◯	◯
Niepokoi mnie wpływ ruchu samochodowego i towarowego na środowisko naturalne	◯	◯	◯	◯	◯

Które z poniższych uczuć najlepiej opisują Pana/Pani, gdy podróżuje Pan/Pani swoim głównym środkiem transportu? *

❶ Proszę zaznaczyć właściwe odpowiedzi
❶ Proszę wybrać od 1 do 3 odpowiedzi.
Proszę wybrać wszystkie, które pasują

- ☐ Lęk
- ☐ Zaniepokojenie
- ☐ Apatia
- ☐ Nuda
- ☐ Relaks
- ☐ Kontrola
- ☐ Zapomnienie o sobie/zaabsorbowanie czynnością/przepływem (Flow)
- ☐ Pobudzenie
- ☐ Nie wiem / bez komentarza

Czy ma Pan/i prawo jazdy? *

Proszę wybrać jedną odpowiedź z poniższych:

◯ Tak
◯ Nie

Czy posiada Pan/Pani samochód? *

Proszę wybrać jedną odpowiedź z poniższych:

◯ Tak
◯ Nie

Ile samochodów jest w Pana(i) gospodarstwie domowym? Proszę wpisać liczbę samochodów w Pana(i) gospodarstwie domowym *

Do tego pola można wprowadzić tylko liczbę całkowitą.
Proszę wpisać odpowiedź tutaj:

Czy Pana(i) gospodarstwo domowe posiada samochód hybrydowy lub elektryczny?
Proszę wybrać jedną odpowiedź z poniższych:

- Tak
- Nie

To pytanie ma na celu poznanie Pana/i stosunku do samochodów *
Proszę wybrać odpowiednią odpowiedź przy każdej pozycji:

	Zdecydowanie się zgadzam	Zgadzam się	Ani się zgadzam, ani nie zgadzam	Nie zgadzam się	Zdecydowanie się nie zgadzam
Samochód ma dla mnie wyłącznie funkcje instrumentalne					
Nie ma dla mnie znaczenia, jakim samochodem jeżdżę					
Wykorzystuję samochód tylko, aby podróżować z punktu A do punktu B					
Samochód zapewnia status i prestiż					
Mój samochód pokazuje kim jestem					
Czasami zazdroszczę komuś, kto ma ładny samochód					
Uwielbiam prowadzić					
Czuję się wolny i niezależny, gdy prowadzę samochód					
Znam samochód marzeń, który chciałbym posiadać					
Lubię jeździć tylko dla zabawy					

Używanie mojego samochodu jest czymś....
(tylko do wypełnienia, jeśli jest Pan/i właścicielem samochodu)
Proszę wybrać odpowiednią odpowiedź przy każdej pozycji:

	Zdecydowanie się zgadzam	Zgadzam się	Ani się zgadzam, ani nie zgadzam	Nie zgadzam się	Zdecydowanie się nie zgadzam
Robię to często					
Robię to automatycznie					
Robię to niemal podświadomie					
Czuję się dziwnie, jeśli tego nie robię					
Robię to bez zastanowienia					
Wymagałoby ode mnie dużo wysiłku, aby tego nie robić					
Należy to do mojej (codziennej, tygodniowej, miesięcznej) rutyny					
Zaczynam to robić, zanim się zorientuję, że to robię					
Trudno byłoby mi tego nie zrobić					
Nie muszę się nad tym zastanawiać					
To bardzo dobrze odzwierciedla „mnie”					
Robię to od dłuższego czasu					

To pytanie dotyczy tego, jak daleko od Państwa domu znajduje się najbliższy środek transportu publicznego.
Jaka jest odległość do najbliższego przystanku transportu publicznego (autobus, tramwaj, pociąg, metro, kolej)? *

❶ Proszę wybrać jedną z następujących odpowiedzi
Proszę wybrać jedną odpowiedź z poniższych:

◯ mniej niż 400 metrów
◯ ponad 400 metrów

Ile kilometrów (szacunkowo) pokonuje Pan/Pani w ciągu typowego dnia nauki/pracy? Proszę oszacować łączną liczbę kilometrów. *

❶ W tym polu można wpisać tylko liczby.
Proszę wpisać odpowiedź tutaj:

Poniższe pytanie dotyczy dziennego czasu podróży Pana(i) podstawowym środkiem transportu.
W typowym dniu nauki/pracy, jak długo podróżuje Pan(i) swoim podstawowym środkiem transportu?
Proszę wybrać tylko ten środek transportu, z którego zazwyczaj Pan/i korzysta.

