MODUL UNIVERSITY
PRIVATE UNIVERSITY VIENNA

Motivational factors for car use despite access to free public transport in Luxembourg

Master Thesis submitted in fulfillment of the Degree

Master of Science

in

Sustainable Development, Management and Policy

Submitted to Dr. Ivo Ponocny

Rick Walentiny

1721044

Vienna, 11 November 2022

AFFIDAVIT

I hereby affirm that this Master's Thesis represents my own written work and that I have used no sources and aids other than those indicated. All passages quoted from publications or paraphrased from these sources are properly cited and attributed. In particular, I did not use any text generators or other paraphrasing tools. My thesis was not proofread without changing or amending the core of my work.

The thesis was not submitted in the same or in a substantially similar version, not even partially, to another examination board and was not published elsewhere.

Date	Signature

ABSTRACT

Luxembourg is among the first countries worldwide to introduce free-fare public transportation for everyone. A few years after the introduction in February 2020, however it has been noted that this policy did not have the desired effect on reducing car use in the Grand.Duchy. That is why this study was conducted, in order to find out what the reasons for car use in Luxembourg are, despite access to free-fare PT in order to help ameliorate the infrastructure of PT in Luxembourg to help reach the goals set by the PNM 2035.

After giving a brief introduction on sustainability in Luxembourg and the envisioned changes to mobility by 2035, this study focuses heavily on the perceived advantages and disadvantages of car and PT use, while also investigating the psychological reasons for car use and the limitations to behavioural change regarding mobility.

This research employed a quantitative approach with questions/statements rooted in the literature in the aforementioned topics and fields. The participants are firstly asked a few demographic questions before being presented with a 5-Point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree) and indicating to what extent they agree or disagree with statements regarding benefits and drawbacks of car of PT use, inspired from previous relevant research, and a few statements regarding their intent to use PT more if certain changes or improvements were to be made.

The findings suggest clear favouritism for car use in Luxembourg, where the benefits that were presented to the participants such as convenience, time savings, of “freedom” were identified to be the most significant. Furthermore, PT was heavily criticised for factors such as safety, convenience, accessibility, punctuality, overcrowdedness, and stress, hinting at the argument that the infrastructure is not up to par or is not attractive enough for people in Luxembourg to be a viable option for mobility. The results also suggest that the reasons for car use are rather emotional in nature than functional, evidenced by the biggest factor in the decision-making for car use being the perceived convenience compared to PT. While the interest to use PT more is given in Luxembourg, according to the results, certain improvements need to be made first. The accessibility of PT in rural areas was criticised by the participants with however also a clear indication that they would use PT more if this concern were to be addressed. As of right now the problem lies that PT in Luxembourg is not as available and convenient for people as a car. If presented the option to choose between the two modes of transportation, the decision is made by the perceived higher convenience of car use compared to PT and justified by the drawbacks of PT.

ACKNOWLEDGEMENTS

First and foremost, I would like to express my utmost thanks to my supervisor Dr. Ivo Ponocny, who helped me immensely through the process of conducting this research and writing this thesis, by providing guidance and assistance throughout the whole project.

I would also like to thank my parents, who enabled me to visit MODUL University Vienna for the past 6 years and who's support and love I deeply value. Thank you for always believing in me, encouraging me and being by my side. I love you!

I would also like to thank all my friends and partner, who supported me throughout this journey, cheered me on and provided help whether that be professional or personal. Thank you for believing in me and I could not have done this without you. I love you too!

From the bottom of my heart, I want to thank everyone that has helped to conduct this research, whether that is through advice, encouragement, support, or taking part in the questionnaire.

Thank you so much! :) <3

TABLE OF CONTENTS

LIST OF TABLES

List of Figures

List of Abbreviations

€ - Euro
A - Abroad
AM - Ante meridiem
CFL - Société Nationale des Chemins de Fer Luxembourgeois
CL - City of Luxembourg
CO_2 - Carbon dioxide
COVID-19 - Coronavirus disease 2019
E&B - Esch & Belval
EU - European Union
G - gram
GGE - Greenhouse Gas Emissions
GHG - Greenhouse Gases
Km - Kilometre
Km/h - Kilometres per Hour
L - Litre
MECDD - Ministère de l'Environnement, du Climat et du Développement durable
MMTP - Ministère de la Mobilité et des Travaux Publiques
NS - Nordstad
PBC - Perceived Behavioural Control
PM - Post meridiem
PNM 2035 - Plan national de la mobilité 2035
PT - Public Transportation
QoL - Quality of Life
RN - Rural North
RPM - Revolutions per Minute
RS - Rural South
SN - Subjective Norm
SR - Suburban Ring
STATEC - Institut national de la statistique et des études économiques
TPB - Theory of planned behaviour
UN - United Nations
US - Urban South

1. INTRODUCTION

1.1. Context and background of the thesis

A phenomenon that has been studied by Hagman (2003) indicates that car users and owners often have practical reasonings as to why their choice of mobility is superior to the more sustainable options such as public transport. Car users consider facts about the negative environmental impacts of their use of personal vehicles are relative and insignificant compared to the grand scheme of things but their effective advantages such as time saving, convenience and 'freedom' (meaning their independence from time schedules of public transport) are non-negotiable. However interestingly, the negative points that were pointed out by participants of this study by Hagman (2003) pointed out that the main drawback of car ownership and use is financial. They argued that taxes, insurance and maintenance costs and especially petrol prices were factors that are driving them away from using cars. Interestingly, costs seem to play a role in the decision-making on whether to use a car. Given the rising prices for petrol for example, one could expect an increase in public transit ridership, especially if it is completely free of charge for users..

This thesis aims to investigate the main reasons as to why people in Luxembourg, meaning residents, commuters and tourists use cars to travel and be mobile, when public transport is completely free of charge since 29 February 2020 (Research Luxembourg, 2022). This includes all forms of public transport such as buses, trains, and also the newly implemented tram line that is also planned to be expanded in the next years. Research Luxembourg (2022) has also found out that, still in 2017, 6 out of 10 people commuted to their work in private vehicles, which has a tremendous effect on traffic congestion, stress levels and finally also the environment (Novaco & Gonzalez, 2009). While precise data regarding an improvement of the situation regarding private car use since the inception of free fare public transport is difficult to establish due to the COVID-19 pandemic naturally influencing the way people lived and consequently traveled in the country. The lockdown measures had a significant impact on traffic in general, reducing the use of the tram significantly. The numbers reduced from 31000 to 1400 daily passengers in March 2020 compared to February the same year however reached a peak in February 2021 with 42000 (Research Luxembourg, 2022). This indicates a positive trend for the use of public transport and it will be interesting to follow these numbers further in the future.

The country Luxembourg also ranks among the highest countries regarding car density per 1000 people in the world (ACEA, 2023b) and in fact the largest number of new motor vehicles registrations in Europe in 2021 (ACEA, 2023a) despite the introduction of free public transport in the Grand Duchy in February 2020. The topic of this research is finding the motivational factors or arguments in favour of car use, despite having access to free public transport in Luxem-

bourg. This research investigates the behavioural pattern of individuals that, in essence, go against the assumption that people are rational and will choose the most economic option if given the choice (homo oeconomicus) as defined by classic economists such as John Stuart Mill, Adam Smith, and David Ricardo. This is a particularly interesting phenomenon considering the recent increases in petrol prices and the growing awareness for sustainability issues, because it hints at a rather unexpected behaviour of the people in the country. Therefore, it might be of interest for certain stakeholders, such as the ministry of transport or environment, or even the national public transport institution to receive an insight into the reasons behind this. Further analysis will also be conducted in order to find out whether there is a significant difference in groups, such as younger generations versus older ones, and finally between residents from rural and urban regions. Through quantitive research, this study aims to investigate certain themes that are predominant, possibly time management and convenience, which could be addressed by the according institutions, to further improve the sustainable management of the country and reduce its CO_2 emissions per capita, which is among the highest across the whole world (Worldometer, n.d.).

1.2. Purpose Statement

The purpose of this study is to explore reasonings of car users why they do not take advantage of the readily available free public transport network in Luxembourg. The study also seeks to investigate factors that would change the behaviour of individuals in favour of the public transport network, meaning what would need to change in order for these individuals to switch their main mean of mobility to a more sustainable, social but also economic alternative.

1.3. Research Question

The main research question that will be addressed in this study is as follows:

What are the motivational factors or reasons for individual car use in Luxembourg, despite the access to free public transport?

1.4. Personal Motivation for the Research

The novelty factor of the introduction of free public transport in Luxembourg was particularly interesting to the researcher and also how this has or has not changed the behaviour regarding chosen mode of transportation of the residents and visitors of the Grand-Duchy. Striving for an improvement of the current environmental situation, especially the disproportionately high CO_2 footprint of the country, it will be essential to switch from personal vehicle transport to public transport since 60% of all greenhouse gas emissions (GGE) in the country are directly linked to transportation (Ministère de l'Environnement, du Climat et du Développement

durable, 2023), so an enquiry into the reasonings for private car use could be beneficial in order to adapt the more sustainable alternative into a more attractive option for people.

1.5. Thesis Structure

This thesis will be divided in 5 main chapters. These chapters will be firstly the introduction, followed by the literature review and methodology. These sections will be followed up by the results of the study conducted and a discussion of the findings. Finally, a conclusion will be presented with potential limitations of the study and suggestions for future research in the field.

The introduction has established the general context and background of the thesis, laying out the setting and the status quo that is currently in Luxembourg regarding public transport and car ownership and use, portraying where the issue lays in a country that still has a disproportionate high rate of car ownership and ranks among the worst contributors to air pollution per capita (Worldometer, n.d.). The literature, where the main theories will be drawn from, will be discussed in a second step. Especially focusing on the current amelioration plans of the governing institutions in Luxembourg regarding sustainability, mobility and what it means to be mobile whether with cars or public transport and how these transportation modes compare regarding advantages and disadvantages in social, economic and ecological aspects as well as psychological factors in the decision-making of transport mode. Finally, there will also be a discussion regarding certain pilot projects of free fare public transport and how they developed. Especially the case of Tallinn, Estonia is interesting since it shows certain similarities to the project in Luxembourg. The methodology will be explained in a next step. Following this section will be the display of the results of the study, analysed through a discussion of findings. This will help to show the results in a first step, before diving into further analysis and hypotheses testing. Finally, the thesis will move on to a concluding chapter that aims to summarise all the findings, literature-related and study-related, and to establish a clear link between the two fields. The results will also be analysed through the scope of different stakeholders and how they could impact or change certain behaviours or policies in the Grand-Duchy. Furthermore, there will be a critical reflection on the limitations of the thesis and the proposal of future research ideas in the field. This thesis will end on the notion of all bibliographic resources and the appendix holding any information utilised in the research of this thesis.

2. LITERATURE REVIEW

In a first instance, the current visions and goals regarding sustainability in Luxembourg will be outlined, before going further into detail regarding car ownership and use and PT and the perceived advantages and disadvantages that come with it. Furthermore, mobility in general will be analysed through this literature review, discussing the benefits and drawbacks of different forms of public transport such as trains, trams, and busses which are all available in Luxembourg as well as the psychological reasonings for car use. Finally, this section will be concluded with a brief summary of all sub-chapters, and a discussion of the relevant theories regarding the topic of this research.

2.1. Sustainability in Luxembourg

Since this research is also closely linked to the sustainable development program of the Grand-Duchy that envisions an improvement of the current situation of 69% of people still utilising cars in order to be mobile (Ministère de l'Environnement, du Climat et du Développement durable, 2021), it is important to outline the policies regarding sustainable development, including the plans for a change in mobility towards a more environment-friendly alternative, namely public transport. An inquiry into this field will be beneficial, since it will allow to portray the current status quo and what the respective ministry has envisioned and planned to change in the near future. It is also useful in order to compare the current situation regarding car use and ownership to the current data regarding public transport use and where perceived advantages such as convenience or time savings for proponents of car use could be critically assessed. A closer look will also be taken at the National Mobility and Sustainable Development Plan and finally the Modu 2.0 strategy that clearly explains the goals for 2035 regarding mobility in Luxembourg, current projects that are being developed or probed regarding a more sustainable form of transport and some levels of predictions and an outlook for 2035.

2.1.1. National Plan for Sustainability

In times of rapidly emerging sustainability issues, it is essential for all countries to tackle these challenges in order to improve the current situation for future generations. Luxembourg has also committed to the Agenda 2030 emitted by the United Nations (UN) in 2015 by identifying and addressing ten main fields of actions. A core aspect of this strategy are the 17 Sustainable Development Goals presented by the UN and Figure 1, which are adopted by the Luxembourgish government in the National Plan for Sustainability. While all goals are important and essential problems to tackle, the government of the Grand-Duchy has decided to focus on ten that seem most appropriate and the most feasible, which will be presented in the next sub-sec-

tion. These focus mainly on development of the own country, potentially leaving room for improvement regarding helping out other countries, tackling these important issues.

FIGURE 1 - SUSTAINABLE DEVELOPMENT GOALS (UN, N.D.)

According to the Ministère de l'Environnement, du Climat et du Développement durable (2020) these ten goals are namely:

1. Assuring better social inclusion and gender equality and providing good education for everybody
2. Assuring good health care for the Luxembourgish people
3. Promoting sustainable consumption and production practices
4. Diversification of the economy
5. Better planning and utilisation of land
6. Assuring sustainable mobility
7. Stopping the degradation of the environment and respecting the natural limits of resources
8. Facing climate change

9. Contributing on a global scale to fight hunger and poverty

10. Financing the fight against climate change

Due to the nature of this thesis, the main focus on the following sections will be on point 6. Assuring a sustainable mobility for residents and visitors is essential as identified by the sustainable development ministry. The aim for the institution to promote and build upon the current public transport structure in order to make them more attractive for people to use. A drastic change that has been made has obviously been the introduction of the free fare public transport for residents, commuters and tourists alike. Although detailed statistics underlining the use of public transport since it became free of charge are difficult to establish, due to the COVID-19 pandemic and its lockdown restrictions that heavily promoted remote work, certain positive trends have been observed that would indicate an increase of public transport use (Research Luxembourg, 2022). However, in order to understand what can be done to increase public transport use and consequently reduce CO_2 emissions in the Grand-Duchy, it will be also necessary to investigate why people choose to not use the network. Although it seems counter-intuitive to not take advantage of this opportunity to access nation-wide public transport free of charge, there is still a significant amount of people that commute by car. That is a knowledge gap that this research aims to close down, in order to ameliorate the public transport network and make it more attractive for everyone, allowing the mobility goals for 2035 to be implemented more easily.

2.1.2. Modu 2.0 - Mobilitéit zesummen erreechen

The Modu 2.0 is a document that outlines the strategy for sustainable mobility in Luxembourg presented by the Ministère de l'Environnement, du Climat et du Développement durable in 2018.

In a first chapter, the current numbers regarding mobility in Luxembourg are presented. It paints an accurate picture of the current situation in the Grand-Duchy where around 250000 empty car seats travel to the capital city (MECDD, 2018) each morning. This hints also at a high rate of congestion and traffic on the main routes in the country, which are correlated to the daily commuters in Luxembourg, especially their routes from to school or work and back have a significant impact on traffic load at peak hours meaning around 9 AM and 6 PM. This is further underlined by the fact that 33% of all commutes between apartment and workplace are under 5 kilometres, with an astonishing 50% of these travels being done by car as established by MECDD (2018). Not only is the current situation detrimental to the environment in the sense that these high rates of unsustainable car use are easily avoidable by a switch to a more sustainable mode of transport, it also costs the user a lot of money. The costs for personal mobility were around 4.2 billion euros with almost 50% of this number being paid by the individ-

ual and only around 900 million being subsidised by the state (MECDD, 2018). In essence this equates to an individual paying around 69% of their own travels by car. With the change to free fare public transport, this number could be greatly reduced, leaving the question why it is not utilised as much as it could be, especially when STATEC (2023) established that mobility still accounts for 15% of all yearly expenses of any given household in Luxembourg, only behind housing, water and electricity and other miscellaneous goods and services. However, a reduction could be identified by STATEC (2023), where the percentage decreased to 12, whether this is due to the COVID-19 pandemic or the implementation of free public transport or other reasons cannot be clearly identified. Interestingly enough however, despite the access to free public transport and the sustainable and economic advantages that come with it on a consumer level, STATEC (2023) identified an increase in new motor vehicle registrations from 2020 to 2021. Compared to the 52279 newly registered vehicles in 2020, there have been 54558 in 2021. This shows a rather bizarre and unnatural behaviour of Luxembourgish people, because it seems as if the monetary aspect of public transport would not be the deciding factor for the chosen mode of transport, hinting at alternative reasons for individuals to use cars instead of public transport.

Modu 2.0 also established four main goals or targets for 2025 in order to reduce traffic congestion, which is one of the main reasons for CO_2 emissions as established by Barth and Boriboonsomsin (2008) at peak hours, which are 9 AM and 6 PM as established beforehand.

Target 1 deals with the modal split of commuting to work which aims to increase the amount of passengers in public transport by 50% by providing more trains and remodeling the bus network. It is also envisioned to shift 95% of commutes that are less than one kilometre to be done on foot and similarly to shift 10% of commutes that are less than 5 kilometres to be done by bicycle. This will lead to an increase of the traffic situation in Luxembourg as long as the remaining ⅔ of commutes to work, that are done in privately owned cars, can be shared between more people. As of right now the average occupancy of private vehicles on daily commutes is only 1.2 and target 2 defines an increase of this rate to 1.5 (MECCD, 2018). Goal 3 deals with the modal shift of school commutes and entails similar actions as goal 1, however with a deeper focus on public transport. It is envisioned to increase commutes to primary school by 21% from 29% by bus and from 70% to 77% in secondary school by bus and by train (MECCD, 2018). Finally the fourth goal is to increase the attractiveness of public transport, without focusing on the aspect price in a first instance. The proposed actions are to reduce the frequency of cancelled trains from 1 out of every 40 to 1 out of 100, reducing the frequency of delayed trains and finally to ensure that busses reach their final destination faster than private cars, actively engaging with a common argument of proponents of private car use that private car travel is faster and more reliable than public transport use (Steg, 2003).

2.1.3. PNM 2035 National Mobility Plan

The PNM 2035 deals with the question on how to tackle mobility in Luxembourg and builds upon the previous Modu 2.0 strategy. It essentially revises the strategy with new knowledge and amplifies the demanded need for change in the way mobility is viewed and used in the Grand-Duchy. This becomes a more and more significant issue since it is predicted that the country will need to accommodate for around 40% more daily trips or commutes than in 2017 (Ministère de la Mobilité et des Travaux publiques, 2022), which will necessitate the improvement of public transport infrastructure, meaning the expansion of rail networks and the increase of bus lines.

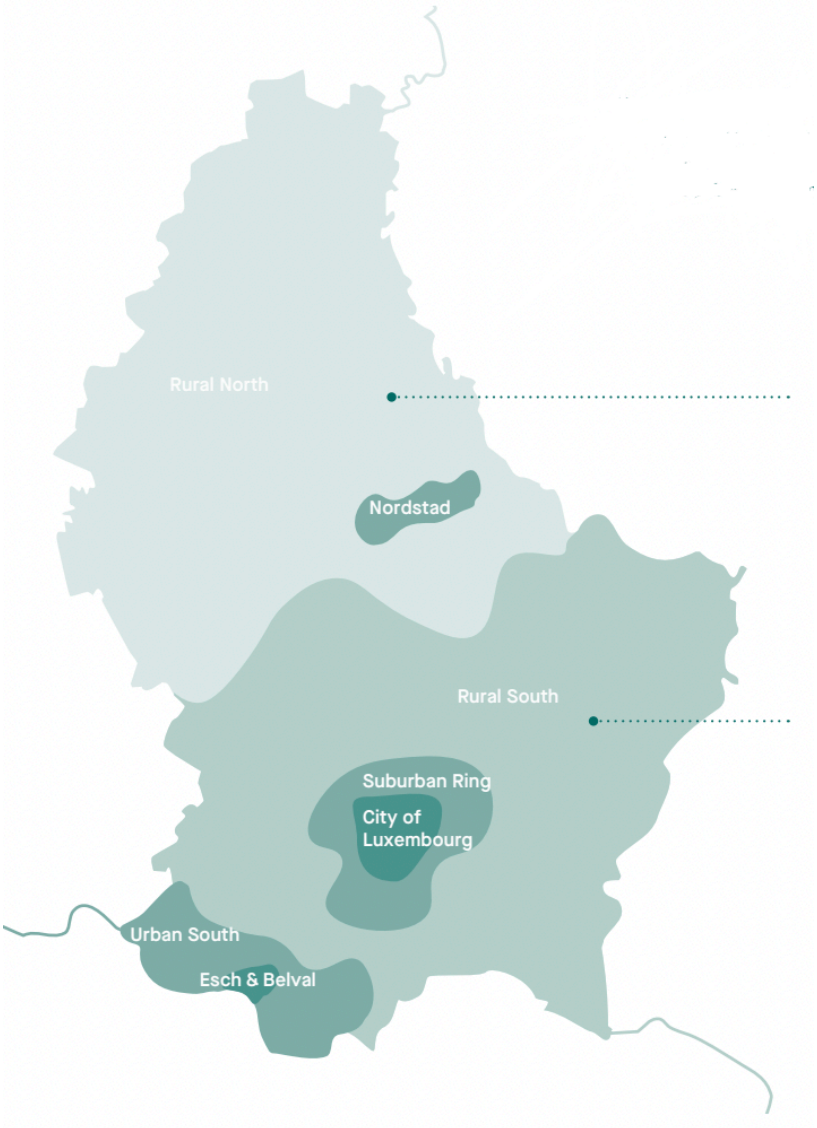

FIGURE 2 - THE TEN MOBILITY ZONES (MMTP, 2022)

It also presents a valuable division of the country in ten different mobility zones that allow for a better analysis of the behaviour of people from various regions that is also widely adopted through research in Luxembourg as shown on Figure 2. These ten zones will play a crucial role in the differentiation of individuals in the results and discussion section of this paper, since it is envisioned to identify relevant variations in behaviour regarding place of residency. The first zone that is presented in the PNM 2035 is the Rural North. This zone covers mostly the northern most part of the country, without the Nordstad which will be presented as well. The Rural North includes certain important cities such as Vianden and Clervaux or even Wiltz, which are regarded as important touristic attractions of the Grand-Duchy (Smith, 1992). Interestingly, the Rural North has a relatively high share of longer travels meaning 31% of all transports are above 25 kilometres with around a third of these being even above 50 kilometres, an astonishingly high number for a country that only has a length of 82 kilometres from North to South and 57 kilometres from East to West (MMTP, 2022; STATEC 2023). The second mobility zone identified is the Rural South. This area covers mostly the South and Eastern parts of Luxembourg with notable towns such as Remich, Schengen, or Grevenmacher. This constitutes the border region with Germany and is characterised by the proximity to the Moselle river. While similar to the Rural North regarding choice of transportation mode with 15% using public transport and 74% using cars, the length of trips differs greatly (MMTP, 2022). According to the ministry, the Rural South is characterised by more shorter trips than the Rural North, with a simultaneously lower share of trips over 25 kilometres (MMTP, 2022). The third mobility zone that is introduced is the Nordstad. This is a specific district in the Rural North that includes the main academic and social cities such as Diekirch and Ettelbruck and is seen as the “major destination for the Rural North mobility zone” (MMTP, 2022). While 34% of all travels to and from the Nordstad are shorter than 5 kilometres, 74% still use the car as their primary mode of transportation, but 18% also use public transport which is the second highest percentage in the whole Grand-Duchy (MMTP, 2022). The highest percentage can be found for the city of Luxembourg with 21% of people that travel by public transport. The city of Luxembourg is the main urban hub of the country and is characterised by very short trips, 40% of all travels are less than 5 kilometres long (MMTP, 2022). The fifth mobility zone is located all around the capital and is the suburban ring of the city of Luxembourg. Notable towns include Strassen, Sandweiler, Walferdange which are all seen as transit towns where traffic flows from and to the capital are prevalent. Notably, this zone holds the unfortunate record of the highest car usage at 81% (MMTP, 2022). Furthermore, the main urban centre of the south of the country, namely Esch-sur-Alzette and Belval, is the next mobility zone. Typical for an urban area, it is characterised by a comparatively high amount of short trips under 5 kilometres with 50% of all trips being this short (MMTP, 2022; Wolday, 2018). Interestingly the share of car users is greater in this zone than in the city of Luxembourg, possibly indicating a superior public transport infrastructure in the capital. The Urban South is less densely populated than the Esch-sur-Alzette and Belval

zone, however forms a similar urban structure with its main towns Differdange, Dudelange and Bettembourg all being close in proximity to each other. With 44% of all trips to and from this region not even being more than 5 kilometres, it is rather surprising to see that the modal share of public transport use, for both the Urban South and the Esch-sur-Alzette zone is only 13% (MMTP, 2022). Finally, the three bordering countries Germany, France and Belgium also play an important role for the Grand-Duchy. According to STATEC (2023), the annual average of cross-border commuters was approximately 218000 people travelling from the 3 neighbouring countries to Luxembourg. That statistic is equivalent to roughly 30% of the whole population of the country. It will be interesting to investigate the chosen method of transportation in the near future for the three countries to commute to Luxembourg.

Having established the main mobility zones of the country and their mobility patterns, it seems appropriate to identify the main reasons for these travels. According to MMTP (2022), the main reason for travels for residents and cross-border employees alike in the country is commuting to work or school. 58% of all travels are linked to one of these two reasons. Astonishingly, ⅓ of all trips under 1 kilometre and even ⅔ of all trips between 1 and 5 kilometres of residents are undertaken by car while simultaneously the travel distance for 54% of all residents in the country is less than 5 kilometres (MMTP, 2022). For comparison, the modal share of public transport equates to around 20% for travels longer than 1 kilometre, indicating a severe underutilisation of the public transport or a disproportionately high use of cars in the country.

Three main challenges are estimated to occur by 2035. The MMTP (2022) has identified the capital city to still be the main destination for trips and therefore calls for a better organisation of traffic flows to the city itself. This is partially because it is the socio-economic centre of the whole country with a high density of workplaces, but also as it is a major tourist attraction of the country (MMTP, 2022; Smith, 1992). As argued by the MMTP (2022), the traffic flow to the city needs to be regulated by ensuring the public transport network can handle the increase in demand and becomes more attractive to individuals than single person car use. It is also predicted that there needs to be a shift to sustainable urban mobility in metropolitan areas. Also this challenge is proposed to be solved by systematically reinforcing the need for better public transport infrastructure. However, MMTP (2022) also acknowledges that there will also still be a need for car use in rural areas, which cover around 83% of the whole country. The problem regarding mobility arises due to the fact that 382000 daily trips are undertaken to and from metropolitan areas, which puts immense stress on the main commuter routes during peak hours (MMTP, 2022). This also indicates that there is a need for the implementation of more public transport options in order to be more viable as a daily commute option.

Directly linking the PNM 2035 to the previously presented Modu 2.0 strategy, the targets are mainly the same. It is envisioned to shift the modal share to more sustainable option such as

the public transport network. An interesting objective presented by the PNM 2035, however, sees the car as a necessary mode of transportation for medium to long distance excursions. This indicates that the focus of the shift to more public transport use is predominantly on the metropolitan areas, however also trying to minimise the need for short trips by car in other mobility zones. This is underlined by the fact that the passenger numbers in public transport need to increase by 89% by 2035. “This will be made possible by a broadened offer of railway connections, the tram network, prioritization of buses and improved intermodality” as argued by the MMTP (2022), however will also need to fit the consumer’s wants and needs. While it is obviously not possible to accommodate for every individual’s wishes and desires for a public transport network and amenities such as interchange hubs, there needs to be a deeper investigation into the consuming behaviour of people travelling in Luxembourg. Moreover an enquiry into the behaviour and reasons for car use could be beneficial in order to better understand the motivations for not using public transport, in order to then finally adapt the envisioned changes and improvements in order to be more successful.

2.2. Psychological Factors

Having established the political landscape of Luxembourg and the proposed strategies and changes that are set to be achieved in the near future, it is essential to also have a look at the psychological factors that play a role in the conscious decision of the chosen travel mode. Whether an individual wants to use public transport or prefers to take a car to reach their destinations can depend on a variety of factors. Attitudes, values, sociodemographic, and infrastructural factors all play a part in the decision-making of an individual. As to the individual weight of these factors some authors would argue that some are more important than others, while others would disagree. The aim of this section is to establish fundamental psychological phenomena and explain what research has been done already on the topic of psychology in mobility and the apparent attitude-behaviour gap between pro-environmental attitudes and unsustainable actions. First of all, however, it is interesting to have a look at the demographics of car and public transport use. These demographics can vary vastly depending on different factors such as age, gender identification, salary, and place of residence. Regarding age, it has become noticeable in recent studies that younger people have less intention to own and drive cars regularly compared to older generations. This has been observed in different places in the world such as China, Germany, or the Netherlands (Zhou et al., 2019; Kuhnimof et al., 2012; Kroesen & Handy, 2013). Moreover, Belgiawan et al. (2014) have researched the motivations of car ownership among undergraduate students in seven different countries in order to better understand the intentions of students to buy a car after acquiring a job. Through a survey, they investigated the attitudes of these students and then compared them to stated future car ownership intentions and concluded that there was a “significant difference between developing and developed countries with students in developed countries having less desire to pur-

chase cars" (Belgiawan et al., 2014). This is an interesting study relating also to the topic of this research, since there will be analysis of the younger generation regarding their car ownership status or if they prefer public transit. With Belgiawan et al. (2014) arguing that students with wealthier backgrounds are more inclined to buy a car in the future, it can be interesting to compare the data from students to Luxembourg to these results in order to see if they align. Regarding gender identification, it has been noted that people who identify themselves as male are more likely to drive cars. As argued by Vance et al. (2005) this is due to patriarchal structures that have been established over the years. Furthermore they argue that this gap in intent for car use has been shrinking over the years, due to factors such as amount of children and different destinations such as workplace or hobbies. These findings are underlined by a study conducted in Sweden by Polk (2004). Daily car use is often done by people who identify as male, who expressed lesser concerns for the environment and valued convenience and accessibility over impact on the climate. However no research regarding non-binary gender identification has been done regarding daily car use, so generalised statements about this group of people is not yet possible. The general wealth of an individual has also been determined to be a deciding factor for the choice of mode of transportation. Studies have found that a higher salary/income can be an indication of daily car use and a reluctance to switch to public transport. This seems logical due to the fact that expenses regarding car use are high, with reparations, taxes, and fuel all being costly and people with lower incomes not being able to afford them. There is evidence supporting this theory by Hergesell and Dickinger (2013), who explore the role of price, time, and convenience among students regarding transport mode choices. They found out that cost plays a major role in deciding on the transport mode. They argue that a significant price discrepancy between transport options is needed in order to incentivise change. With the prices all forms of public transport, being zero, one could expect that young people would be open to using these more frequently for example. This also further underlines an inclination of younger generations to use public transport given the right circumstances. Finally, place of residence also plays a role in the chosen mode of transportation. Given a decent public transport infrastructure, people tend to use cars less due to the perceived advantages of public transport. This is mostly true for urban travels, within a given city for example, however does not necessarily remain true for destinations in rural areas. With limited options for public transport, long waiting and walking times, many individuals will see the car as a necessity for their lifestyle, be it for their commute to work, to go shopping, or pursue any hobbies. While these are general observations that can be made, they can vary from person to person and personal preferences should also be accounted for.

2.2.1. Attitude-Behaviour Gap in Sustainable Mobility

While sustainability as a concept has become more widely accepted and adopted by a grander public, the behavioural implications that would be expected to follow are still rather inconse-

quent. Prillwitz and Barr (2011) argue that while many have adopted more sustainable alternatives such as recycling materials or reducing electricity consumption through the adoption of energy-saving lightbulbs, changes to the personal transportation and mobility patterns and habits are scarce, despite their significant impact on the current CO_2 emissions. However, in order to identify what needs to change to rectify unsustainable travel choices it is essential to understand why certain individuals prefer one alternative to the other. Specifically for this study, it is necessary to find out why people in Luxembourg still heavily rely on cars, despite the access to free public transport. Offering a more sustainable option that is also more affordable than car use, should be favourable for a majority of people, yet it is seemingly not. This phenomenon has been studied in the past, where the negative environmental impact of car use is known and access to public transport is given, yet the latter is not used as much as it could. A psychological concept that has been used as a theoretical framework for this attitude-behaviour gap has been the theory of planned behaviour (TPB) which aims to relate beliefs to behaviour and help to reduce the attitude-behaviour gap. Introduced by Ajzen (1991), it essentially indicates that when an individual has a positive attitude towards a behaviour, the behaviour alines with a general consensus of being "good", and finally it can be expected that the behaviour can be easily performed, it can in turn also be expected that the behaviour will be performed. The TPB therefore reunites attitude and intention, subjective norm (SN) and perceived behavioural control (PBC) as defined by Ajzen (1991). Following the theory and its use as theoretical framework in several studies, one would expect that people in Luxembourg would use public transport as their main mode of travel. Generally, using public transport is regarded in the public eye as a good thing for the environment and it is rather accessible for the majority of people. This would indicate that there may be an incline to not use the free public transport because the personal attitude of Luxembourgish people is against it. As to why this is the case, if the public transport is not attractive enough or if alternatives, such as personal vehicles, are favourable for different reasons such as "flexibility, independence, availability, speed, reliability, safety, carrying capacity and comfort" (Steg et al., 2001) will be the question of this study.

The question remains on what makes sustainable transport actually attractive for consumers and helps bridge the attitude-behaviour gap between environmentally friendly intentions and often unsustainable practices. The attitude-behaviour gap is the term that refers to the inconsistency a person may portray regarding attitudes and decisions. More specifically, a person may have a positive attitude towards sustainable practices, may however act contrary to their beliefs (White et al., 2019). Past studies have put forward different strategies in order to promote the use of public transport such as the improvement of efficiency for the different transport modes such as trains or buses, reducing the distances between the home and different destinations such as work, shops, and other recreational places, offering the access to public transport for an economically favourable price, and finally raising awareness through social marketing for public transport (Lovins & Cramer, 2004; Stead & Marshall, 2001; European Con-

ference of Ministers of Transport, 2004; Brög, Erl & Mense; 2004; in Hunecke et al., 2007). Luxembourg seemingly reunites all these strategies through its small size, free-fare approach, and its great marketing of the offer. Only potentially a lack in reliability and efficiency in the public transport offer could be criticised, which would however not entirely explain the statistically 7 out of 10 people that still travel by car as established by the MECDD (2021). This indicates that there are ulterior motives for people in Luxembourg to travel by car. Hunecke et al. (2007) explain that besides the infrastructural factors, which greatly influence mobility behaviour, sociodemographic and attitudinal factors also have a significant impact on individual mobility choices. The sociodemographic factors include aspects such as age, employment status, personal wealth, or place of residency, which lay out the fundamentals of personal mobility options of an individual. The attitudinal factors determine personal preferences and include values, norms, and obviously attitudes which indicate what might be preferable for an individual regarding personal mobility (Hunecke et al., 2007). Therefore it can be concluded that a combination of the three aspects plays a deciding role in the transport mode of choice. Infrastructure, sociodemographic, and attitudinal factors have to be analysed in order to find an answer to the overarching question on why people in Luxembourg prefer the less sustainable and economic alternative to public transport.

Poortinga et al. (2004) argue that the main contributor for more environmentally friendly travel choices would be the socio-economic parameters. According to them, income plays an important role in the decision-making in chosen travel mode. Depending on intent and general attitude to the importance of sustainability, Poortinga et al. (2004) explain that many individuals are not willing to change their mobility pattern, due to the perceived high efforts that are required.

Further research has been conducted on the question: “Why do people choose to use a car to be mobile?”. Anable (2005) for example has based her research on psychological factors leading to travel behaviour on the previously explained TPB. She identified 6 distinct psychographic groups, 4 of which were car owners and 2 of them were not. These 6 groups were firstly the “Malcontented Motorists”, which were characterised by a high moral responsibility to reduce their personal car use, an above average intent to partake in sustainable behaviour such as green shopping and reduce their car use for sustainability reasons, and a regret for using cars if not urgently necessary (Anable, 2005). However, this group is reluctant to change their ways, because they still enjoy driving, despite high traffic rates and perceive that their change will not matter in the grand scheme of things. While there is a clear intent to change their behaviour, this group sees high difficulties for doing so, explaining why they have not adapted their travel behaviour yet (Anable, 2005). This ties back to the findings of Poortinga et al. (2004) and Ajzen’s TPB and underlines their point that intent alone is not enough to switch from personal car use to public transport if other requirements such as infrastructure or socio-economic situ-

ation are not optimal. The second group that is presented by Anable (2005) are the “Complacent Car Addicts”. This group is characterised by a general low engagement in sustainable behaviour and therefore also do not see the environmental impact their travel behaviour has as an issue. In general the intent to engage in more sustainable behaviour is not given for this group and the drawbacks of car use are not realised. Notably, their preference for car use does not stem from a distaste for alternatives such as public transport but rather from indifference and established habits (Anable, 2005). The third group that was identified by Anable (2005) are the “Die Hard Drivers”. This group has the lowest intent to reduce car use, since they believe that it is their right to use the car whenever they desire. Notions such as freedom and a perceived gain of time are prevalent with this group that is rather unwilling to change their unsustainable behaviour, since moral, attitudes, values, and the ability to change do not align. The fourth group was labeled the “Aspiring Environmentalists”. Some traits of this group are the intent to change their mobility behaviour by reducing car use and using more public transport, because they feel obligated to tackle the challenges imposed by climate change. This group notably judges both, car use and public transport, as problematic and worthy of improvement (Anable, 2005). For example, the “Aspiring Environmentalists” feel guilty for travelling by car, but also acknowledge that it would be difficult for them to completely forgo car use and argue that it is still notably faster in terms of personal use than public transport (Anable, 2005). This group captures the current zeitgeist relatively well with a clear intent to change mobility behaviour while simultaneously having some reservations about completely committing to public transport use. This further indicates that a change in infrastructure might have the desired effect of reducing the perceived drawbacks of public transport use. The two non-car-owner groups that were identified by Anable (2005) were the “Car-less Crusaders” and finally the “Reluctant Riders”. The “Car-less Crusaders” are characterised by a stern determination to tackle environmental issues by their decision to not own or use cars as their mode of transportation. They believe that choosing alternative modes of mobility such as public transport is favourable and they do not see the drawbacks such as lack of privacy or time loss as inherently bad. Finally the last group that was identified were the “Reluctant Riders”. Contrary to the fifth group this group sees issues with public transport that need to be overcome to become more attractive. Furthermore this group is “not particularly motivated by environmental issues” (Anable, 2005), which is reflected by their reluctance to engage in sustainable behaviour through green shopping such as group 1 for example. Interestingly, this group had a lower average income than other groups, meaning that socio-economic background may play a role in the chosen mode of transportation. This is particularly fascinating in the context of this research, where the cost factor of public transport is non-existent. Anable (2005) argues that the income is an “actual” constraint on behaviour, meaning that costs of public transport play a role in decision-making, so it will be interesting to investigate whether the behaviour can be influenced in favour of public transport if this factor falls away or if it does not play a significant enough role.

2.2.2. Restrictions to behavioural change towards sustainable travel

As previously established, despite the intent to change travel behaviour to be more sustainable by using public transport, the perceived ability to implement these changes are not always given. A major point that has been criticised for using public transport has been the perceived decrease in quality of life (QoL). This is also particularly important for the acceptance and implementation of policies and the envisioned mobility plan that was previously explained. However these future strategies need to take into account the different values and socio-economic parameters that make up QoL of individuals. While the awareness for sustainability issues and the detrimental effects of personal car use are known, the transition to the use of public transport is not always easy. In particular, short-term drastic changes to mobility behaviour are difficult for certain car users (Steg & Gifford, 2005). In their study, the researchers defined 22 QoL indicators where freedom and privacy ranked among the highest whereas nature and biodiversity were perceived as less important. This explains the reservation of the general public about drastic changes to their personal travel behaviour. The researchers came to the conclusion that environmentally friendly behaviour is seen as less important to QoL than health for example. This indicates that given the choice, people would prefer an alternative that is safer than one that might be better for the environment. This was also observable through the recent COVID-19 pandemic, where ride numbers of public transport declined even without strict lockdown restrictions. The ability to decide over their mobility is important to individuals as explained by Steg and Gifford (2005). The point that has to be made here is that future sustainability plans need to respect QoL factors, in order to be generally accepted by the population. Furthermore the researchers argue that communication of the grand scheme and the envisioned behavioural change needs to put the emphasis on the future QoL improvements rather than the short-term restrictions for the individuals. Only then, through clearing up misperceptions and educating the population, it is possible to convince the general public of more sustainable modes of transportation. In the case of Luxembourg and the free-fare public transport and the PNM 2035, there needs more effective communication and a clearer explanation of the advantages of reducing car use and switching to alternatives.

Furthermore it has been determined in previous research that other restrictions for the change from car to public transport use are the established habits of individuals, for example the daily commute to work or to the grocery shop has always been done by car and therefore it is difficult to break this habit. As argued by Havlíčková & Zamecnik (2020), habit is a determining factor for travel mode choice. They explain that a commute by car for example defined as a “frequent behaviour in a stable context” can be identified as a relationship between context and behaviour as part of a script or a schema. A script can be defined as a “mental road map” where individuals are expected to do a specific sequence of things. An example for this may be the daily commute to work where individuals are expected to climb into the car and drive to

work and disregard the available alternatives altogether. This is because the script is closely linked to habits and changes to the script are seen as abnormal or odd. Through the categorisation of mobility choice as part of a script, Havlíčková and Zamecnik (2020) argue that behaviour is not sufficiently explained by TPB and its extensions but habits need to be considered as well. In order to achieve change towards more sustainable travel modes, it is important to take habits into consideration in order to offer a viable alternative to established habits. Other factors that act as constraints to behavioural changes to mobility are the attitudes towards the different forms of transportation and the perceived importance of environmental issues and moral obligations to act sustainably (Prillwitz & Barr, 2009). This means that people will decide on their mode of transportation by evaluating the alternatives by previously established perceived advantages and disadvantages, while "moral obligation, responsibility, social desirability and response efficacy are seen to be the main motivators for environmentally friendly behaviours" (Prillwitz & Barr, 2009). If these psychological factors are not met by an individual their tendency to adopt sustainable travel behaviour is rather unlikely. Moreover other barriers to behavioural change regarding more sustainable travel are the perceived reduction in comfort and flexibility as well as privacy and health concerns. Health is also a factor that determines QoL, which underlines Steg and Gifford's (2005) findings.

In general, it can be argued that there are several restrictions that prevent the change from car use to public transport. The perceived reductions in QoL play a major role for individuals when confronted with their behaviour. A reluctance to change can be observed when individuals fear that their personal freedom and convenience is restricted. Attitudes and previous experiences with car and public transport use also shape the perception of an individual and establish certain assumptions that are difficult to change. For example, if a person has made positive memories while driving a car, because of the enhanced accessibility, comfort and time gain and/or has made negative experiences while using public transport such as delays or overcrowdedness, their behaviour is unlikely to change due to the fact that their perception is influenced by these experiences. However, this concept also applies the other way round. When an individual has made negative experiences during driving, such as stress induced by traffic or high costs associated with driving and has made positive experiences with public transport such as stress-free commutes and significantly lower costs, they will also be more inclined to continue to use public transport. This is a point that should be explored further. As explained by Steg and Gifford (2005) clear communication is essential to challenge the difficulties of behavioural change in mobility. Through campaigns that clearly show the advantages of public transport and the positive effects it can have compared to use of cars environmentally, socially, and financially, people could be convinced to change their behaviour. The challenge here lies in finding a way to propagate public transport without restricting an individual's freedom, which is seen as one of the main QoL indicators. It will also be challenging to find a way to break established habits

of individuals since travel mode can be a part of a script, which are notoriously challenging to change.

2.3 Advantages and Disadvantages of car use

Since the perceived benefits and drawbacks of car use are plentiful and are the backbone of this inquiry it is essential to explain what common reasons have been given in previous studies. Notably, Hagman (2003) explains the cognitive dissonance of many car users by stating that arguments and reasonings as to why the car is perceived as advantageous or disadvantageous are different. While benefits of car use such as time savings stem from personal experience and shaped behavioural patterns, drawbacks such as the impact on the environment are seen as distant and negotiable. In essence, arguments in favour of car use are irrefutable because they are perceived as real facts that are observable every single day through, for example, time savings on the commute to work. Arguments against the use of cars or in favour of public transport are seen as abstract ideas that are negotiable or whose impact is debatable (Hagman, 2003). These advantages and disadvantages will later be compared to the benefits and drawbacks of public transport and analysed in order to find the most common answers and have a basis for the survey questions. The first section will discuss the perceived advantages of car use that are mentioned the most in literature, which will be explained, followed by an exploration of the most commonly mentioned disadvantages of car use.