Proszę wybrać odpowiednią odpowiedź przy każdej pozycji:

	od 0 do 15 minut	więcej niż 15 minut, ale mniej niż 30 minut	więcej niż 30 minut, ale mniej niż 60 minut	więcej niż 60 minut, ale mniej niż 120 minut	więcej niż 120 minut
Samochód (jako kierowca)	◯	◯	◯	◯	◯
Samochód (jako pasażer)	◯	◯	◯	◯	◯
Car Sharing	◯	◯	◯	◯	◯
Taxi/Taxi Sharing	◯	◯	◯	◯	◯
Autobus/Tramwaj/Metro	◯	◯	◯	◯	◯
Kolej	◯	◯	◯	◯	◯
Rower	◯	◯	◯	◯	◯
Pieszo	◯	◯	◯	◯	◯
Inne (np. skuter)	◯	◯	◯	◯	◯

(To pytanie jest wymagane)
Ta sekcja dotyczy Państwa planów kupna lub sprzedaży samochodu. *

Proszę wybrać odpowiednią odpowiedź przy każdej pozycji:

	Tak	Nie wiem	Nie
W ciągu najbliższych 12 miesięcy: Czy planuje Pan/Pani zakup samochodu?	◯	◯	◯
W ciągu najbliższych 12 miesięcy: Czy planuje Pan/Pani sprzedaż swojego samochodu?	◯	◯	◯

Czy kiedykolwiek korzystał Pan(i) z usług typu car/taxi sharing (e.g. Panek, Traficar, 4mobility, Uber, Lyft, Bolt)? *

Proszę wybrać jedną odpowiedź z poniższych:

◯ Tak
◯ Nie

Czy kiedykolwiek korzystał Pan(i) z usług typu bikesharing (system rowerów miejskich, np. Nextbike Polska, Jakub Giza)?

*

Proszę wybrać jedną odpowiedź z poniższych:

◯ Tak
◯ Nie

Proszę oszacować, ile pieniędzy wydaje Pan(i) średnio MIESIĘCZNIE na transport (np. wydatki na paliwo, ubezpieczenie, podatek, konserwację, naprawy i części zamienne, utrata wartości pojazdu, koszty parkowania).

Proszę wybrać jedną z następujących odpowiedzi
Proszę wybrać jedną odpowiedź z poniższych:

- ◯ < 300 Złotych
- ◯ 301 - 600 Złotych
- ◯ 601 - 1000 Złotych
- ◯ 1001 - 1500 Złotych
- ◯ 1501 - 2000 Złotych
- ◯ Nie wiem/brak komentarza

Jeśli preferowanym przez Pana/Panią sposobem podróżowania jest jazda samochodem, ale obecnie korzysta Pan/Pani z transportu publicznego, jakie są tego powody? Proszę wybrać maksymalnie 3 najważniejsze, lub pozostawić tę tabelę pustą.

Proszę zaznaczyć właściwe odpowiedzi
Proszę wybrać co najwyżej 3 odpowiedzi
Proszę wybrać wszystkie, które pasują

- ☐ Czas
- ☐ Koszty
- ☐ Wygoda
- ☐ Bezpośredniość
- ☐ Punktualność
- ☐ Aspekty Emocjonalne (Radość, Status, Niezależność, Wolność)
- ☐ Środowisko
- ☐ Parking
- ☐ Brak innych możliwości

Jeśli preferowanym przez Pana/Panią sposobem podróżowania jest transport publiczny, ale obecnym sposobem podróżowania jest prowadzenie samochodu, jakie są tego powody? Proszę wybrać do 3 najważniejszych lub pozostawić tę tabelę pustą.

Proszę zaznaczyć właściwe odpowiedzi
Proszę wybrać co najwyżej 3 odpowiedzi
Proszę wybrać wszystkie, które pasują

- ☐ Czas
- ☐ Koszty
- ☐ Wygoda
- ☐ Bezpośredniość
- ☐ Punktualność
- ☐ Aspekty Emocjonalne (Radość, Status, Niezależność, Wolność)
- ☐ Środowisko
- ☐ Parking
- ☐ Brak innych możliwości

Jeśli jest Pan/i kierowcą samochodu:
W jakich warunkach przesiadłby się Pan/Pani na przyjazny środowisku środek transportu? Proszę wybrać najwyżej 3 odpowiedzi.
(Jeśli to pytanie Pana/Pani nie dotyczy, proszę pozostawić tę stronę pustą)

Proszę wybrać co najwyżej 3 odpowiedzi
Proszę wybrać wszystkie, które pasują

- ☐ Podwyżka cen benzyny
- ☐ Mniej miejsc parkingowych
- ☐ Zwiększona opłata parkingowa
- ☐ Ograniczenie prędkości do 30 km/h w centrach miast
- ☐ Bezpłatny transport publiczny
- ☐ Zwiększenie częstotliwości korzystania z transportu publicznego
- ☐ Wzmocnienie bezpieczeństwa poprzez ochronę / nadzór wideo
- ☐ Rozbudowa systemu park and ride/rower and ride
- ☐ Rozwój elastycznych usług shared mobility
- ☐ Zintegrowany system transportu publicznego: jednolity system sprzedaży biletów i informacji pasażerskiej, koordynacja rozkładów jazdy