2.3.1. Perceived benefits of car use

Hiscock et al. (2002), whom this section follows, investigated whether cars do actually provide psycho-social benefits to their users through interviewing car users in Scotland. The main drivers were “protection, autonomy, and prestige”. In a first step the notion of protection will be explained further. The interview partners in the study mentioned that they feel more safe from violence from strangers in cars than in public transport. Interestingly, many shared this sentiment about public transport being unsafe also due to poorly lit waiting areas at night. The people felt unsafe about strangers that might be intoxicated or violent and would prefer to simply commute by car, because it allows them to have a safe space that strangers or potentially dangerous people cannot enter especially at night. Another aspect of protection that was investigated was the protection against accidents. Many interview partners explained that they feel more safe in cars, because they felt in control of the vehicle and were less relying on the abilities of a bus driver for example. Although it needs to be mentioned that other interview partners also valued the safety in buses or trains because of the bigger size of the transportation vehicle, the professional predisposition of the drivers and for trains the absence of traffic congestion, which often leads to car accidents. Although the opinion on accident-avoidance is split between car use and public transport use, it can be deduced that those in favour of car

use value the perceived control and prefer to not rely on others to drive them around safely. Finally, cars are also seen as more comfortable and private than public transport. In general, the interview partners of the study agreed that cars have their advantage over public transport against bad weather, because the travel to bus or train stations can be cumbersome, while the car is usually very close to home and allows to regulate temperature and creates a comfortable experience even in pouring rain. Moreover, some interview partners reported that they value the privacy the car offers a lot especially the aspect that personal space is guaranteed in a private vehicle. This also ties back to the point that was made earlier with some people feeling unsafe at public transport hubs. On the other hand, some others do like the social aspect of public transport and do not see it as a drawback. The second major benefit to car use according to the study is autonomy. This point is further subdivided into convenience, choice, and reliability. Convenience is a major point for a lot of car users, since it allows them to shorten their travel time significantly as evidenced by the research. It encompasses topics such as frequency and immediacy, where public transport is not as favourable as car use. While travels with public transport are often faster than with a car, time is lost waiting and travelling to public transport hubs. With other factors such as bad weather or feelings of unsafeness combined, a lot of people will choose the more unsustainable option and do not utilise public transport. It becomes clear that the infrastructure for public transport needs to accommodate for these demands of people in order to incentivise positive and sustainable change. Secondly, the convenience of cars is also underlined by the fact that carrying heavy luggage is easier than in public transport. Furthermore travelling with children was also a point of discussion where cars where seen as more convenient than public transport. Interview partners argued that it was easier to access remote locations and gave them a sense of liberty and independence of public transport schedules. Through the Scottish study, one can also conclude that people that were not living in close proximity to a public transport hub or whose destination was not close to one, preferred the use of cars for travelling because of perceived convenience. Finally, reliability was also criticised for public transport. Interviewees suggested that they could not rely on public transport to be punctual and felt that a car was a more viable option. Especially, for chronically ill people, public transport can be cumbersome due to being difficult to access for disabled people or exposing individuals at risk to potential health hazards. With cars, this risk and tiring nature can be reduced, which is another advantage for the use of cars. Finally, cars are also often seen as prestige objects and associated with a wealthy and luxurious lifestyle, while public transport is often associated with the opposite as explained in the 2002 study. Furthermore, driving itself is often seen as a thrill and exciting on its own and can lead some individual to prefer driving to public transport.

Having established that the three main factors for car use are autonomy, prestige, and protection, these need to be evaluated and put into context in order to further enhance the understanding of psycho-social benefits. The researchers argue that the practical advantages of the

car derive from factors such as coziness and comfort but are enhanced through the established infrastructure geared around car use. This is an idea that Hiscock et al. (2002) have adopted from Dupuy (1999). Their analysis on France revealed that the allure of car use stems from the increased efficiency that results from the network of cars and the ability to travel at maximum speed (allowed). Through this increased attractiveness of car use, a vicious circle is created where more people drive cars, society becomes more accustomed to it and adapts itself to car use, and finally more people will start driving again through the infrastructure that is centred around car use. Dupuy (1999) argues that the only way to break this is to rival the car infrastructure by making public transport a more viable option. An example for this would be to reduce speed limits for cars and to introduce more bus lanes that would give public transport a competitive edge over car use in terms of speed (Hiscock et al., 2002). Moreover, the advantage of cars over public transport is often linked to distance travelled. Interview partners in the study mentioned frequently that long distances between destinations led them to choose travelling by car over travelling by public transport, due to the perceived increased convenience and comfort that a car can offer on longer journeys. This will be an interesting point for this study, since it is one of the core research categories. During this research, the travel mode of choice of people from urban and rural areas of Luxembourg will be analysed in order to investigate whether there is a significant difference. Also foreign workers and locals will be distinguished during this research, which will help to establish which group of people expects what from public transport and to find out if and subsequently why they prefer travelling by car in Luxembourg despite the access to free fare public transport. Furthermore, the study explains that the perceived advantages of car use are not absolute but rather comparative to the available options such as public transport. For example the perceived advantage of reliability and convenience of cars compared to public transport does not inherently stem from cars alone being reliable and convenient but are rather seen as more reliable and convenient than public transport. Nuisances such as delays or crowdedness are seen as more annoying than congestion for example, which instigates people to choose the car over public transport despite the potential drawbacks. The researchers also argue that there is a similar thinking for the notion of prestige. While luxurious vehicles could be seen as prestige and desirable objects that project wealth and status, a vast majority of vehicles does not do that. Instead the notion of prestige of car use rather derives from the common conception that public transport is “poor quality”. These are points that need to be addressed if the PNM 2035 is to be achieved in Luxembourg. The current advantages of car use are predominantly the perceived convenience in of itself but also the perceived drawbacks of public transport. Hiscock et al. (2002) has demonstrated through their research on travel mode of choice that people are not inherently in favour of car use because they want to drive (except a few outliers) but because the car infrastructure is perceived as superior and more efficient to public transport. While this indicates that there is a lot of work to be done to achieve societal behavioural change, it indicates that

there is a possibility to do so. By adapting the public transport infrastructure and addressing certain issues such as common delays, bad connections to rural areas, or increasing the safety at waiting hubs and implementing measures and policies to decrease the efficiency of car use by decreasing speed limits or introducing bans on cars in urban areas, the public transport offer could see an increase in popularity, which in change would be beneficial for this planet.

2.3.2. Drawbacks of car use

Similar to the advantages of car use, arguments against the use of cars are also plentiful. In this section, a closer look will be taken at the major drawbacks of car use. Firstly, driving requires a rather large set of prerequisites. To begin with, an individual will need a driving license to legally drive a car around, which, in Luxembourg, will take a minimum of 28 hours combined theoretical and practical lessons and will cost at least around 1500€, depending on location. Then they will need to pass both a theoretical and practical exam before even being able to drive. Essentially, the initial effort to being able to drive in Luxembourg is rather high, especially when public transport is available for free. After the initial investment for the drivers license, an individual will need to acquire a vehicle in order to drive. People have the choice to select a used vehicle for a lower price, with higher maintenance or reparation costs or buy a new vehicle altogether. New car registrations were down for 2022 and reached a record low since 1999 with 42094 new registrations in Luxembourg. This can be attributed to the COVID-19 pandemic and the delayed delivery of many vehicles according to STATEC (2023). However the 4 most registered car brands were Volkswagen, Mercedes, Audi, and BMW indicating that people are spending at least between 10000€ and 20000€ for a new car. Combined with the costs for the drivers license, the initial costs for driving in Luxembourg are astonishingly high, even if a used car was chosen. For comparison, a first class ticket, which are usable for 2 hours without any restriction on distance travelled and are the only paid option in the country, for any train in Luxembourg costs 3€ (CFL, 2023). This means that for the initial investment of car use for at least 11500€ in a normal situation, where a car is bought and not gifted by parents for example, an individual could travel 3833 times in first class in a train. The point here is that driving , owning, and maintaining a car is really expensive and taking into consideration the high petrol prices at the moment and inflation in general, these expenses could be saved by switching to public transport. Especially in Luxembourg, where public transport became free of charge in 2020, it is astonishing that the offer is not taken as much as it probably should. Furthermore, safety is also a concern for car use. According to STATEC (2023) there have been 21 fatal road accidents and 1266 casualties in 2021 in Luxembourg. Similarly, it can be argued that the car is the most dangerous mode of transportation available. “Over the last 10 years, passenger vehicle death rate per 100,000,000 passenger miles was over 10 times higher than for buses, 17 times higher than for passenger trains, and 1,623 times higher than for scheduled airlines” (National Safety Council, 2023). This means that car use is statistically more dangerous than any

other method of transportation, yet it remains the most used. The risk of an accident is omnipresent while driving with, for example, bad weather conditions turning roads slippery, other drivers being inattentive, or mechanical failures among many other reasons for accidents. It becomes clear that driving is one of the most dangerous ways of commuting with many uncontrollable factors influencing and potentially stopping the travel. Another major drawback of car use is traffic congestion. It is the source of discontent and is often mentioned as one of the main nuisances among car drivers (Hiscock et al., 2002). Traffic congestion is characterised by a decreased speed of movement and consequently longer travel times and and increase in vehicle queues, which are also another potential risk for accidents while driving. In essence, traffic is slowed down due to the fact that too many cars and other road-going vehicles are trying to traverse a given street at a given time. This can have many reasons such as rush hours for commuting to and from work, traffic accidents and road works, which restrict the flow of a road or even bad weather conditions (Afrin & Yodo, 2020).

Additionally, pollution is arguably one of the main drawbacks of car use. It has been established that carbon dioxide is one of the main drivers of climate change and that emissions need to be reduced significantly in order to secure a better future for coming generations. This has been recognised and targeted by the EU, with policies such as the European Green Deal as proposed by the European Parliament. While a decrease in GHG by around 90% is envisioned by 2050, and some sectors such as industry, agriculture, or energy supply already decreasing their emissions in the last three decades, emissions through personal mobility has even increased by around 34% (European Parliament, 2023). Furthermore, reducing the emissions made by the transport sector will be particularly difficult, since “the rate of emission reductions has slowed” (European Parliament, 2023) and current projections predict only a 22% reduction of GHG emissions instead of the envisioned 90% compared to 1990. Specifically, road transportation is the biggest contributor among the transport/mobility sector with 71.7% according to the European Parliament (2023), with cars being responsible for around 60% of this section. In total, car use alone is responsible for 43.5% of CO_2 emissions, which is 3 times as high as aviation for example, so it becomes clear that car use is detrimental for the environment. Particularly in Luxembourg, according to STATEC (2022), 38% of CO_2 emissions by households stemmed from mobility related actions. However, as Fontaras et al. (2017) would argue these emissions are even higher in real-world application compared to the calculations made in a scientific setting. This discrepancy of emissions in theory and in real-world applications of an average European car which emits approximately 120 g CO_2/km is argued to be between 30% and 50% or “an extra 36-48 gCO_2/km or an increase of fuel consumption of about 1.5 to 2 l/100 km” in petrol (Fontaras et al., 2017). This means that not only are the pollution levels significantly higher than indicated by car manufacturers, but also the car users need to refuel more often, which in turn are additional operating costs for their car. Fontaras et al. (2017) explain that this fluctuation between theory and practice stems from outdated theo-

retical tests that do not properly measure the emissions and also increased traffic congestion in recent years. The biggest contributors for these varying emission reports are trailer towing, aggressive driving, and traffic congestion (Fontaras et al., 2017). For this study the focus will remain on average passenger vehicles and less on exceptional modes of transportation such as trailer towing, which is why trailer towing will be mentioned here for completion's sake but not be elaborated on further, except the increased fuel consumption due to the increased load of the car and the decreased aerodynamics. However, aggressive driving, which is defined as a mix between fast accelerations, high speeds and revolutions per minute (RPM), and sharp braking have been proven to have a direct effect on fuel consumption. According to Fontaras et al. (2017) aggressive driving is impacting the fuel consumption a lot more in urban areas due to the sudden start and stops and waiting periods at red lights or intersections for example. In a rural or highway setting, the driving style still has an impact on fuel consumption but it is not as pronounced as in cities. This underlines the point that using cars in urban areas is not only not very economic but also not very environmentally friendly. This further strengthens the hypothesis that public transport would be the better option to choose in an urban setting and the question as to why people do not use it becomes prevalent again. Especially for Luxembourg, it is difficult to understand as to why public transport in urban areas is underused, since distances that need to be travelled are typically not large, given the size of cities and even the country and given the fact that public transport is completely free of charge for users. Another major point of discussion regarding fuel consumption and GHG emissions is traffic congestion. In 2022, the city of Luxembourg, which is the capital and the socio-economic hub of the country, the yearly travel time of a 10 kilometres drive in a petrol driven car was 120 hours with more than a third of this time being lost due to congestion (TomTom, n.d.) This equated also to 778 kg of C02 emissions per capita and a yearly expense of 572€. While these figures are similar to values found in other European capitals such as Vienna or Tallinn, one also has to remember the small size of Luxembourg. One would expect that travel time would be significantly lower in Luxembourg, yet that is not the case. Furthermore one would expect that with a positive attitude to sustainability and a general behaviour that is expected according to classic economic theory, that emissions and costs would be lower, since the introduction of the free-fare public transport. An assumption that is underlined by the continuation of several health care policies such as remote work, which did lower emission and congestion rates, but not to a significant amount. In order to further analyse the traffic situation in Luxembourg it is important to know when congestion happens the most and where. According to TomTom (n.d.), the main times that people drive on Luxembourg's roads is between 7 AM and 6 PM during weekdays, which is similar to other places in the world. The morning and evening rush hours where people commute to work are the timespan that the streets are frequented the most and traffic congestion is at an all time high. Especially 8 AM and 5 PM are the hours where a 10 km drive takes the longest between 15 and 16 minutes (TomTom, n.d.). Through the help of data from

the MMTP, a visual representation could be made for the last 4 years that show the most frequented roads in Luxembourg. These maps were created through QGIS, a mapping software that allows to portray data through visual geographical means. It needs to be mentioned that this data portrays only hotspots that have a traffic measuring instrument installed, so it could be possible that some streets do in fact register high rates of traffic, yet are not portrayed on these maps. Generally these maps however do give an insight into where people use cars the most. The four heatmaps show in red and yellow where the most cars travel and display the railway routes for comparison. A general trend that can be observed is the close proximity of hotspots to the railway line, which again underlines the question as to why public transport is not utilised as much. Furthermore, it becomes apparent that the border regions to France, Belgium, and Germany are frequented a lot by car, which can be explained by the numerous foreign residents commuting cross-border to work in Luxembourg. Also a large frequentation of cars can be seen around the capital city, which is the destination of a lot of work commutes. As previously alluded to, the capital city is the central hub of Luxembourg for any social, economic, and professional activities and therefore it is not surprising that it is often frequented. What is surprising however, is the chosen method of transportation. Congestion rates are high in the capital as explained beforehand, and a majority of public transport will eventually end up in Luxembourg City. Buses, trains, and even the newly established tram line all offer a more social, economic, and sustainable option to car use in the city, yet traffic rates suggest an underutilisation of the free-fare public transport. While it is true that congestion reduced in 2020 visibly compared to 2018 and 2019, this can be attributed to the COVID-19 pandemic and the different lockdown measures and policies that led to a slowed economy and limited opportunities to travel altogether. Moreover, the results of 2021, after several measures got lifted, suggest a similar situation to 2019 even though public transport became free of charge. Of course, remote work also became more limited again, yet it is however fascinating to see how the situation has not changed a lot. Another focus point is the Schengen area in the South-East of the country. The town borders Germany and France and is therefore frequented a lot for different reasons. Interestingly, there is no train line that connects this “tri-state” area, which means people have less options to choose public transport.

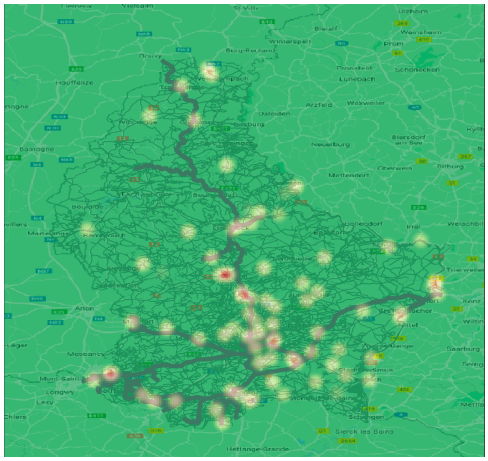

FIGURE 3- TRAFFIC IN LUXEMBOURG IN 2018

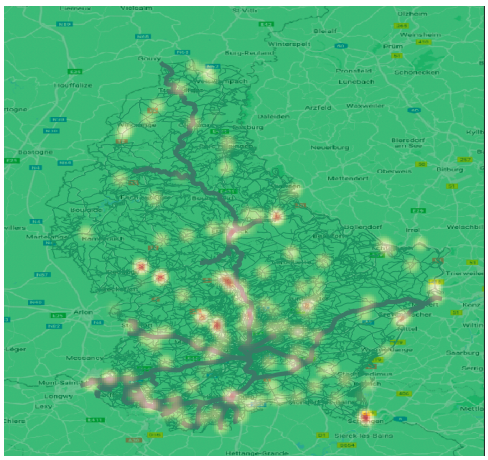

FIGURE 4 - TRAFFIC IN LUXEMBOURG IN 2019

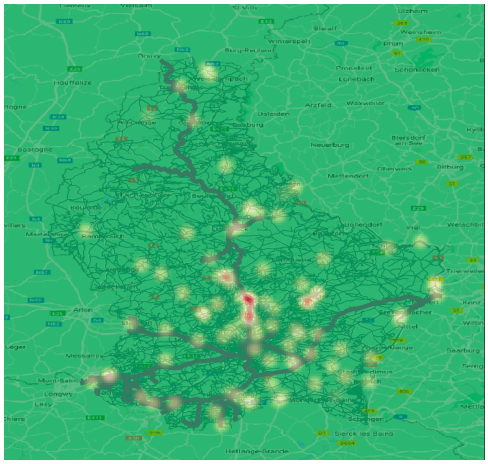

FIGURE 5 - TRAFFIC IN LUXEMBOURG IN 2020

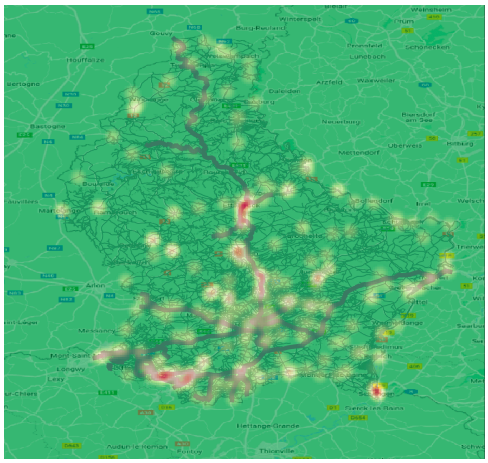

FIGURE 6 - TRAFFIC IN LUXEMBOURG IN 2021

Since it has been established that congestion ultimately leads to lost time, higher emissions, and higher fuel-related costs, it would seem obvious that people would try to avoid it. So naturally the hotspots that have been shown in Figure 3 to 6 are not necessarily places of traffic congestion, however give a good indication as to where the risk is elevated. A high occupancy of vehicles on a road will eventually lead to congestion and restricted traffic flow as elaborated on by Fontaras et al. (2017). In order to reach minimal GHG emission output, a petrol car needs to drive at a steady pace between 60 and 80 km/h and interestingly trips with a low average speed, meaning below 30 km/h, showed the highest output of CO_2 (Fontaras et al., 2017). This is noteworthy because the average speed in Luxembourg City during rush hour is between 36 and 39 km/h (TomTom, n.d.), bordering to be as inefficient as a car can be. Regarding fuel consumption, a steady pace will also lead to better results. Congestion on the other hand can lead to an increase in fuel consumption to up to 40% (Fontaras et al., 2017). Furthermore, a full-stop because of a traffic jam will also lead to longer periods of cars idling, which has a negative impact on fuel consumption and CO_2 emissions, if a car is not equipped with a Start-Stop mechanism, which currently around 50% of vehicles are not (Fontaras et al., 2017). These prolonged standstill periods are then often counteracted through aggressive driving. As previously mentioned, aggressive driving is characterised by strong accelerations and decelerations, which are not very fuel-efficient. Due to the caused stress, delay, or irritation through traffic congestion, drivers may opt to drive more carelessly and try to make up for lost time, which in return will be bad for the fuel consumption and result in a higher GHG output (Fontaras et al., 2017). One could interpret this findings by stating that a sort of vicious cycle is created. Through the use of cars on heavily frequented roads, such as highways or main roads in urban areas, the total amount of cars will eventually reach a critical mass that oversteps the capacity of the given road. This will then lead to congestion that causes stress and irritation that can possibly lead to a more aggressive and less eco-friendly driving style. In other terms, when fuel consumption and CO_2 emissions are increased through suboptimal driving factors such as congestion or traf-

fic jams, people will tend to compensate for this with higher fuel consumption and CO_2 emissions. This situation can only be solved through a steady pace at driving, which is especially difficult to maintain in urban areas and during rush hours. It underlines the statement that driving a car is inherently unsustainable due to the perfect driving conditions that need to be met in order to reach the most optimal fuel consumption and consequently CO_2 emissions. Moreover, this increased fuel consumption will lead to more trips to refuel, resulting in higher operating costs for an individual driving a car.

Another point that needs to be mentioned concerning the drawbacks of cars is the parking situation. Curb-site parking is currently very limited in urban areas of Luxembourg. While it is true that in rural areas, the competition for curb-site parking spaces is less predominant, urban centres such as the capital or Esch with many workplaces, suffer from limited availability of parking spaces on roads. It has also been proven by Ponnambalam and Donmez (2020) that there are significant drawbacks related to the search for parking spaces on the street. While it has been known that "urban areas that allow street parking exhibit a heightened crash risk that is often attributed to factors such as reduced road width, decreased visibility, and interruptions to traffic flow", they further investigated how the search for limited parking spaces has a negative impact on driver behaviour. The previously mentioned factors also reinforce the pollution of urban areas, through a higher risk for traffic congestion due to reduced speeds and a risk for overcrowded roads. Regarding physiological factors that influence parking space search, participants of Ponnambalam and Donmez (2020) study, which had to find a parking space on a road without any time constraints, reported increased stress, were less vigilant by looking into the distance and off the road more than usual during driving and drove significantly slower. These are factors that are not only unhealthy, but also potentially dangerous. To circumvent this restricted curb-site parking availability, bigger car parks have been built in urban areas. In Luxembourg City, there are currently numerous car parks available to station cars. However the parkings with the biggest capacity are often situated in locations that are convenient to access by cars, yet necessitate the use of public transport to travel to the city centre. Furthermore, these car parks are often occupied by a lot of cars, meaning that the search for a parking spot can be rather tedious. For example the Park and Ride Bouillon which is free of charge for 24 hours, located in Hollerich (a district in Luxembourg City) within close proximity to the highway connecting Esch and Luxembourg City has a capacity of around 2442 cars. However, it is almost completely filled with cars during working days (Luxembourg City, n.d.). Similarly other free of charge Park and Ride facilities, such as the Adenauer parking in Kirchberg (an important European and economic centre) or the Luxembourg Sud A parking in Gasperich (an emerging economic centre in Luxembourg) show high occupancy rates, indicating that people and presumably work commuters are interested in reducing parking costs. This is underlined by the fact that car parks where an hourly rate is charged, such as the Royal-Hamilius parking in the city centre have lower occupancy rates, but are situated more conveniently and allow to access

shops and workplaces comfortably by foot. These occupancy rates also indicate a positive attitude to public transport in an urban area, since the Park and Ride facilities and important workplaces are often a fair distance from each other, which could be considered cumbersome by foot. Similarly, increasing prices for parking spaces may discourage some people to drive by car altogether. If no cheap and accessible option for car parking is given, people may start to change their travel mode habits and think about adopting public transport as their choice of mobility. Parmar et al. (2020) suggest that "out-vehicle costs, which may be the combination of parking charges, cruising time and walk time, are more important to users than in-vehicle costs like fuel cost, travel time, etc.". This means that people are more concerned with the parking situation and their perceived drawbacks than the environmental impact their entire journey had. With a more restrictive access to parking and lowering the convenience of it, positive change regarding public transport use could follow. Studies have also shown that parking in urban areas has become an almost as relevant topic of discussion than congestion rates. It has been determined that parking availability and pricing effects a commuter's trip significantly, including time of departure which in turn could help to reduce congestion on roads during rush hours in the morning (Yang et al., 2013). The researchers also concluded through their study on parking constraints that a mix between reserved and unreserved parking spaces for commuters will lead to lesser traffic congestion due to the fact that commuters without an allocated parking spot will leave their home earlier to find a parking spot.

2.3.3. Reflection on the advantages and disadvantages of car use

To conclude this section, it is worthwhile to reflect on the findings of the benefits and drawbacks of car use. This is because these findings are the backbone of this study and will outline the questionnaire presented to the participants. First of all, the advantages of car use are often perceived to be non-negotiable and immediate. Benefits such as convenience, defined by parameters such as speed, shelter from bad weather, and safety are also often comparative to alternatives such as public transport. Studies have shown that cars are not seen as the better choice because of the inherent benefits but rather because the infrastructure of public transport is not up to par. By further developing and improving the public transport network and addressing the perceived benefits of car use, a positive change towards sustainable travel behaviour may ensue. Furthermore, the perceived control over the travel, meaning that there are less restrictions to travel destination and luggage capacity are other factors that proponents of car use have given to explain their choice of travel mode. Moreover, for some car users driving has been seen as fun on its own and fundamentally like the feeling of driving. Finally, the car is still seen as a status symbol by many and the prestige that follows by owning a car have been shown to be an influential factor in decision-making. On the other hand, the drawbacks of car use are often seen as negotiable by car users. Significant environmental impacts such as pollution and economic drawbacks such as high costs are seen as negotiable and necessary for the

own convenience. In many cases the direct benefits, such as speed and convenience outweigh the impacts on an economic and sustainable level. Even though arguments in favour of public transport use such as lower (and for Luxembourg non-existent) costs, generally enhanced safety, low environmental impact, and no need for a parking space all have their merit and convincing power, it remains interesting to observe this underutilisation of public transport. Having established that advantages of car use are relative in theory, it remains interesting to see whether this study can confirm these findings. Determining whether people in Luxembourg prefer the car because they perceive it as better than the public transport infrastructure or whether they think the car is inherently advantageous compared to public transport, will be a vital point of this study.

2.4. Advantages and Disadvantages of Public Transport use

This section will deal with the theoretical advantages and disadvantages of the different public transport option such as busses, trains and trams. The aim is to establish common arguments for and against public transport use and ground the study and its questions in previous academic research. This section will also be subdivided into the perceived advantages of the different transport modes, followed by the disadvantages.

2.4.1 Benefits of public transport use

Here the different advantages of the different forms of public transport will be presented. This will include an exploration of benefits of busses, trains, and the recently opened tram line in Luxembourg. While the concept of free-fare public transport is relatively new, there has been some research on it already. An inquiry by Cats et al. (2016) investigated the effect of such a project in Tallinn, Estonia and found evidence that the use of the system increased by 14% in one year and that “the mobility of low- income residents has improved”. However they also explain that the effects of taking away the price barrier of public transport did not entail the expected ridership increase that was predicted. This is however due to the fact that the infrastructure was affordable and provided good service even before it became free (Cats et al., 2016). This is very similar to the situation that has been established in Luxembourg now over the last two years and gives an insight as to what extent free public transport can be beneficial for low income residents and their mobility. To begin with, one should mention the economic benefits of public transport use. Generally, it can be argued that public transportation is cheaper than owning and maintaining a car. By looking at the average prices of car acquisition and maintenance, it becomes clear that costs north of 600€ per month are not that rare. These costs consist of the depreciation that is estimated to be around 2% per month according to the insurance company Roadzen, taxes, registration fees, insurance, financing costs, reparations, and finally fuel. While these costs can vary a lot depending on chosen car and location, mean-

ing that a small petrol-powered car in Eastern Europe will on average be cheaper than a sports car in Norway for example, they do give an indication of the minimum of costs that can be expected for car ownership and use. The cheapest place to drive and maintain a car in Europe in 2022 by averaging the first four years of ownership with a total of 120000 kilometres driven was Greece, with an expected monthly payment of 905€ and the most expensive country in the Europe was Switzerland with expected car related costs of 1313€ per month (LeasePlan, 2023). The average cost of car use in Luxembourg was 1063€ and for Austria 1092€. To put these costs into perspective regarding the cost advantage of public transport: A yearly ticket for public transportation in the city of Vienna costs only 365€, roughly a third of the monthly expenses calculated for car use in Austria. In other words, for the price of one year of car use in Austria (13104€), a person could travel almost 36 years in Vienna. Another cost benefit of public transport use is the parking fee that is often required for stationing cars. In Luxembourg City, the hourly fee for parking curb-side is usually 1€, but can be a lot higher for dedicated parking houses. Again these are fees that are avoidable by using public transport and show that reducing car use can be economically beneficent. The literature shows that even in countries where public transport is not free of charge, it is still significantly cheaper to use public transport compared to car use. The classic economic theory would suggest that this would be the main argument for public transport use, since it is cheaper and it is widely available, however that is not the case. Secondly, the environmental benefits of public transportation are plentiful. Based purely on the operation and use of public transport infrastructure and buses, trains, and trams, they emit significantly less GHG than cars. Specifically for the use of trams and trains, the emissions are zero, because they are powered by electricity. Cars and especially petrol need a lot of resources in order to be produced. Especially, petrol is becoming more and more challenging to source and Peak-Oil is a serious challenge that needs solving through innovation and societal change towards more sustainable options in many aspects of life. The facts indicate that using public transportation uses less resources and emissions are reduced compared to individual car travel. The American Public Transportation Association (2008) estimates that CO_2 emissions can be reduced by 37 million metric tons per year by switching from car use to public transport. On an individual level this equates to a reduction of 20 pounds of CO_2 emissions per day. Additionally, public transportation allows to transport a lot more people at the same time than individual cars. This reduces the energy needed to be mobile for energy significantly compared to car travel, where on average a maximum of five people can be transported in a same vehicle. But not only on its own does public transportation help to reduce the environmental impact that mobility has on the planet, but it can also help to reduce the environmental impact of other mobility-related aspects. First of all, by utilising public transportation, people can help to reduce the traffic congestion that is often formed through high car use. This in turn will lead to lesser time spent idling, which is unfavourable for a car's emissions. In fact, according to Fontaras et al. (2017), the optimum speed for a car is around 70 km/h in order to emit the least

amount of GHG possible, as previously discussed, so by reducing the risk traffic congestion for cars by using public transportation, car use can even be improved sustainably. This also ties back to the vicious circle of traffic congestion and aggressive driving, which were established as the main contributors for excessive GHG emissions from cars, and therefore it can be argued that by implementing a good public transportation network car drivers may be incentivised to switch their transport mode, which will not only reduce their CO_2 emissions but will also reduce the CO_2 emissions of other drivers since the risk of traffic congestion and the accompanying idling and increased fuel consumption are also reduced. Another major advantage regarding sustainability is the land use. By specifically focusing on the development of central transit hubs, urban sprawl can be limited, a phenomenon where cities tend to expand outwards often at the expense of nature or agriculture. If cities are planned around cars, then this can lead to the destruction of nature in favour of car-related infrastructure such as roads or parking lots. On the other hand, when cities are planned around transit hubs such as tram and bus, or train stations, the development in these areas are enhanced rather than trying to expand in new areas. This can also help to create more walkable cities, which will further reduce the need for cars in a given area. Since the need for expansion is reduced, public transportation can help to preserve the natural resources of an area, which is important for the environment, specifically the biodiversity. Finally, public transportation is also beneficial for the third pillar of sustainability, which is the social aspect. It offers access to jobs, education, and leisure activities to people who may not be able to access a car. Whether their income is too low in order to afford a car and its maintenance or whether they are too old or too young to legally drive, public transportation offers a viable option to people to access the same opportunities than people who can drive cars, which can also be beneficial for the economic development of a region. Finally, there are also certain health benefits linked to public transportation. The walking or biking needed to arrive at transit hubs can help to increase the physical activity and have significant health benefits, especially compared to car use, where physical activity is often limited. Generally, it can be said that public transportation has major advantages in three pillars of sustainability. Economically speaking, public transport is the superior choice over car use, because the costs are significantly lower. There are no maintenance costs for the consumer of public transport, and they are far less likely to be influenced by price spikes of petrol for example. Environmentally speaking, public transportation is also better than car use. There are significantly less resources needed to transport an individual with a train or a bus than by a personal vehicle. Furthermore, the net GHG emissions of an individual using public transportation are significantly less than a person driving by car, indicating that public transportation is less harmful for the environment. Finally, socially it helps to reduce inequalities in mobility between people and can help to foster social bonds and provide opportunities for jobs and education. It becomes apparent that in all three senses of sustainability, public transportation is superior to car use. The literature shows that the potential for travel behaviour change lies in people that are will-

ing to adopt more sustainable measures into their life, so it can be beneficial for policy makers to direct their marketing on this group of people. For the case of Luxembourg, the next section will have a deeper insight into the specifics of free-fare public transport and what advantages this concept holds, followed by a discussion on the potential drawbacks and complications a (free-fare) public transport system may have.

2.4.1.1. Advantages of Free-Fare Public Transport

In general, from a consumer point of view, free-fare public transport is a profitable and sustainable option compared to private car use. Volinski (2012) has done extensive research on the implementation and outcomes of fare-free transit systems and sought to answer the question on benefits but also drawbacks of free public transport. The research was done in the United States, yet can give a deeper insight on the concept as a whole and will therefore be further explained in this section. Firstly Volinksi (2012) notes that established free-fare public transport systems are mostly found in “small urban areas with relatively modest ridership and large rural areas with relatively low ridership” which characterises Luxembourg as a country rather well. It is true that in Luxembourg, the urban areas such as the capital city and Esch see more public transport users compared to the rural areas, but in general ridership is still lower than one might expect. First of all, the most obvious point should be addressed. For users of the service, it is essentially free and allows great access for everyone to general mobility within a certain region for everyone. It is a very inclusive policy that allows people from every socio-economic backgrounds to access public transport and increase their mobility and freedom. The cost barrier that may prevent people with lower incomes such as students or elderly people is absent and allows them to explore the country without having to worry about financial resources. Additionally, it allows people to save money during their daily commutes. Driving to and from work can be expensive, especially with petrol prices reaching an all time high at the moment. Free-fare public transport offers an economic alternative for people that want or need to save money and can even allow people to access more remote places, such as cheaper grocery stores that are often located in more remote locations in Luxembourg. Volinski (2012) even adds that public transport can be compared to education, recreational parks or, to an extent, roads which are all free of charge for users and could be regarded as a “public good”. It could also be argued that a fare-based public transport infrastructure is not as cost-effective as one may expect. Volinski (2012) presents many costs that may even surpass the income that is generated through fare collection. Expenses such as building up the infrastructure through the purchase of ticket vending machines, the development/purchasing of ticket or pass designs and providing the necessary security through cameras, as well as the maintenance and management of all these factors need to be accounted for. Personnel to manage the accounting and the whole infrastructure behind the paywall are all expenses that could potentially even surpass the income that is generated from the fares, essentially indicating that the public

transport infrastructure is economically ineffective even when consumers need to pay for it (Volinski, 2012). Another advantage regarding financials, is that the subsidy required to fund an individual's free-fare ride is lower than for conventional public transport infrastructures. This is because the general efficiency and productivity of public transport is enhanced through the implementation of a free-fare policy (Volinski, 2012). Furthermore Volinski (2012) adds that the productivity and efficiency of public transport may be impaired if there is a fare to pay. Especially in buses, needing to explain and purchase tickets from the bus driver, can have a negative impact on the schedule and lead to delays. Secondly, it can be expected that a free-fare public transport system will lead to an increased ridership, leading to less congestion on roads and consequently lead to lower emissions. As Volinski (2012) explains, numerous studies and research have been done on the topic of the adaptation of free-fare public transport discussing the pros and cons, yet one persistent fact or assumption has been that it will eventually lead to an increased ridership. According to the "Simpson-Curtin Rule", that has been used by many public transport operators to predict the impact of fare changes to ridership, an increase of the fare of 10% will lead to a decrease in ridership by 3%, meaning that a reduction of 100% such as the case for free-fare public transport an increase of ridership of around 30% can be expected (Volinski, 2012). This means that all the advantages of public transport, such as the better ecological footprint, the lower costs for an individual are seen by a lot more people that may continue to use public transport and drive less cars. Finally a social aspect of free-fare public transport has been the reduction of social hierarchies in places where such a policy has been implemented, and generally increasing the happiness and quality of life of all citizens that have access to it (Volinski, 2012).

2.4.2. Drawbacks of public transport

Under this section, the researcher will have a closer look at the disadvantages of different forms of public transport. By starting off with a broader outlook on potential drawbacks, this section will narrow down on Luxembourg specifically and free-fare public transport in order to give a better representation of the theory. Generally public transport offers a lot of advantages for the environment compared to car use, however at the cost of personal convenience. Arguments against public transport are for example the limited flexibility, since users need to adapt their schedule to the schedule of the public transport infrastructure. This is particularly aggravated for people that travel long distances or that live in suburban or rural areas where access to public transport is limited. For example, a person wishing to travel from Kayl, a city in the south of Luxembourg to the capital, to Hamilius, the central transit hub for the capital city, will need approximately 45 minutes by public transport with having to change from bus to train, while driving would only take around 20 minutes (Google Maps, 2023). This is a significant time loss for taking public transport. Furthermore, the train line that arrives in Kayl only frequents the train station every 30 minutes, strengthening the statement that flexibility is limited for

many people that do not live in urban areas. Another drawback regarding time schedules of public transport are limited opportunities to travel at night. Individuals who might need to travel at night to commute to or from work, such as shift workers have very limited options to travel by public transport. Moreover, the indicated time schedule is not always guaranteed. It is very possible that delays and disruptions cause major problems for public transport. May it be traffic congestion for busses without dedicated bus lanes, or maintenance issues or other perturbances for train lines, the schedule cannot always be kept in, leading to people having bad experiences and prejudices against public transport. For Luxembourg, there are currently a hand full of disruptions and planned works. The most notable one is the construction and reparation works near Kautenbach. The railway line between Gouvy (Belgium) and Luxembourg City is an important transit route and is utilised by a lot of commuters daily, since it it is a line that connects the north of the country with the capital. However currently, there are reparation works on this route due to a collapsed tunnel in August 2022. The national railway service CFL can currently not accurately predict when this tunnel and subsequently the train line will reopen again. As of right now, CFL offers a bus line to circumvent the collapsed tunnel, which leads to another potential drawback of public transport. It is true that overcrowding during rush hours can be an issue, even in perfect operating conditions, and can lead to uncomfortable travel, this disadvantage is enhanced in this situation. Naturally the fleet of buses cannot accommodate for as many passengers as a standard train would hold. Then again, busses are susceptible to traffic congestion which on this route is really elevated as portrayed on Figures 3 - 6. All around the situation is far from ideal currently, regarding this train line and will possibly shape the perception of individuals for a certain time, who will start using cars to commute and in turn become more reluctant to change back to train travel once everything is fixed due to the creation of a habit. As explored previously, limited storage space and opportunities and safety are also disadvantages of public transport. As stated by interview partners in Hiscock et al.'s (2002) study being able to carry large items is important for some individuals, and safety is also a concern for some, especially at night. Regarding accessibility, the train and bus stations are also not always near to an individual's home or chosen destination. This can turn away many potential users, simply due to the fact that they perceive the distance to be too long or too exhausting. While it is naturally not possible to accommodate for every single individual, there is a notable lack of public transport options in rural areas of the country. Trains lines run along the main axis of the country, yet do not serve more rural areas, which are served by buses. However, these buses again often only frequent any given stop once every 30 minutes to an hour, which can be frustrating for potential users, that then will switch to private car use. This can also potentially lead to a distorted image of the intent to use public transport. For example, due to the long waiting times or remote bus stops, people will drive by car, because they perceive it as more convenient. Then the firms of these buses could restrict the operation of the buses even further because they believe that people do not want to use public transport,

which is not necessarily the case. A more restrictive access to public transport would then lead to even less users and reinforce this negative feedback loop.

2.4.2.1. Drawbacks of Free-Fare Public Transport

Regarding the main advantages of free-fare public transport, which are the cost-effectiveness, and the lesser impact on the environment compared to cars, one needs to mention drawbacks at the same time. While not necessarily topic of this study, the whole project needs funding. Again, the focus for this research lies on the free-fare concept for consumers and does not necessarily go into depth regarding the expenses for the State that cover the lost fare revenue, but it should be mentioned anyway. A project like the one in Luxembourg, is very cost-effective for its users but means an extra expense of taxes on the project and could lead to a negative perception of the project. However, as previously established under another section, a free-fare public transport system will drop the subsidy per passenger needed (Volinski, 2012) and therefore become more effective and productive despite the larger investment needed. Furthermore it needs to be mentioned that busses for example need to reach a minimum capacity in order to be more sustainable than cars. It is clear that an empty bus will have a similar GHG output than a personal car and indicates a real issue that needs to be resolved. In order to be more sustainable and reach the established goals for 2035, the infrastructure needs to become as attractive as possible, since certain aspects will need to reach a certain quota in order to be a more viable option than car use. While not necessarily a problem for trains and trams, the use of combustion engines in buses for example is an issue that needs to be tackled. If a bus is often driving around without many passengers, it will subsequently emit a comparable amount of emissions than a personal car. Only if there is a behavioural change in people, where buses are seen as a decent option, they become more sustainable than personal cars. Alternatively, the utilisation of buses without combustion engines might be favourable, but this will again necessitate an upgrade to the infrastructure with charging stations for example and an investment in new buses. Furthermore, there might even ensue a rebound effect in regards to traffic. If the public transport infrastructure offers a viable or even better alternative to car use and leads to reduced traffic congestion, active car users might be incentivised to drive more with their cars, since one of the main perceived drawbacks of car use, namely congestion, is reduced. Moreover, Volinksi (2012) explains that with an expected increase in ridership, there may be some complications. In an initial stage, the increase of passengers may overwhelm the capacity of the system or infrastructure. A free-fare public transport network needs to be able to accommodate for a 30% increase in ridership, according to the “Simpson-Curtin Rule”. Also the presence of disruptive passengers, such as “loud teenagers and vagrants” (Volinski, 2012) can hinder the positive experience of free public transport users and might influence them to no longer use public transport. An effective measure against these disruptions may be the employment of more security personnel, which will lead to further investments into the system.

However, it needs to be noted that according to Volinski (2012), these “troublemakers” only make a negligible portion of all passengers and “bus operators prefer to deal with a few more disruptive passengers if it means that they do not have to deal with fare collection and fare disputes”. A more pressing issue is the need to upgrade the ridership capacity in general. With an increase in passengers, rarely frequented stops will become more frequented, meaning that stops where usually very few to no passengers entered or exited, will see some frequentation. This can lead to delays, especially if there is a large amount of passengers entering. It is also true that the expected or current level of quality of public transport needs to be maintained or even improved with more passengers using the service. This will again mean a significant investment into the infrastructure, with more trains, buses, and trams, but also the expansion of the whole network. Finally, a major concern for free-fare public transport systems is that it does not reach the desired audience. Volinski (2012) explains that only a relatively small percentage of new trips through the implementation of free-fare public transport stems from a switch from motorised vehicles such as cars. It became clear through numerous observations of free-fare public transport networks that the increase in ridership stems to a major part from people that engaged in sustainable behaviour anyway, such as people that use bicycles or walk to their destination and from people that were encouraged through financial limitations such as students or elderly people. Car users were rather resistant to adopt the free alternative, because they were less influenced by the financial barrier, since driving itself is costly in and of itself and a cheaper alternative such as public transport is not perceived as an argument against car use by many drivers. It appears that lowering the cost-barrier has no measurable effect on driving behaviour, if the car is still seen as a more “comfortable” or convenient option for drivers. This is amplified by the current status quo, where public transport options in Luxembourg are limited. As previously explained, many rural areas are not serviced by trains, or rarely frequented by buses, which is perceived as a limitation to convenience, time management, or “freedom”. In general it can be said that the main drawbacks of public transport use can be divided in two categories. Firstly, the disadvantages of public transport use on its own are the bad connections in rural areas, which are defined by long waiting times and remotely located bus stops, and the susceptibility to delays and disruptions. These are factors that need to be addressed, but will be more difficult to avert, since they will need significant investment in the infrastructure. On the other hand, there are the factors that are comparatively worse against car use. Cons such as the limited flexibility of time schedules, the safety factor, the overcrowdedness, or the difficulty to transport heavy or large things are all arguments against public transport use, but are tangent problems that can be solved. With people explaining their reasons for car use despite access to public transport, these are among the most cited arguments (Hiscock et al., 2002) and show what people are really concerned with, when choosing a car over public transport. While it is difficult to address problems such as the limited flexibility and adapt to every individual’s wants and needs, an expansion of public transport access in

rural areas in Luxembourg may be a small step forward in order to reach the goals of the PNM 2035. By increasing the frequency of buses traversing certain rural towns, some people may be incentivised to use public transport more often. This could also be a foundation for solving the problem of overcrowdedness in public transport especially during rush hours. Another point that needs to be mentioned is the safety factor of bus or train stops. Simple measures such as employing security personnel, security cameras, “safety phones”, and/or bright lights directly address the concerns of many people regarding public transport and could in turn have a positive impact on ridership numbers.