Wyobraź sobie, że jesteś zatrudniony lub pracujesz na własny rachunek. Twój pracodawca/klient oferuje Ci różne opcje, jeśli korzystasz z innych środków transportu niż własny samochód.
Proszę wybrać opcję, którą by Pan(i) wybrał(a). Jeśli żadna z opcji nie odpowiada Panu(i) lub nie ma do Pana(i) zastosowania, proszę wybrać "brak wyboru/inne". *

Proszę wybrać odpowiednią odpowiedź przy każdej pozycji:

	Opcja 1: Samochód (jako pasażer)	Opcja 2: Car / Taxi Sharing	Opcja 3: Transport publiczny (Autobus / Tramwaj / Metro / Kolej)	Opcja 4: Rower, Skuter, Pieszo	Opcja 5: Łączą Państwo różne środki transportu (Samochód / Taksówka (współdzielenie), Autobus, Tramwaj, Metro, Pociąg, Jazda na rowerze, Chodzenie Pieszo, E-Scooter)	brak wyboru/inne
	Czas oczekiwania wynosi 5 - 10 minut.	Twój czas oczekiwania (punkt udostępniania) wynosi 5 - 10 minut.	Czas oczekiwania (na stacji) wynosi 5 - 10 minut.	Twój czas oczekiwania (w przypadku współdzielenia) wynosi 5 - 10 minut.	Czas dojazdu / oczekiwania (na najbliższym punkcie / stacji) wynosi 5 - 10 minut.	
	Czas podróży wynosi 25-30 minut.	Czas podróży wynosi 30 - 35 minut.	Czas podróży wynosi 30 - 35 minut.	Czas podróży wynosi 35 - 40 minut.	Czas podróży wynosi 30 - 35 minut.	
	Odległość od ostatecznego miejsca parkowania do miejsca pracy jest mniejsza niż 50 metrów.	Odległość pieszo od miejsca opuszczenia pojazdu do miejsca pracy jest mniejsza niż 200 metrów.	Odległość piesza od stacji do miejsca pracy jest mniejsza niż 400 metrów.	Twoja odległość pieszo do miejsca pracy wynosi 5 metrów.	Twoja odległość do miejsca pracy wynosi 5 - 10 metrów pieszo.	
	Podróżujesz z maksymalnie 2 pasażerami.	Podróżujesz z mniej niż 4 pasażerami.	Podróżujesz z więcej niż 2 pasażerami.	Podróżujesz sam.	Liczba pasażerów podróżujących z Tobą zależy od wybranego przez Ciebie środka transportu.	
	Twój pracodawca / klient pokrywa 20% kosztów transportu.	Twój pracodawca / klient pokrywa 30% kosztów transportu.	Podróżujesz za darmo - Twój pracodawca / klient pokrywa koszty transportu.	Twój pracodawca / klient nagradza Cię nowym E-Bike'iem lub E-Scooterem.	Twój pracodawca / klient pokrywa 50% kosztów transportu i nagradza Cię konwencjonalnym rowerem lub skuterem.	
mój wybór:	○	○	○	○	○	○

Proszę wyobrazić sobie następującą sytuację: Jesteście Państwo w mieście (np. wizyta u lekarza, zakupy, spotkanie z przyjaciółmi, itp.) w normalnych warunkach pogodowych. Państwa samochód (jeśli go Państwo posiadają) nie jest dostępny aby zabrać Państwa do domu.

Które z poniższych rozwiązań byłoby dla Pani/Pana najwygodniejsze?

Proszę wybrać opcję, która najbardziej odpowiada Pani/Panu. Jeśli żadna z opcji nie odpowiada Pani/Panu lub nie ma zastosowania, proszę wybrać "brak wyboru/inne". *

❶ Proszę wybrać jedną odpowiedź
Proszę wybrać odpowiednią odpowiedź przy każdej pozycji:

	Opcja 1: Samochód (jako pasażer)	Opcja 2: Car / Taxi Sharing	Opcja 3: Transport publiczny (Autobus / Tramwaj / Metro / Kolej)	Opcja 4: Rower, Skuter, Pieszo	Opcja 5: Łączą Państwo różne środki transportu (Samochód / Taksówka (współdzielenie), Autobus, Tramwaj, Metro, Pociąg, Jazda na rowerze, Chodzenie Pieszo, E-Scooter	brak wyboru/inne
	Czas oczekiwania wynosi 15 - 20 minut.	Twój czas oczekiwania (punkt udostępniania) wynosi 5 - 10 minut.	Czas oczekiwania (na stacji) wynosi 5 - 10 minut.	Twój czas oczekiwania (w przypadku współdzielenia) wynosi 5 - 10 minut.	Czas oczekiwania (na najbliższym punkcie/stacji) wynosi 5 - 10 minut.	
	Czas podróży wynosi 25-30 minut.	Czas podróży wynosi 25-30 minut.	Czas podróży wynosi 30 - 35 minut.	Czas podróży wynosi 35 - 40 minut.	Czas podróży wynosi 30 - 35 minut.	
	Odległość od ostatecznego miejsca parkowania do domu jest mniejsza niż 50 metrów.	Odległość pieszo od miejsca opuszczenia pojazdu do domu jest mniejsza niż 200 metrów.	Twoja odległość pieszo od stacji do domu jest mniejsza niż 400 metrów.	Odległość piesza do Twojego domu wynosi 5 metrów.	Odległość piesza do domu wynosi 5 - 10 metrów.	
	Podróżujesz z maksymalnie 2 pasażerami.	Podróżujesz z mniej niż 3 pasażerami.	Podróżujesz z więcej niż 2 pasażerami.	Podróżujesz sam.	Liczba pasażerów podróżujących z Tobą zależy od wybranego przez Ciebie środka transportu.	
	Płacisz o 20 % więcej niż w przypadku dotychczasowego sposobu podróżowania.	Płacisz o 30% mniej niż w przypadku dotychczasowego sposobu transportu.	Płacisz o 50 % mniej niż w przypadku dotychczasowego sposobu podróżowania.	Płacisz mniej niż 95% przy obecnych kosztach podróży.	Płacisz o 25% mniej niż w przypadku dotychczasowego środka transportu.	
mój wybór:	○	○	○	○	○	○

(To pytanie jest wymagane)

Jak dobrze poniższe stwierdzenia opisują Pana/i osobowość?

Postrzegam siebie jako osobę, która.... *

Proszę wybrać odpowiednią odpowiedź przy każdej pozycji:

	Zdecydowanie się zgadzam	Zgadzam się	Ani się zgadzam, ani nie zgadzam	Nie zgadzam się	Zdecydowanie się nie zgadzam
... jest powściągliwa	○	○	○	○	○
... jest ogólnie ufna	○	○	○	○	○
... ma tendencję do bycia wygodną	○	○	○	○	○
... jest zrelaksowana, dobrze radzi sobie ze stresem	○	○	○	○	○
... ma mało zainteresowań artystycznych	○	○	○	○	○
... jest otwarta, towarzyska	○	○	○	○	○
... ma tendencję do doszukiwania się wad u innych	○	○	○	○	○
... wykonuje dokładną pracę	○	○	○	○	○
... łatwo się denerwuje	○	○	○	○	○
... ma aktywną wyobraźnię	○	○	○	○	○

Jak dobrze poniższe stwierdzenia opisują Pana/i skłonności do podejmowania ryzyka?

*

Proszę wybrać odpowiednią odpowiedź przy każdej pozycji:

	Zdecydowanie się zgadzam	Zgadzam się	Ani się zgadzam, ani nie zgadzam	Nie zgadzam się	Zdecydowanie się nie zgadzam
Naprawdę nie lubię nie wiedzieć, co się stanie	○	○	○	○	○
Zwykle postrzegam ryzyko jako wyzwanie	○	○	○	○	○
Postrzegam siebie jako osobę unikającą ryzyka	○	○	○	○	○
Postrzegam siebie jako osobę poszukującą ryzyka	○	○	○	○	○

To pytanie dotyczy optymizmu. Optymiści to ludzie, którzy z ufnością patrzą w przyszłość i którzy w większości oczekują, że wydarzą się dobre rzeczy. Jak opisałby/opisałaby Pan/i siebie? *

Proszę wybrać odpowiednią odpowiedź przy każdej pozycji:

	1 w ogóle nie optymistyczny	2	3	4 neutralny	5	6	7 bardzo optymistyczny
Jak bardzo optymistyczny/a jest Pan/i ogólnie?	○	○	○	○	○	○	○

To pytanie dotyczy pesymizmu. Pesymiści to ludzie, którzy są pełni wątpliwości, kiedy patrzą w przyszłość i którzy najczęściej spodziewają się, że wydarzą się złe rzeczy. Jak opisałby/opisałaby Pan/i siebie? *

Proszę wybrać odpowiednią odpowiedź przy każdej pozycji:

	1 w ogóle nie pesymistyczny	2	3	4 neutralny	5	6	7 bardzo pesymistyczny
Jak bardzo pesymistyczny/a jest Pan/i ogólnie?	○	○	○	○	○	○	○

Dziękujemy za udział i mamy nadzieję, że się podobało.

Zapraszamy do dzielenia się z nami swoimi sugestiami i pytaniami na podany adres e-mail "Transportation2021@online.de".