2.4.3. Reflection on the advantages and disadvantages of public transportation

In general it can be argued that the advantages of public transportation, especially in Luxembourg, lay in the economic and environmental pillar of sustainability. Since it is completely free of charge for users it is a very inclusive policy and allows people from any social background to be mobile in the country. Also it helps to drastically reduce CO_2 emissions in mobility, because not only does the energy required to transport one person is lower than for car use, a functioning and operating public transportation network can also help to reduce CO_2 emissions of car users due to the decrease in traffic, if it is attractive enough for individuals to use it. So what are the drawbacks of public transportation? At the expense of increased environmental protection and lower costs, users of public transportation usually have to reduce their flexibility and are dependent on public transportation schedules. This is a major concern for many people that drives them away from public transportation use. Also the accessibility to transit hubs is restricted for many people in more rural areas of the country, making it difficult for them to profit of the free-fare public transport in Luxembourg. With restricted access or long waiting times for public transportation, many people decide on cars as they are perceived to offer more flexibility and operate whenever an individual wants. While the positives of public transport are good for the planet and for an individual’s wallet, cars are often seen as necessarily evils for the convenience of an individual. This is because people have different needs and wants and some destinations are difficult to reach by public transport or take a longer time compared to car use. Especially for people that own cars and therefore have a choice on which transport mode to take, the decision is often made out of convenience rather than sustainability reasons.

2.5. Conclusion of the Literature Review

To conclude this section, it is favourable to look back at the findings and summarise them under this section. Firstly, an outline of the current situation regarding mobility in Luxembourg was given, followed by an analysis of the Modu 2.0 strategy and the PNM 2035. These documents published by the MMTP show that there is an increased need for the use of public

transportation in Luxembourg in order to achieve the envisioned sustainability goals. The PNM 2035 also subdivides the Grand-Duchy in different mobility zones to better show where the need for cars is higher and to make the analysis of the situation easier. This study will use these different zones to make relevant conclusions about the travel behaviour of people in Luxembourg. Most importantly the PNM 2035 acknowledges the lack of public transport infrastructure in rural areas of the country and the need for improvement in this regard. Regarding urban areas, the idea is to reduce the attractiveness of car travel, due to the limited capacity the roads in urban areas can sustain and the increase in traffic that is expected by 2035. The demographics suggest that there is a tendency of male people with a relatively high income to be the stereotypical car driver, however an increase in female drivers is notable in recent years. Notably, younger people have less interest in purchasing or using cars, compared to older generations. A major deciding factor in the choice of transport mode, is the psychological aspect. Although the TPB would indicate that public transportation should be the favourable mode of transport, because it is generally, regarded as “good” thing, people tend to have a good opinion on it, and it is easily accessible for most people, the individual needs of people differ significantly, which may explain the underutilisation of public transportation. For example, a person may perceive public transportation as a good thing and think that it is better for the environment, yet not have great access to transit hubs and therefore decide to use a car. It is particularly this notion of convenience and flexibility that car drivers value particularly over public transportation, even if they engage in sustainable behaviour elsewhere. Another major psychological factor in the choice of travel mode is habit. Many current drivers perceive a switch to public transportation synonymous with great efforts and decrease in QoL that seem too overwhelming to realise. Also through this habit of commuting to work everyday by car, a script or schema can form, which can be notoriously challenging to overcome. This leads a restricted possibility of individuals to change their travelling behaviour, since using a car is deeply ingrained in their daily routines that they do not even think about other available alternatives such as public transportation. Finally, the advantages and disadvantages of both car use, and public transportation are plentiful and all hold their merit, yet it becomes clear that many of the advantages of car use are relative to public transportation. In essence, people often argue that cars are more flexible or offer more “freedom” but interestingly not necessarily because cars are inherently better, but because public transportation is not as flexible as car use. On the other hand, avid defenders of car use argue that advantages of public transportation such as the sustainability aspect or the reduced costs compared to cars are often negotiable and are not worth the sacrifice in convenience and comfort on an individual level. This is an aspect that could be decreased by clearly addressing the concerns of individuals about their mobility by focusing marketing efforts not on the short-time shortcomings but rather on the long-term improvements in QoL.In the result section it will be interesting to reflect on these hypotheses in order to see to what extent people in Luxembourg agree with the common arguments for and

against car use and public transport use, taking into consideration that the public transport is free of charge. From this section it became clear that the arguments for car use are rather relative to public transport use and subjective to the users. Many drivers argue that the benefits of public transport use for the environment and for economic reasons are negligible for their perceived convenience underlining Hagman's (2003) study. Interestingly, the perceived benefits of car use stem from the perceived drawbacks of public transport use, meaning that driving is not inherently seen as "better" than public transport use, except for people that indicated that driving is fun. However, the drawbacks of car use are plentiful, ranging from the obvious detrimental impact on the environment through GHG emissions and the costly nature of driving, to stress related to traffic congestion and parking space search among others and are points where the free public transport in Luxembourg has its advantages. In general it can be said that the literature indicates that an increase in public transport use is possible, through the adaptation of certain measures that appeal to the customers, notably improvements in areas such as convenience, punctuality, and safety (Beirão & Cabral, 2007). Moreover, the general attitude and psychological factors influencing the decision making in travel behaviour should not be underestimated. There is a clear distinction between people that are willing to adopt public transport use as their main mode of mobility and people that prefer to use cars. Beirão &and-Cabral (2006) suggest that " the choice of transport is influenced by several factors, such as individual characteristics and lifestyle, the type of journey, the perceived service performance of each transport mode and situational variables". This means that people will have different needs for their journey, for example a parent might want to take their child to go shopping and will subsequently need some more storage room and easy access to their home again, which is facilitated by using a car. On the other hand, a person travelling to the city centre to have dinner might need a quick, cheap, and direct route which will be facilitated by public transport use. So in essence, the choice of travel mode highly depends on personal preferences and situational factors. This leads to a situation where some people will be willing to adopt a more sustainable travel behaviour, whereas others might be more difficult to convince to use cars less. Since Beirão et Cabral (2007) also explain that policies that seek to decrease the use of cars should focus on the people that are most likely to use change their current behaviour of car use to public transport. For this research this will give valuable insight into what people truly desire from the public transport infrastructure and what is currently less favourable than in car use. This will in turn facilitate the switch from car use to public transport use, if car use is less convenient and easily accessible and public transport is seen as a valuable alternative.

2.6. Hypotheses Development

The quantitive hypotheses development serves to investigate the relationship between variables of a given phenomenon. Typically, these hypotheses are formed on the basis of previous research on the topic, which will also apply for this study. There are two types of hypotheses.

Firstly the H0 hypotheses. This so called “null-hypothesis” indicates that there is no significant relationship between variables. The alternate hypothesis that is juxtaposed, predicts a direct link between variables or phenomena.

For this study, seven hypotheses have been developed, which will be presented under this section and analysed through the means of statistical analysis later, followed by an exploration of further results through demographical variables.

An expected outcome of this study and as such a hypothesis that can be stated is that the perceived benefits of car use, such as convenience, comfort, and prestige as established by Hiscock et al. (2002) outweigh the drawbacks in importance for Luxembourgish people. In essence, this tests Hagman’s (2003) assumption that people perceive their benefits of car use as imminent and non-negotiable, while the drawbacks such as the environmental impact are negotiable or less significant compared to the enhanced flexibility, convenience, comfort, and prestige for the drivers. The aim of the first hypothesis is to establish whether the status quo of car use in Luxembourg is firstly confirmed by the participants of this study and secondly to find out whether the car is seen as inherently better as public transportation, or whether the perception of public transportation is simply inferior to the one of car use. In a similar way it is expected that the benefits and drawbacks of public transportation also play a role in the selection of the transport mode.

Hypothesis 1: Driving/using public transport matches with the subjective perception of benefits/disadvantages of the respective transport mode in Luxembourg.

Due to the nature of mobility being a rather personal subject, the reasons for individual car use can be plentiful. However, it will be interesting to investigate whether the reasons for car use in Luxembourg are rather rooted in emotionality with factors such as fun, status, or stress or if they are rather explained by the functionality of cars such as the shelter, privacy, or transportation possibilities offered. It is predicted that the functionality is more significant than the emotional factors, as explained by Hiscock et al. (2002).

Hypothesis 2: The reasons for car use in Luxembourg are rather functional in nature than emotional.

Through the established infrastructure around car use and the ensuing enhanced attractiveness of car travel as argued by Hiscock et al. (2002) and Dupuy (1999), the practical advantages of car use over public transportation regarding convenience are significant, which means that the expected result that the autonomy as defined by Hiscock et al. (2002) as reliability, convenience, and choice is the most important aspect in the decision-making process regarding mobility with protection and prestige being less important factors. A perceived reduction in QoL is

often met with rejection, as argued by Steg and Gifford (2005) and prejudices against the convenience of public transportation for example often limit the intent for change.

Hypothesis 3: Convenience is the most important factor for car use in Luxembourg.

Attitudes towards car use and intent to change towards sustainable travel with public transportation are often limited by the presence of habits. As explained by Havlíčková and Zamecnik (2020), habits should be considered as a factor in the decision-making in mobility questions. With frequent behaviour in a stable context, the intent for change is limited, so the role of habits is expected to be a determining factor for the choice of travel mode. This will be reflected by the frequency of car use per week, compared to the intent to using to public transportation for their next travel into urban and rural areas.

Hypothesis 4: The stronger the habit to drive in Luxembourg, the lower the intention to use public transportation.

Another expected outcome of this study is that people living in rural areas, will be more reluctant to switch towards public transportation, due to the perceived limited access to it and the perceived decrease in QoL that would follow a mobility switch as argued by Steg and Clifford (2005). Furthermore, it is also predicted that these people will see a car as a necessity for their lifestyle. On the other hand, people residing in urban areas are expected to be less frequent drivers and more open to using public transportation, while seeing cars as less of a necessity.

Hypothesis 5: There is a difference between the residents of the different mobility zones in Luxembourg regarding intent to use public transportation and seeing cars as a necessity for their lifestyle.

Previous research on free-fare public transport in Tallinn, Estonia by Cats et al. (2016) indicates that free-fare public transportation is successful in general and increases the attractiveness of public transportation, however is rather adopted by lower income citizens. Furthermore Volinski (2012) argues that the introduction of free-fare public transport also often attracts people that were travelling more sustainably anyway, meaning that rather than an anticipated modal shift in mobility from car use to public transportation, the increase in ridership numbers in public transportation after the omission of fares stems from pedestrians, or bicycle riders. With however a large proportion of people in Luxembourg being quite wealthy, with a mean disposable income of 3641€ per month in 2020 according to STATEC (2023) and only 17.4% of the working population being considered being at risk of poverty (STATEC, 2023). For comparison, the mean disposable income per month in Tallinn in 2020 was around 950€ (Statistikameet, n.d.). It appears as the the introduction of free-fare public transportation did not have the de-

sired impact on the majority of the population, since they mostly have sufficient funds to spend on car use.

Hypothesis 6: The introduction of free-fare public transport in Luxembourg was particularly met with an increase of ridership from lower-income citizens and sustainable travellers.

The intent to switch to more sustainable travel modes such as public transportation is expected to largely depend on the amelioration of the infrastructure and less on inconveniencing car use. This is based on Steg and Clifford's (2005) assumption that a perceived decrease in QoL will have a negative effect on intent to change mobility behaviour. which is why the seventh hypotheses is the following:

Hypothesis 7: The improvement of the public transportation infrastructure is more convincing for car drivers to incentivise mobility change than inconveniencing car use.

These seven hypotheses will be analysed at a later stage in order to define the status quo of the situation in Luxembourg regarding car and public transportation use, the main reasons for car use, the reason for the underutilisation of free-fare public transportation, and also the role of psychological factors such as emotionality, habits, and perceived QoL. Following the analysis of these seven hypotheses, there will be another section dealing with the responses of the questionnaire by different socio-demographic variables in order to see what group of people is more or less inclined to change their mobility behaviour in order to reach the goals of the PNM 2035 as defined by the MMTP.

3. METHODOLOGY

This section will explain the methodology and the manner in which it was utilised to determine the reasons for car use in Luxembourg despite the access to free-fare public transportation since 2020. This will include a detailed outline of the chosen research design with its advantages and disadvantages, possible alternatives and why they have not been chosen, an explanation of the data collection, a description of the questionnaire, followed by the sampling process and study sample in this research. Finally the data analysis tools will be highlighted.

3.1. Research Design

Choosing the right research design is essential for a study in order to be representative and successful. Creswell (2012) argues that there are three main design methods that a researcher can choose from, which are namely a qualitative, a quantitative, and finally a mixed-methods approach.

A qualitative approach is defined by Creswell (1994) in Lanka et al. (2021) as “an inquiry process of understanding a social or human problem based on building a complex, holistic picture, formed with words, reporting detailed views of informants, and conducted in a natural setting”. In simpler terms, qualitative research predominantly uses non-numerical data in order to understand and explain concepts, opinions, and experiences. This can be very helpful for sociological research topics, since it allows to dive deep into the personal opinions and beliefs of participants and investigate what people that are affected really think about a given topic. Other advantages of qualitative research include the flexibility, meaning that, contrary to quantitative research, data collection or the analysis of the collected data can be altered if need be since there is no set structure in place (Bhandari, 2023). Also the natural setting, meaning that the data collection is done in a real-world context adds to the validity since the researcher does not interfere with the current situation if they simply observe what is happening (Bhandari, 2023). The disadvantages however are that a qualitative design may be rather unreliable, since uncontrollable factors may influence the observed situation and the subjectivity of the analysis may affect the validity of the results. Since there is only one researcher that conducts the analysis, it is difficult to replicate, which decreases the validity of the results. Also generally, in qualitative research the sample is rather small, which limits the generalisability of the results, because they may not be inclusive of other opinions and cannot be applied to a wider public (Bhandari, 2023).

A quantitative approach is defined as collecting and analysing structured data that can be analysed through statistical means (Goertzen, 2017). Quantitative research deals with the demographics of a population and allows to make generalised statements about a specific group of

people. It is easy to deduce certain patterns and trends from quantitative research, yet it fails to uncover the “why”. The direct advantages of a quantitative approach is the easy replication of the study, due to the established data collection methods utilised and the ability to be able to easily compare the results with different groups of people (Bhandari, 2022). Also the naturally larger samples compared to qualitative research allow for more accurate analysis, which can in turn enable the researcher to make generalised statements that capture the zeitgeist. Some disadvantages however of quantitative research that it may be oversimplifying complex phenomena such as emotions and that a too strict focus on the predetermined research process can hinder the natural revelation of knowledge (Bhandari, 2022). Also the “unnatural” context of many quantitative studies through laboratories may prevent the inclusion of historical or cultural contexts and some research biases can lead to inaccurate results, which both may jeopardise the validity of a study (Bhandari, 2022).

The third and final research approach is mixed methods. Very simplified it is a combination of both, qualitative and quantitative research. It seeks to combine the best of both approaches by for example addressing the small sample size for qualitative research and compensating for it with a larger sample size in quantitative research. Similarly disadvantages of quantitative research such as the limited insight into personal experiences are compensated for with the qualitative part. The disadvantage however of this approach is however that the results of the both approaches may contradict each other. Also the comparison of both approaches can be rather challenging due to the fact that the two approaches have very different processes (George, 2022).

Of the three discussed types of research design, the most appropriate one for this thesis would be the fixed strategy. This is because of the quantitative nature of the research, with a focus on a survey in order to gather the answers to the main question, which is why people in Luxembourg still predominantly use cars in order to be mobile. The fixed strategy is arguably the best choice for this thesis since it is also very theory-driven. The plan for the thesis is to ground the survey and its questions in the theory, meaning the available literature on mobility, car ownership and use reasons, and also public transport. This allows to better draw conclusions from the answers and results of the survey and compare them to the literature and also compare existing phenomena with the revelations of this study. Since the thesis is also concerned with group properties, meaning how a specific type of people behave and also their general tendencies will be explored, a fixed strategy seems to be the optimal choice for this study. While it is positive that the fixed design allows to further investigate the behavioural patterns of people and will be useful in order to identify trends and common grounds, it will be difficult to identify individual responses and therefore overlooks more personal opinions on the topic. This is however not necessarily a problem for this thesis, since the aim is predominantly to investigate the phenomenon of car use and ownership regarding a larger group of people, in order to improve

the available alternative, namely public transport. The thesis will be conducted through the means of quantitative research, since it helps to better analyse the trends and behavioural patterns of the participants of the survey. The main point of the research is to establish certain trends and similarities between this unusual or counter-intuitive behaviour of people. Although a mixed methods research with an exploratory sequential design would also have been possible, with a first phase where common reasons could have been researched through interviews and in a second phase presenting these findings to survey participants in order to analyse if these statements represent the general consensus of car owners and users in Luxembourg, the researcher opted against this option. This is because the researcher believes that the personal importance of a car in Luxembourg is too subjective and therefore would yield a too broad set of responses in the first stage. This is why the researcher opts for a solely quantitative approach to this research with the survey deeply embedded in theory and literature. The literature on mobility and public transport (even on free public transport) is vast and behavioural reasons for car use have also been studied in the past, allowing for a great resource of material to model a quantitative study around. Again, the aim for the thesis is to establish the reasonings behind people in Luxembourg to drive cars, when a more economic and sustainable option is available, especially with growing concerns for the environment and rising prices in petrol. This means that the focus is less on personal opinions that can vary vastly between participants but rather on presenting the participants with established and researched phenomena and arguments stemming from literature and to see how much they can identify themselves with these statements in order to identify social tendencies and finally conclude from these findings an optimisation strategy for the public transport network in order to ameliorate the CO_2 footprint of the Grand Duchy.

3.2. Data Collection

In order to be able to investigate the reasonings behind people in Luxembourg choosing to drive and own cars, while public transport, a more economic and sustainable option, is readily available, this thesis utilises a quantitative research approach. Since a quantitative approach allows to generalise the findings for a larger group of people, ideally the entire population, it is more suitable for this specific research (Holton & Burnett, 2005). Since the aim of this research is to study the behaviour of car users and owners and to ideally apply the findings into the amelioration of the public transport network, it is favourable to use a quantitative research approach compared to a qualitative because a there is a particular need to be able to generalise the findings. As established beforehand, the nature of the very research topic holds various different opinions and positions that would be too diverse in order to summarise in a coherent paper. That is why the study opted for a survey with questions based on literature on mobility and its economic and sustainable factors, car ownership and use, and finally (free) public transport. Holton & Burnett (2005) also explain that a quantitative approach can facili-

tate drawing comparisons between different social groups, such as younger and older generations, gender identification, or residents and foreigners/commuters. Through detailed analysis, this research design also allows to make adequate assumptions and even predictions for the future. Since these group comparisons are also a core part of the analysis of the results of this study, since they could be very beneficial for the future planning of the public transport network, it reinforces the decision to conduct quantitative research. The particular method of research is a cross-sectional survey design, which by nature seeks to investigate current phenomena. As Creswell (2012) argued, this design can "examine current attitudes, beliefs, opinions, or practices", which seems ideal for this research on the current situation in Luxembourg. The questionnaire will firstly start off with general questions, enabling to identify what social groups the participants are part of such as questions regarding gender identification, age, and place of residence. These questions allow to categorise the answers in different fields and help to confirm or deny different hypotheses stated before. Then the survey will move on to the main part of the questions. The main part of the questionnaire, which will consist of a series of statements regarding car use and (free) public transport and why it was not chosen as the mode of transportation. Obviously, the questions will be stated in a way that do not suggest any judgement from the side of the survey and researcher, since this could decrease the rate of completion of the questionnaire. Additionally it might also be interesting to mention that the survey will be available in 4 languages, because of the various different nationalities and languages spoken in the Grand-Duchy. This is to ensure a high amount of respondents that can participate in the survey and are not inconvenienced by a survey that might not accommodate for their language preference. This is particularly important for commuters and immigrants in the country that might only speak one of the four languages commonly understood and spoken in the country. Therefore an English, German, French and Luxembourgish version of the survey will be available online for answering, which can be found in Appendix A to D. The online format is also a distinctive choice made by the researcher in order to further enhance the reach of the study and also allows respondents to answer at their own pace and at their preferred time (Evans & Mathur, 2005). This decision seems favourable over other formats for this research, since a larger sampling size will be needed for the analysis of trends regarding car ownership and use in Luxembourg. Furthermore, as established by Evans and Mathur (2005), there are some drawbacks to the online survey research format that need to be addressed. Examples for this are notably the impersonal nature of online survey, and potentially unclear questions that cannot be reformulated right away from the researcher. These are points that need to tackled before the publication of the survey in order to ensure the best possible experience for the respondents which will in turn increase the respond rate and add validity to the final results. Regarding distribution and in essence also sampling, a preliminary mail asking for consent and willingness to participate will be sent to numerous enterprises and private email addresses, without any particular sampling beforehand, ensuring a random selection of participants.

Evans and Mathur (2005) argue that sending email with surveys can have its repercussions, since they can be perceived as spam and that there needs to be an option for participants to opt-out of the survey. After agreeing to partake the people will be send a short email with the URL to the survey. Following the email distribution of the survey, it will also be published on social media.

3.3. Questionnaire Development

The chosen method of data collection for this quantitative study is a questionnaire with questions and statements drawn from the literature review. The survey will start off with a few general questions to the respondent regarding their gender identification, age, place of residency and if they are commuters or not. These initial questions help to classify the respondents in the four major groups that will be revisited later on for significant differences through statistical analysis and compared. After that the respondents will be presented with a selection of statements regarding car use and the perceived advantages and disadvantages, free public transport in Luxembourg and its perceived advantages and disadvantages and general questions regarding mobility, the financial and economic situation in Luxembourg and sustainability. Utilised was a 5-point Likert scale ranging from “Strongly Disagree” equaling to 1 and “Strongly Agree” equaling to 5. The questionnaire however needs to be clearly structured, inclusive and accessible, meaning that more difficult concepts from the literature review need to be worded in a way that they are understandable for all audiences. Adding to this point, the survey will also be available in four different languages in order to facilitate the access to it. Luxembourg is a highly diverse country with many international backgrounds and 4 most commonly spoken languages, so it is natural that this research will try to accommodate for this fact. Analysing the results will be done through statistical software, allowing to group together the different gender identifications, age groups and residents and comparing their responses on the Likert scale to one another.

To begin with, the questionnaire presented the participant with a question regarding their preferred language. The participant was able to choose between English, French, German, and Luxembourgish and was redirected after that to the questionnaire in the language they felt comfortable in. Then the first true section of the questionnaire began, where the participants were presented with a brief description of the research topic and were informed that their participation is anonymous and that their responses would be treated with the utmost confidentiality and only used for the sake of this study. The first questions dealt with the participant themselves and included questions regarding gender identity, age, monthly income, education level, and place of residence among others. These questions were essential to categorise the later answers regarding car and public transportation use and to paint a clear picture of the situation in Luxembourg and to make comparisons between groups of people and their atti-

tudes towards mobility in the Grand Duchy. The second set of questions were statements about cars and traffic. This specific design of a Likert Scale was chosen in order to allow participants to share their feeling towards statements in a controlled manner and because it facilitates the analysis of the answers compared to open-ended survey questions for example. The statements themselves stem from the researched literature regarding car use and the perceived advantages and disadvantages that have been noted by other researchers. The participants are therefore presented with common arguments for and against car use and indicate to what extent they agree with these statements, which can help to determine whether the results of previous research aligns with the findings of this study specifically targeting Luxembourg. Regarding the questions about Luxembourg, they can help to show where drivers see the most benefits to driving cars or on the other hand which factors do not bother them as much as maybe hypothesised.

The second set of questions were again statements but this time about the public transportation. Similar to the first section the participants needed to decide to what extent the presented statement aligns with their personal opinion on a scale from 1 (Strongly Disagree) to 5 (Strongly Agree). These statements were again elaborated from the literature review and are essentially common advantages and disadvantages of public transportation that are perceived by consumers. There were also a couple of similar questions to the first section such as “I think that public transportation is convenient” and the similarly worded “I think that a car is convenient” to facilitate the analysis and aid comparability of the opinions on the different transportation mode.

Finally the third section dealt with questions regarding the future of mobility in Luxembourg. Again, the participants were presented with statements which they needed to rate from 1 to 5 according to their agreement with them. The majority of the statement in this section begin with: “I would use public transportation more if…” followed by the most common arguments in favour of car use and against public transportation in order to see which changes to the public transportation infrastructure might incentivise car drivers to consider switching their mode of transportation. This section will also help with the analysis of the restrictions to behavioural change as explained in the literature review. It has been noted that people are notoriously reluctant to change their ways if it requires too much effort and is perceived as a decrease in QoL, so directly asking participants what factor (if any) would need to change for them to consider taking public transportation could be a valuable insight for this study but also for the further development and improvement of the infrastructure.

3.4. Sampling and sample size

In an ideal world, any research would investigate the entirety of a population, however in most situations this is not possible. This is why sampling is implemented. Sampling is a technique to find a sample, so a section of a population that is representative of the whole population, which holds significant value in research (Acharya et al., 2013). That is why this section will deal with the sampling for this precise study and explain how and why this method will help to solve the research questions on why people choose to use cars in Luxembourg when free public transport is available.

Firstly, the target population needs to be established, which should also be defined in terms of elements, extent, time, and sampling units. The element in question for this research in particular are car users and owners in Luxembourg, who essentially do not behave in a way that would be assumed as rational by classic economists. The information interesting to know here from the participants is why they act the way they act, despite better social, economic, and ecological practices available, namely the use of the free public transport network. The participants will be able to answer the questions on their own transport and mobility behaviour best, so it is preferable to focus on them as an element in the target population. The extent, so the geographical boundaries, are set to Luxembourg as well as the three neighbouring countries Belgium, France, and Germany and its residents. However it should be noted that the extent itself is limited to the grounds of the Grand Duchy, but participants so elements will most likely be from the four nations mentioned beforehand. Since the focus of the research is on the free public transport infrastructure currently unavailable in France, Belgium, and Germany at the moment, the extent will also only limited within the borders of Luxembourg. The time period under consideration for the study is from March 2020 until May 2023. This is because the free fare public transport has been established then and any car use since then is relevant for this study. Data collection itself however, was done from April 2023 until May 2023. Finally as for sampling unit, all car users in Luxembourg since March 2020 are relevant and useful for the study. While the sampling is rather general and randomised, a division of the respondents will be made through the survey regarding gender, age, place of residency, and finally commuters and residents.

A second step in the sampling process is deciding on the sampling frame. The participants, so the car users in Luxembourg since March 2020, will be reached through an online based survey with a link available through email and social media. The major advantage of online surveys is the enhanced reach and the comfortability for the respondents regarding time (Evans & Mathur, 2005), which will be essential in order to achieve the envisioned 125 to 150 respondents to the survey, because otherwise the generalisation of the results might not be not be accurate or representative later on.

The third step to sampling is the design, where probability or non-probability sampling, simple random sample or systematic sample, or stratified or cluster sample techniques have to be chosen. Since it is rather difficult to identify the individual population parameters in this research, it is favourable to utilise a non-probability sampling. The scope of the research is too large for a probability sampling approach, because every unit in the target population, so car users in Luxembourg, would need an equal chance of being selected, which is unfortunately not feasible under the given circumstances, because it would indicate the need for the study to possibly reach everyone that has driven in Luxembourg in the last three years, including tourists or people that have moved away. The two most suitable sampling techniques for this research would be convenience sampling and snowball sampling. Convenience sampling is the most accessible form of sampling, because members of the target population are chosen through practical criteria such as "easy accessibility, geographical proximity, availability at a given time, or the willingness to participate" (Etikan, et al., 2016). The main issues that need to be addressed however with convenience sampling are the homogeneity of the population, meaning that it is essential to guarantee that any other sample of the population would have yielded the same results and to address selection bias. Selection bias can have a negative effect on the validity of the research therefore it is important to mitigate for sampling bias. A first step to address these issues would be to explain in detail all aspects of the methodology and sampling in order to allow for replicability, which would increase validity. Moreover a large sample size may also be helpful in reducing bias, in the sense that it may increase randomness and diversity across the survey, which should also be distributed through different platforms and different points in time. This also addresses the problem of the undercoverage bias. Snowball sampling, where the researcher firstly contacts a selected circle of participants that fit the criteria, who then invite peers that also fit the study, might also be an option, because it allows to show rare characteristics and would therefore also lead to a more representative result than convenience sampling (Parker et al., 2019). However the main weakness of Snowball sampling is the time-consuming nature of the technique. It also faces the same fundamental issue than convenience sampling, which is that it does not start from a statistically relevant random point and naturally holds a certain degree of selection bias. The question that arises now is what sampling technique to use. While both seem adequate for the scope of the study, a convenience sampling approach may be favourable, because it is more time-efficient and the rare characteristics that a Snowball sampling may bring to light are not necessarily desirable in this research. Not only does it focus on a rather large population, but the studied phenomena and reasons are well established in literature and the quantitative nature of the research leads to a fixed set of statements on which the respondents will reflect on and indicate how much they can identify themselves with these statements.

Establishing the sample size of the study is a necessary step in order to donate validity to the research. By accepting a margin of error of around 8 to 9%, a confidence level of 95%, and a

population size of around 600000 car users daily in Luxembourg, the recommended sample size according to the Sample Size Calculator by Raosoft Inc. (2004) is 119 for a confidence level of 9% and 151 for a confidence level of 8%. It is envisioned to gather answers from around 125 to 150 participants in order to underline the validity and relevance of the study and mitigate some of the limitations of the chosen sampling approach.

Finally some other limitations of the data collection include the previously mentioned biases, such as the sampling bias or the undercoverage bias and obviously the large scope of the study limits the generalisation. There is a large population size that would be very interesting to study with a randomised approach, which however sadly overgrows the budget and scope of this thesis. In order to mitigate the dangers to validity and reliability for this project it is important to address the biases stated beforehand and accept that a generalisation to the entire mobility and transport situation in Luxembourg is not feasible.

3.5. Data Analysis

The collected data of the participants is transformed into information about the current situation in Luxembourg through the use of different software such as PSPP, Microsoft Excel, QGIS, and Google Forms. In a first step it was important to lay out the individual answers to the different questions in order to give an overview. These figures and explanations give a first insight into the results and depict the current status quo in Luxembourg regarding car and public transportation use as well as the demographics and future intent on mobility behaviour shift. In a second step, the reliability of the questions is tested through the use of Cronbach's Alpha. Due to the fact that Cronbach's Alpha deals solely with metric data, some questions cannot be tested for their reliability, particularly those in the demographics section of the questionnaire. The reliability scores will be divided into the four categories, according to the theme of the questions in the questionnaire, meaning demographics, questions on car and public transportation use and finally future intent to using public transportation. In a third step, the data will be analysed through factor analysis, in order to find out whether there are underlying themes in the variables. It is expected that there are different factors for the whole data set. Naturally through the questions regarding different topics as just explained, but also regarding the advantages and disadvantages of car and public transportation use as well as more underlying themes such as emotionality and functionality among others, which remain to be explored. In a forth step there will be the testing of the hypothesis presented previously through meticulous testing and statistical analysis and finally in a fifth step there will be an analysis of the responses through the lens of demographics in order to see which group of people have which opinion regarding the subject of this study. Identifying target groups could be beneficial for future mobility marketing.

3.6. Ethical Considerations

During the data collection process, the participants were greeted with a message addressing several data protection concerns. The anonymity and the confidentiality of the data shared by the participants was guaranteed, by not asking for any concrete identifying data such as names, addresses, or similar. Moreover, the participants were informed that there is no obligation to complete the survey, if they deemed it to be too overwhelming or too intrusive. All questions were able to be left blank, if the participant so chose. The collected data was treated with utmost caution and not shared with any third parties.

4. Results and Discussion

This section will deal with the findings of the study. In a first step, this section will simply present the answers under the form of descriptive statistics. Due to the fact that the survey was available in 4 different languages, the presentation of the results will, instead of including a graph of the answers for every single language, present an overall graph, showing the total result of any given question. Then at a later stage give deeper insights by finding correlations and testing the previously established hypotheses.

4.1. Descriptive Statistics

This section will present the results of the 79 questions that the participants answered in the survey regarding car use and public transportation in Luxembourg. In total there were 228 participants from many different demographic backgrounds aiding in the representativity of the study.

4.1.1. Demographics

In a first step, the demographics of the survey will be presented in order to allow for further analysis later on.

4.1.1.1. Language Selection

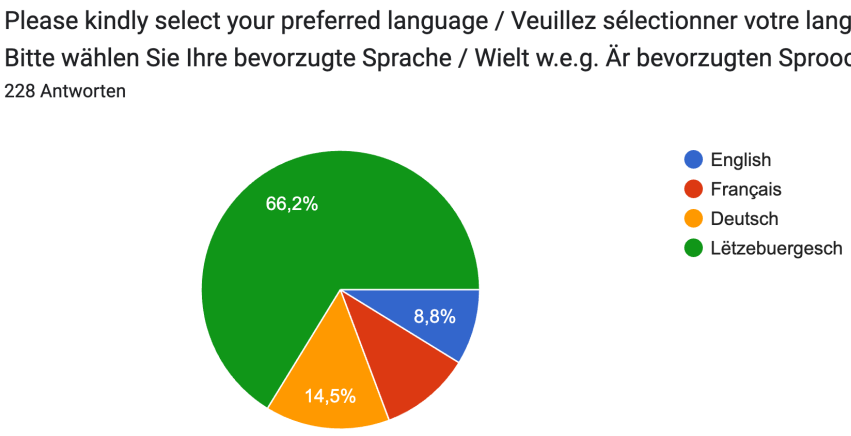

Figure 7 - Language Selection Distribution

According to Figure 7, ⅔ of the 228 respondents chose to answer in Luxembourgish. It is not uncommon for people in Luxembourg to know all four of these languages, but most citizens will have a preference for one of these four languages. It is however, noteworthy that Luxembourgish was the language that was chosen by the participants the most, since it is indeed the most widely spoken language at home but only the third most spoken language at work behind French and English (STATEC, 2019), who were far less often used in order to answer this survey.

4.1.1.2. Gender Identity

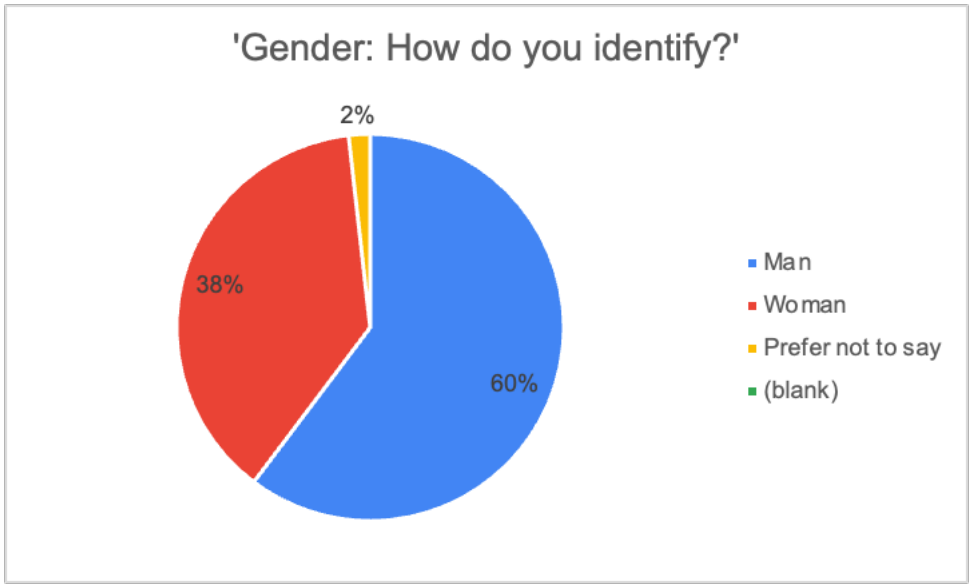

FIGURE 8 - GENDER IDENTITY DISTRIBUTION

Figure 8 shows that men made up the biggest portion of the participants. While a Non-Binary option was given, none of the participants of this survey identified as such.

4.1.1.3. Age Group

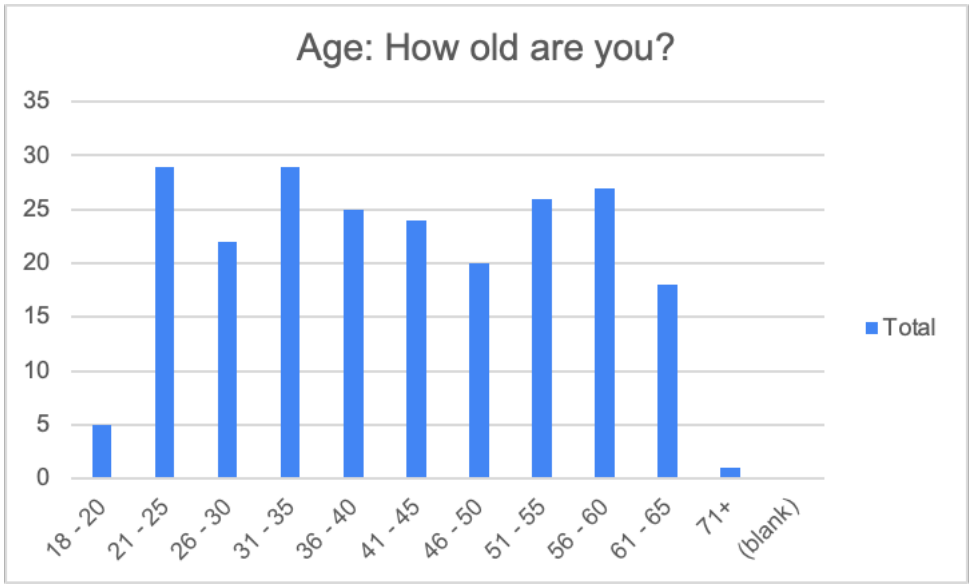

FIGURE 9 - AGE GROUP DISTRIBUTION

The age groups of this survey were fairly diversified with the majority of the participants being between the ages of 21 and 25, and 31 and 35 with 29 respondents or 12.8% each as shown by Figure 9. Also the age groups between 26 and 30, 36 and 40, 41 and 45, 46 and 50, 51 and 55, 56 and 60, and also 61 and 65 all making up for around 10% each with the only outliers or less represented age groups being the 18 to 20 year olds and the people over the age of 71.

4.1.1.4. Education Level

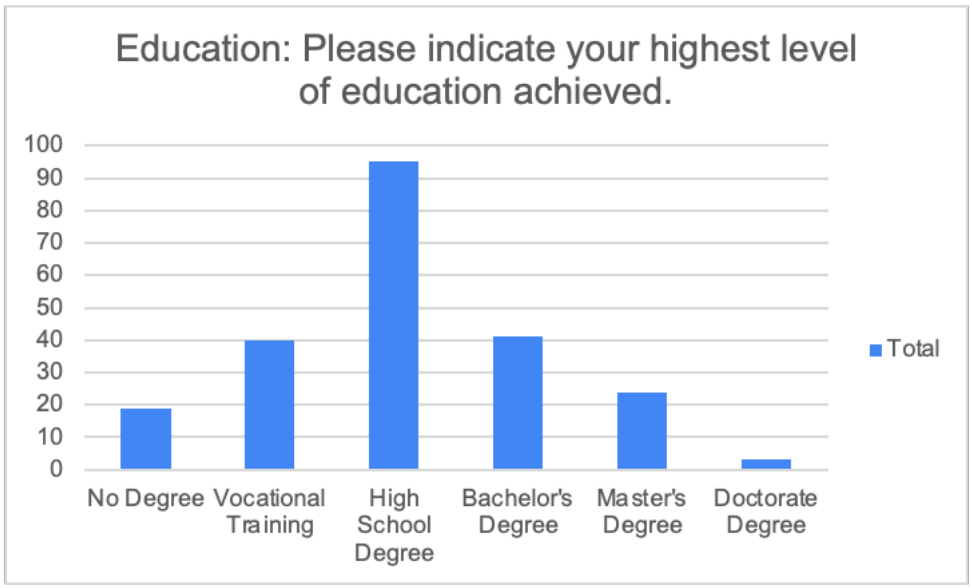

FIGURE 10 - EDUCATION LEVEL DISTRIBUTION

Figure 10 indicates that the respondents of the survey come from a diverse academic background with the majority having achieved a high school degree as their highest diploma. To be exact, 95 out of 222 answers or 42.8% have achieved this degree with vocational training and Bachelor's degree taking the second place with 40 and 41 people respectively or around 18%. No degree and Master's degree were achieved by 19 and 24 people respectively with the only real outlier being the Doctorate degree that only 3 people in this survey managed to achieve. As shown in Figure 10, the curve follows a normal distribution.

4.1.1.5. Employment Status

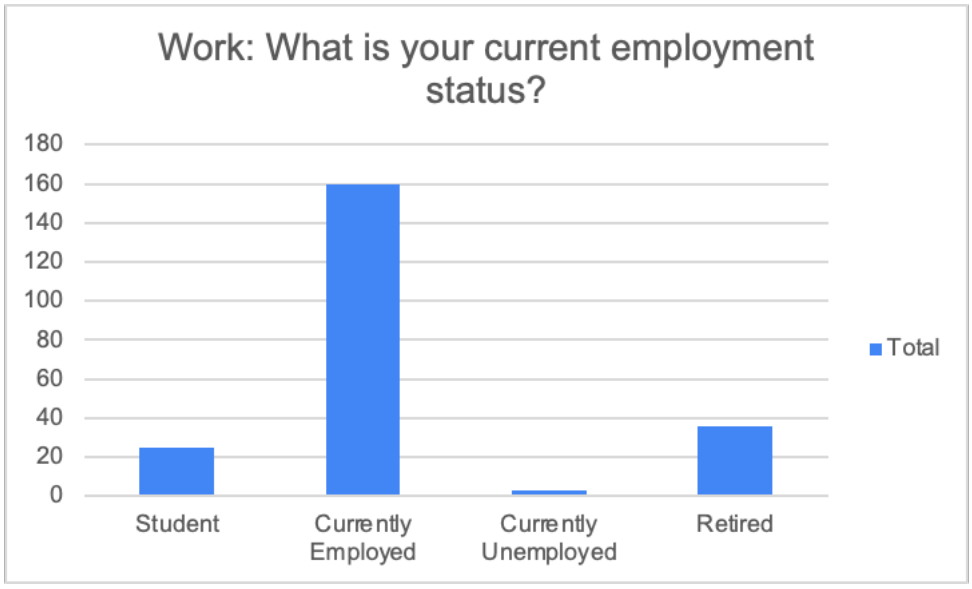

FIGURE 11 - EMPLOYMENT STATUS DISTRIBUTION

The employment status of the survey participants was divided into 4 options. People could choose between Student, Currently Employed, Currently Unemployed, and Retired. Figure 11 explains that the largest proportion of the participants are currently working with 71.4% or 160 out of 224 people. Students and pensioners accommodate for 11.2 and 16.1% respectively and only 1.3% of the participants were unemployed at the time of answering the questionnaire.

4.1.1.6. Financial Situation

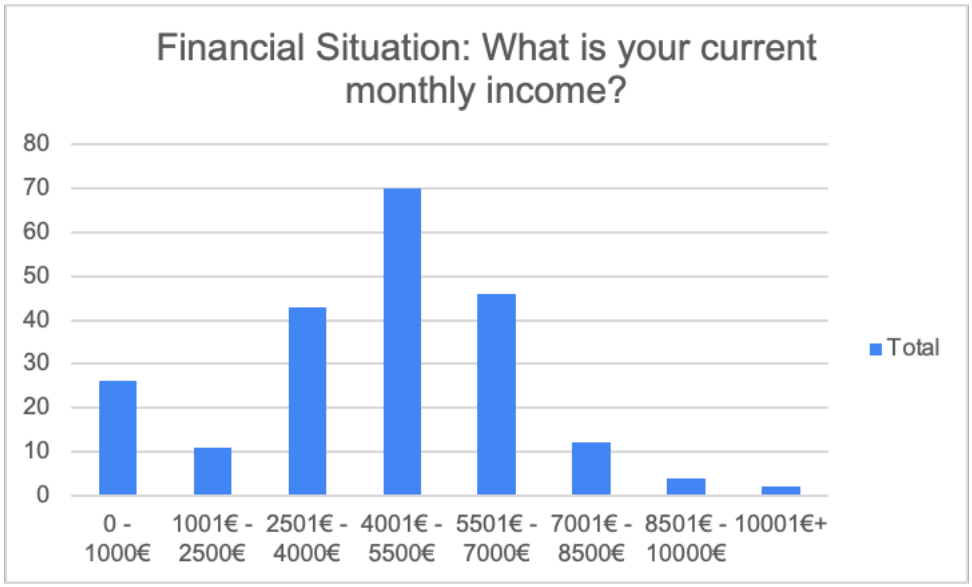

FIGURE 12 - FINANCIAL SITUATION DISTRIBUTION

The financial situation of the drivers in Luxembourg is interesting, since around 32.7%, and the majority of participants of this study, indicated that they have a monthly income between 4001 and 5500€, according to Figure 12. Luxembourg is known for having among the highest salaries in the entire EU and shows that money may not be a major factor in the decision making of the transport mode. What is surprising however, is the 12.1% of people that seem to not have a high income, yet still choose to drive a car. A possible explanation may be that they do not have other expenses such as rent to pay by living with their parents for example but this could be an interesting demographic to further analyse.

4.1.1.7. Place of residence: Mobility zones as defined by the PNM 2035

The participants of the study were not directly asked in which mobility zone they live in, because they may be unaware of the PNM 2035 or simply be unsure as to which zone to choose. That is why the participants were simply asked for their town of residence, which were then categorised by the researcher into the respective mobility zone as defined by the PNM 2035 and the MMTP.

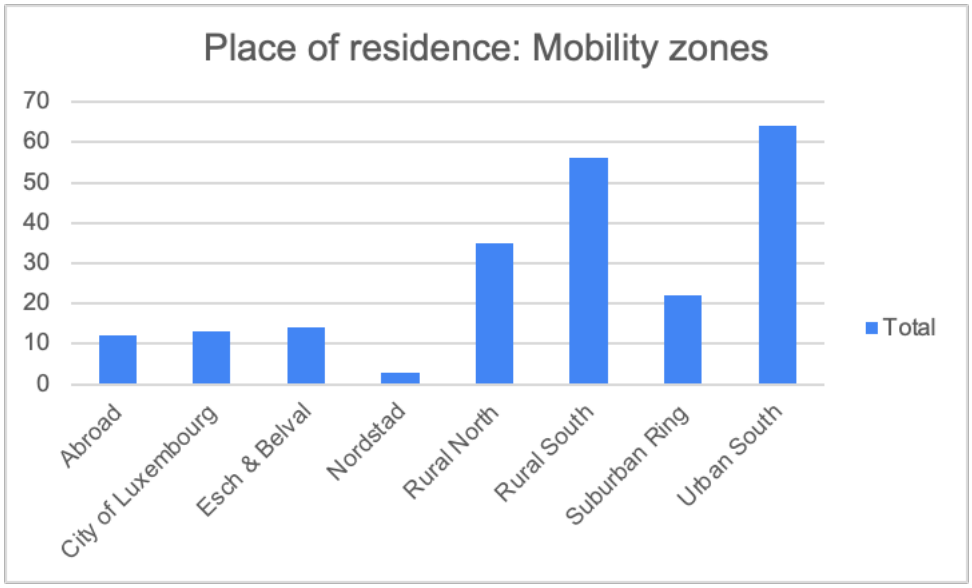

FIGURE 13 - PLACE OF RESIDENCE: MOBILITY ZONES DISTRIBUTION

Since the ten mobility zones are made up from 7 in the country and 1 per neighbouring country, the researcher grouped the neighbouring countries together since there have not been enough respondents that live outside the country's borders to be significant enough for a deeper analysis. Under this "Abroad" section which includes 12 people, around 30% have also been from people that study or work in further away countries such as Switzerland or Austria. Figure 13 shows that the majority of survey participants live in the Urban South of the Grand Duchy closely followed by the Rural South. This seems logical due to the fact that these areas are the most densely populated in the country with Dudelange, Differdange, and Schifflange all being larger towns with higher populations. The suburban ring and the urban towns, meaning the city of Luxembourg and Esch & Belval were less represented in this study, which may be due to the fact that their mobility zones are much smaller compared to the Rural South or the Urban South but are also fairly densely populated. Finally the North of the country, meaning the Nordstad and the Rural North are naturally less densely populated than the rest of the country so their 17% share in this survey also seem natural.

4.1.1.8. Place of work/education: Mobility zones as defined by the PNM 2035

Similar to the last section, participants were also asked the town the work/study in in order to facilitate the answering of the question. The mobility zones identified in this section were identified by the researcher after the data collection.

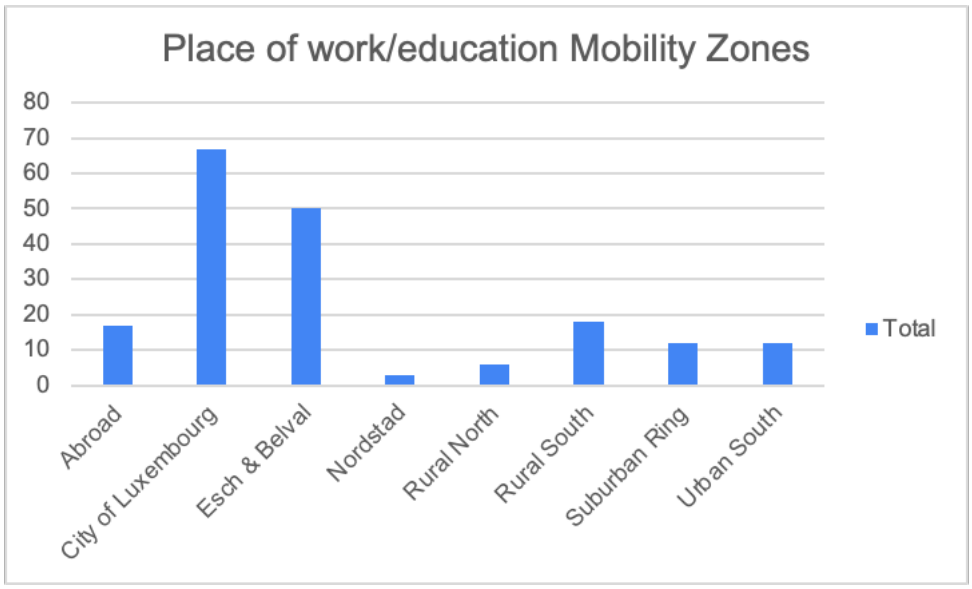

FIGURE 14 - PLACE OF WORK/EDUCATION MOBILITY ZONES DISTRIBUTION

It is apparent that the grand total is significantly lower for this data set compared to others, however this is due to the fact that 36 participants were retired at the time of responding to the questionnaire. As expected Figure 14 underlines that the highest percentages, namely 36.2 and 27 work/study in the City of Luxembourg or in Esch & Belval. These two large urban areas are known for being the socio-economic hubs of the country and hold a lot of workplaces. This also means that traffic into these areas in the morning and evening rush hours is not to be underestimated. The other mobility zones see less frequentation of workers and students. The Rural and Urban South see some degree of traffic while the Suburban Ring and the whole North of the country are not a place of work for many participants of the survey. Again regarding the Abroad category, which stems from a majority of students that live and study in other countries that are farther away.

4.1.1.9. Free-Fare Public Transport Awareness

Out of the 228 respondents to the survey 225 indicated that they know that public transport is free of charge for users and the other 3 people did not answer at all to this question. So it can be argued that everyone that took part in this study knows that public transport is free in Luxembourg. This indicates that the marketing of this policy has been really successful.

4.1.1.10. Choice of Transport Mode for Work/Education

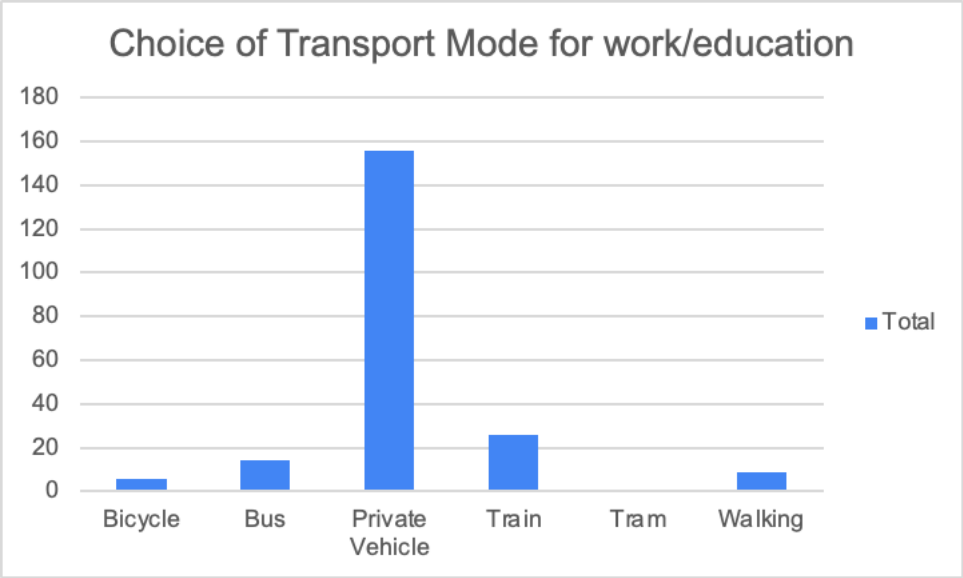

FIGURE 15 - CHOICE OF TRANSPORT MODE FOR WORK/EDUCATION DISTRIBUTION

The results of the choice of transport mode for work or education, as portrayed by Figure 15, suggest a clear picture of the situation in Luxembourg. 73.5% of people drive to work or their place of education, which is in line with other studies. The second largest group commutes to work by train, followed by commutes by bus which make up for 12.2 and 6.6% respectively. Comparatively, these percentages are really low nonetheless.

4.1.1.11. Choice of Transport Mode for Shopping

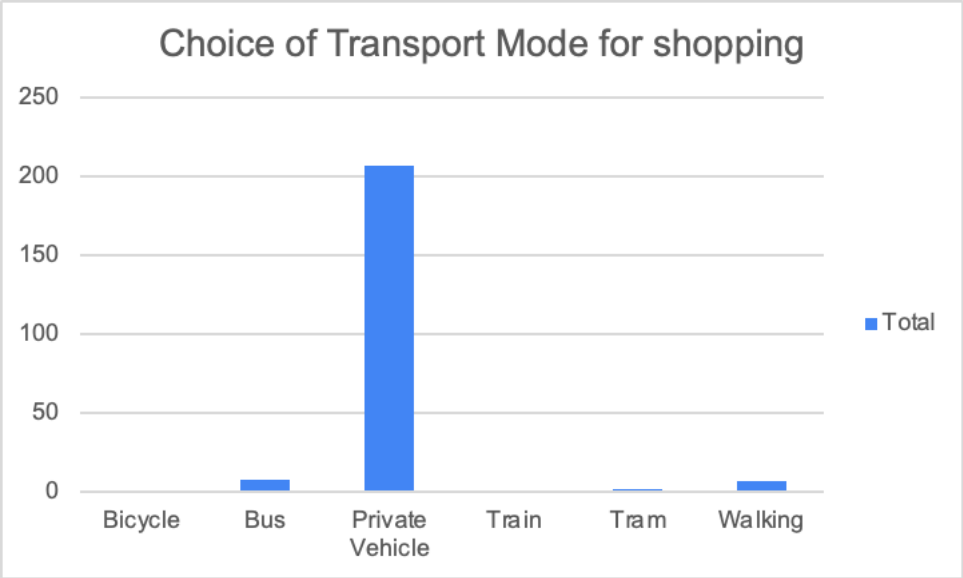

FIGURE 16 - CHOICE OF TRANSPORT MODE FOR SHOPPING DISTRIBUTION

For shopping purposes, 91.5% of the participants indicated that they drive to do shopping, whether that be clothing or groceries as evidenced by Figure 16. This is a really high percentage of people but has been hinted at by the theory. Especially for grocery shopping, or when heavier bags are involved, people prefer to use the car because of the perceived convenience of transport. Not only does driving facilitate the access to shops, it also helps with transporting potentially heavy or large bags. Especially in Luxembourg, prices for groceries are comparatively high and many people opt to do their weekly shopping in other countries for example because of that. This may be one reason for this distribution. Notably the third biggest portion walks to do their shopping, a rather astonishing result, however not a significant amount of people with only 3.1%.

4.1.1.12. Choice or Transport Mode for Leisure Trips

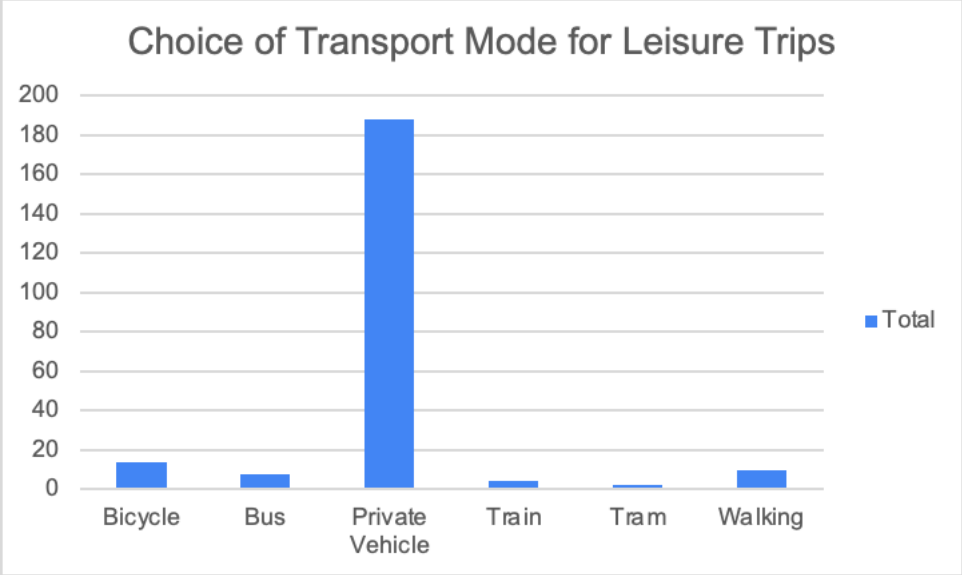

FIGURE 17 - CHOICE OF TRANSPORT MODE FOR LEISURE TRIPS DISTRIBUTION

Interestingly for leisure trips, the percentage of people that drive to their destination is lower than for shopping, according to Figure 17. The private vehicle is still the favourite transport mode with 83.1%, which is more than for commutes to work however. Essentially, people drive less to work than to pursue hobbies. This could be due to the increased traffic and the induced stress during rush hours, since hobbies are typically pursued outside of these hours. The underutilisation of the public transport infrastructure is also apparent under this section since they only make up for 6.2% of leisure trips, the same amount that bicycles have for example.

4.1.1.13. Daily Distance Travelled

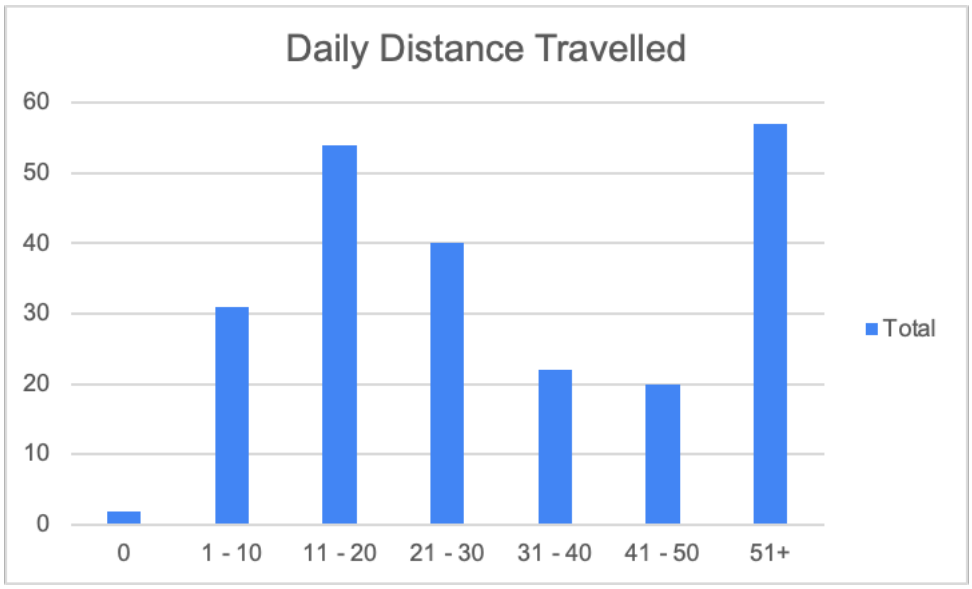

FIGURE 18 - DAILY DISTANCE TRAVELLED DISTRIBUTION

Regarding daily distance travelled, the majority indicated that they travel more than 51 kilometres per day as shown by Figure 18. This could be due to their commutes to work if they live further away from their work. The second biggest group indicated that they only travelled 11 to 20 km a day, which could be a group that the MMTP could focus on regarding the promotion of more sustainable forms of mobility. It can be said that the daily distance travelled shows a fairly diverse set of answers, which was expected due to the very individual nature of mobility.

4.1.1.14. Weekly Trips by Car

FIGURE 19 - WEEKLY TRIPS BY CAR DISTRIBUTION

Figure 19 indicates that more than 65% of people use their car nearly everyday to everyday. This could lead to a habit of using a car which will limit the potential of switching the mode of transport to another option such as public transportation as previously explored in the literature review. But similar to the daily distance travelled, there are around 30% of people that only use their car between 1 to 4 times a week, which could be a group that could be more open to changing their ways.

4.1.1.15. Weekly Trips by Public Transportation

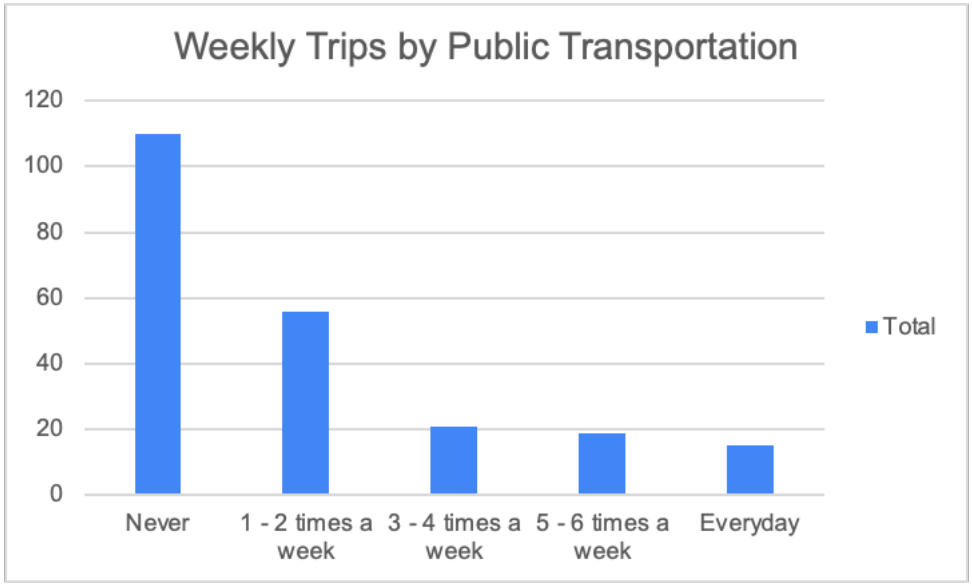

FIGURE 20 - WEEKLY TRIPS BY PUBLIC TRANSPORTATION DISTRIBUTION

Figure 20 shows a fascinating trend that can be observed under the weekly trips by public transportation that almost 50% of participants indicated that they never use public transportation in Luxembourg. Following this trend, the people that indicated that they use public transportation everyday were in the minority and only made up for 6.8% of the sample. This underlines the underutilisation of public transportation in Luxembourg still after the introduction of the free-fare policy and indicates a need for change and improvement in order to achieve the goals that were set in the PNM 2035.

4.1.1.16. Importance of Sustainability

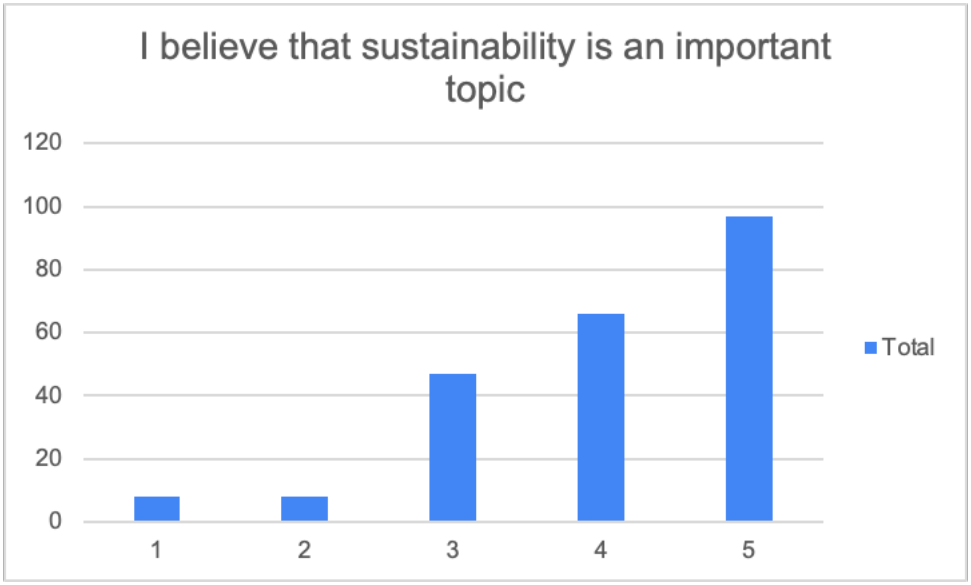

FIGURE 21 - THE IMPORTANCE OF SUSTAINABILITY DISTRIBUTION

Although the use of cars in Luxembourg would indicate that people would be less interested in sustainability, Figure 21 suggests otherwise. 42.9% of the participants said that they believe that sustainability is an important topic. The question remains however, why people believe in sustainability, yet do not engage in more sustainable behaviour when an alternative such as public transportation is given. This could also be a group of people that could be targeted for the envisioned mobility transition. However, it also needs to be noted that more than 25% of the respondents indicated that they not believe that sustainability is an important topic. These people might be more persistent in their choice of transport mode. The average accordance with this statement was 4.04.

4.1.1.17. Importance of the Environment

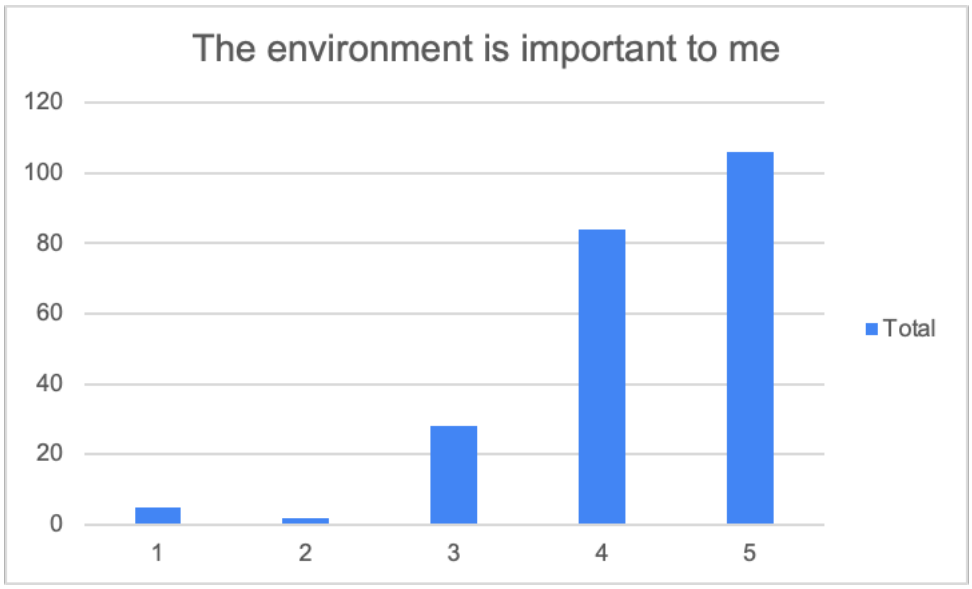

FIGURE 22 - THE IMPORTANCE OF THE ENVIRONMENT DISTRIBUTION

Similar to the importance of sustainability, the participants indicated that they care about the environment as shown by Figure 22. Notably however, more people seem to care about the environment than about sustainability since the average was 4.26 (0.22 higher than for the notion of sustainability). By purposely wording advertisements with "environment" instead of "sustainability", people could be more inclined to act more environmentally-friendly.

4.1.1.18. Frugality

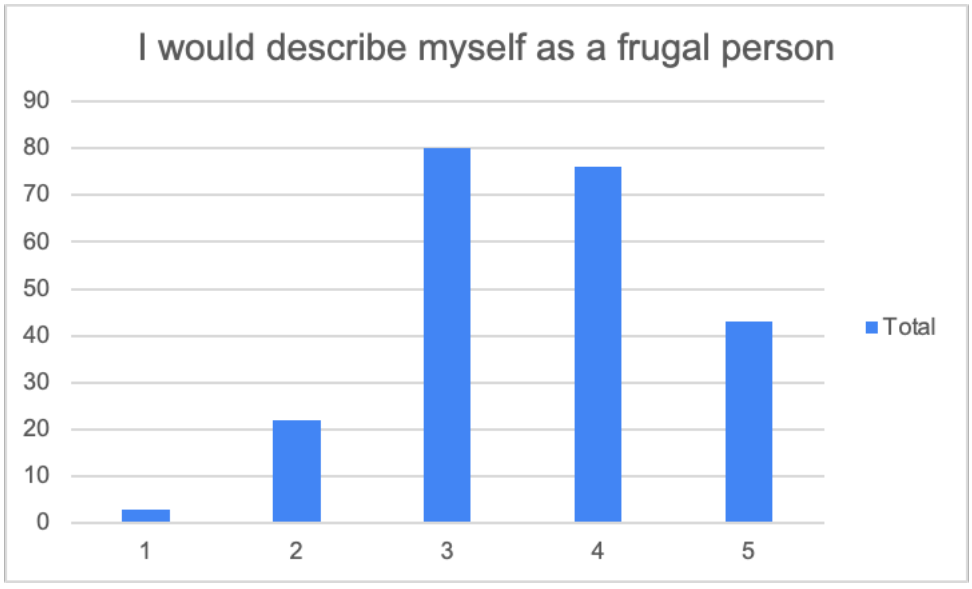

FIGURE 23 - FRUGALITY DISTRIBUTION

Figure 23 suggests that people in Luxembourg would rather describe themselves as frugal. The average score was 3.6, meaning that the participants are slightly more concerned with saving money. 53% would even say that they align themselves with this statement. This strikes up the question again why people choose to drive cars in Luxembourg even though a cheaper option is available that is comparable to car use.

Having established the demographics of the study, it will be interesting to see at a later stage, how different groups of people compare and whether their answers to the remaining questions regarding car use, public transportation, and amelioration propositions differ. This can in turn lead to significant insights into the behaviour of people and show if and where there is need for change in the public transportation infrastructure.

4.1.2. Car use in Luxembourg

The questions were written as statements where the participants needed to indicate to what degree they agree or disagree with a given statement. They were given a 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree) with which they could rate the statements. The statements themselves stem from the literature as they are common reasons for and against car use and its impacts on the environment. The goal was to see whether the people in Luxembourg agree with these common arguments or not and to find out what the participants really think about their car use.

4.1.2.1. Safety on the road

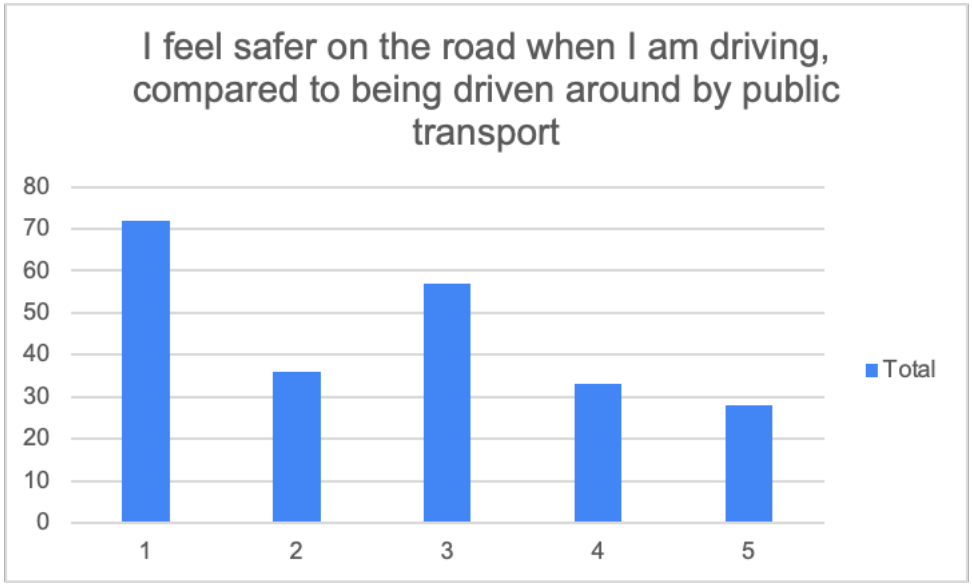

FIGURE 24 - SAFETY ON THE ROAD DISTRIBUTION

With an average score of 2.6, Figure 24 explains that participants perceived the safety on the road to be higher when driven around by public transportation than in their private vehicle. With these mixed results, Hiscock et al.'s (2002) study is reinforced. Drivers know about the risks of traffic accidents, but the opinions differ on who is most likely to cause a crash. The drivers believe in their ability to drive safely and trust themselves more than for example others on the road, yet also feel safer in larger vehicles such as buses or public transportation in general such as trains and trams that have few touching points with car traffic.

4.1.2.2. "Freedom"

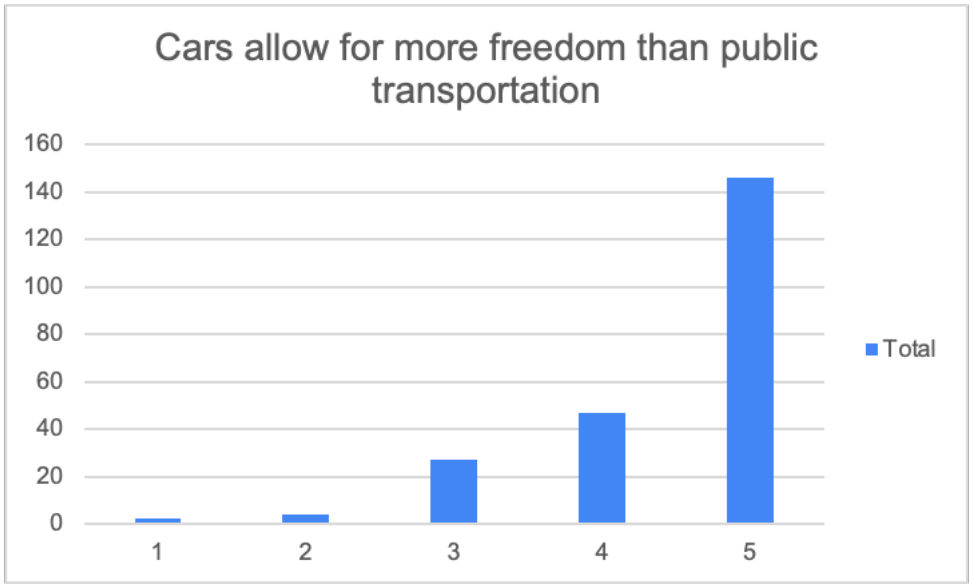

FIGURE 25 - CARS AND THE NOTION OF "FREEDOM" DISTRIBUTION

Figure 25 states that 146 out of 226 (64%) completely agreed with the statement that they feel that cars allow for more freedom than public transportation. Especially the notion of freedom is often utilised when arguing for private car use as it is composed of convenience and the independence of external factors such as public transport time schedules. The average score for this statement was 4.46. This shows a certain limitation to mobility change as argued by Anable (2005) who identified the notion of "freedom" as prevalent with "Die Hard Drivers" that were reluctant to adopt public transportation.

4.1.2.3. Privacy

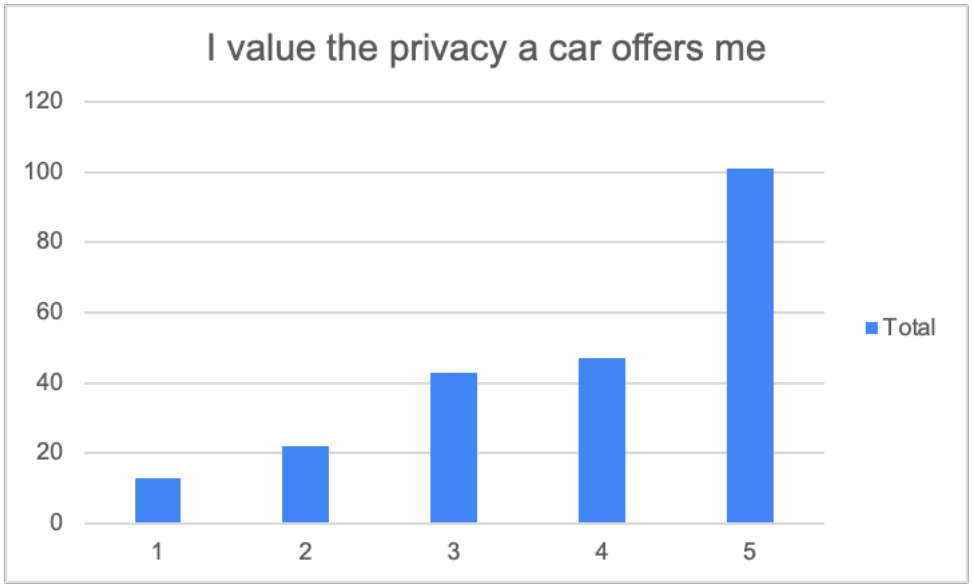

FIGURE 26 - CARS AND PERCEIVED PRIVACY DISTRIBUTION

Similarly to the last section regarding “freedom”, privacy is also valued a lot as evidenced by Figure 26. Almost 50% of the people answered that they completely agree with the presented statement. This underlines the findings of Hiscock et al. (2002), who argued that people value the personal space that is guaranteed in a private vehicle, which may be a possible hint at the importance of protection regarding the chosen transport mode. The average score was 3.89.

4.1.2.4. Shelter

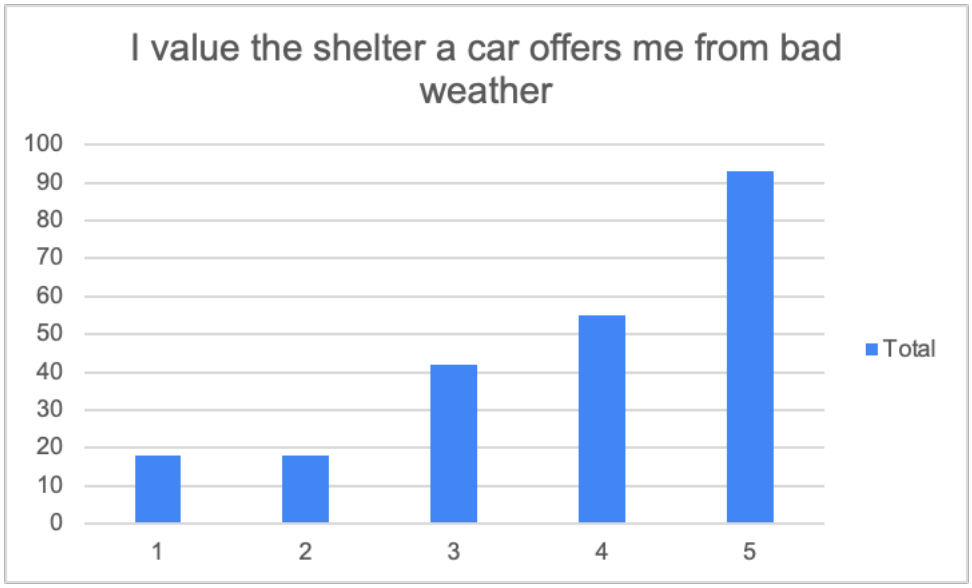

FIGURE 27 - CARS AND PERCEIVED SHELTER DISTRIBUTION

Shelter from bad weather is another topic of discussion regarding “protection” as defined by Hiscock et al. (2002). Similarly to privacy, people will prefer to use cars during bad weather conditions due to the typically easier access to a car than to public transportation if both options are available. Especially the walk to and from transit hubs can be even more cumbersome for some people in bad weather, which explains the distribution of Figure 27. 148 out of 226 people agreed to some extent with the statement above, which is around 65.5%. The mean score for this statement was 3.83.

4.1.2.5. Travel Time

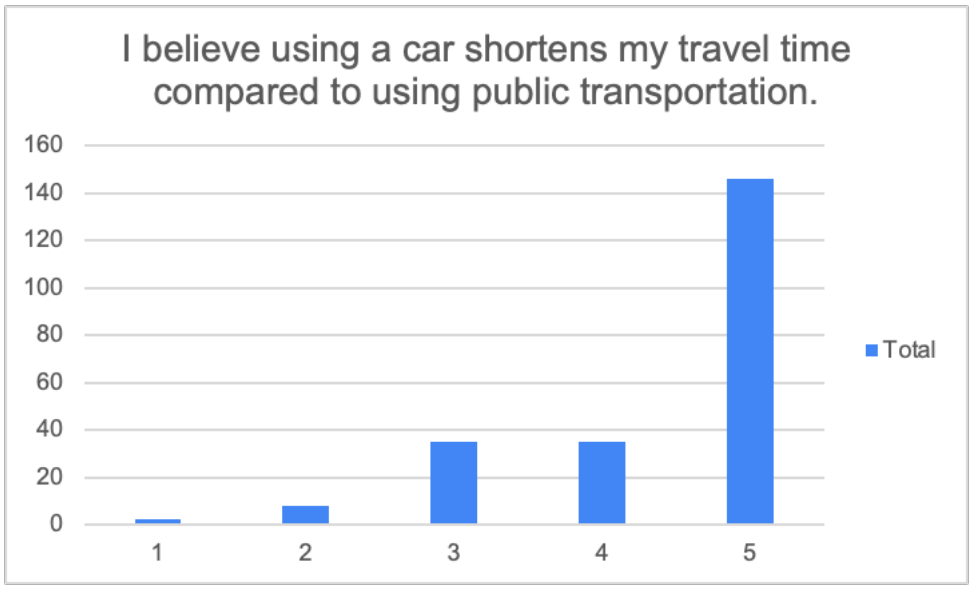

FIGURE 28 - CAR TRAVEL TIME DISTRIBUTION

Travel time is a deciding factor for the choice of transport mode, according to Hiscock et al. (2002). It falls under the autonomy section and specifically under convenience and many people perceive public transportation to be significantly slower compared to car travel. These findings are in line with the results of Figure 28 where a total of 181 out of 226 (80.1%) participants agreed to some extent with this statement and only 10 people (4.42%) in total disagreed to some extent. Therefore the mean score is also rather high with 4.39.

4.1.2.6. Transportation of heavy objects

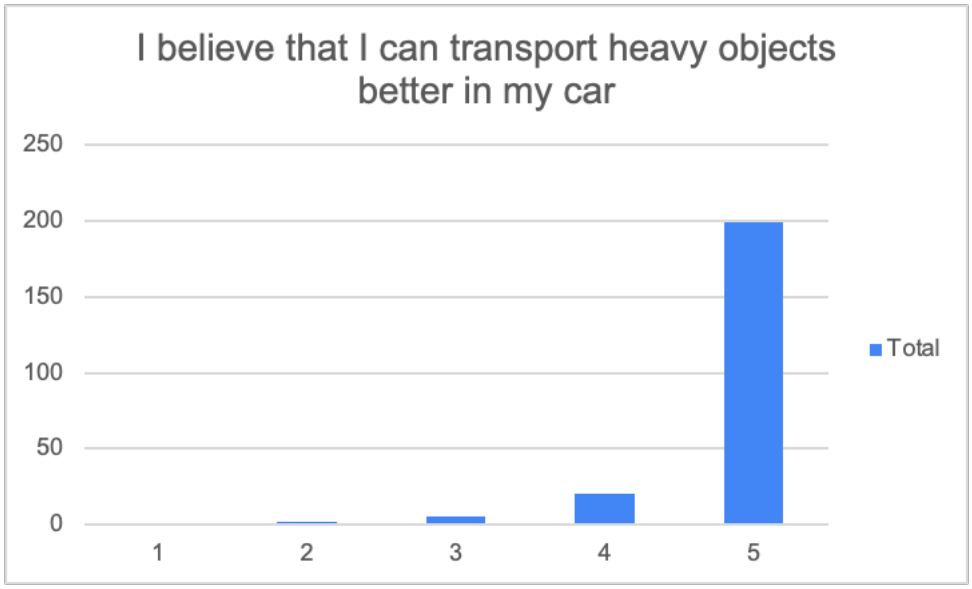

FIGURE 29 - TRANSPORTATION OF HEAVY OBJECTS DISTRIBUTION

From Figure 29 a clear trend is again observable where the majority of people agree that they can transport larger and heavier objects easier by car than by PT for example. 97% of the participants agree to some extent, further reinforcing Hiscock et al.'s (2002) hypotheses regarding autonomy and more specifically convenience playing a major role in car use. The mean score for this statement was 4.84.

4.1.2.7. Travelling with children

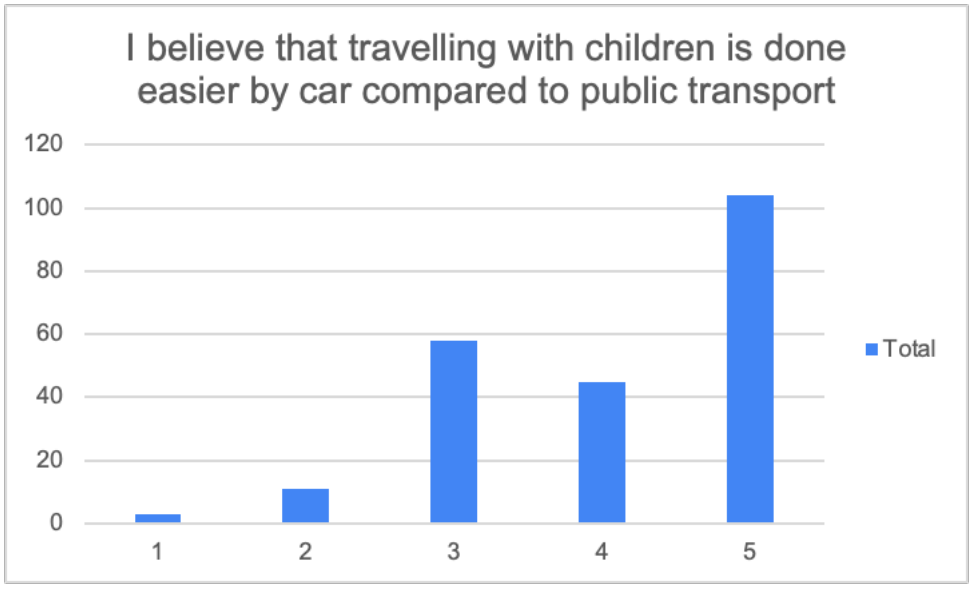

FIGURE 30 - TRAVELLING WITH CHILDREN DISTRIBUTION

Following in line with the transportation of heavy objects statement, people majorly believe that travelling with children is easier done by car than with public transportation. This is another convenience point that was established by Hiscock et al. (2002). The mean score for Figure 30 was 4.07.

4.1.2.8. Convenience of cars

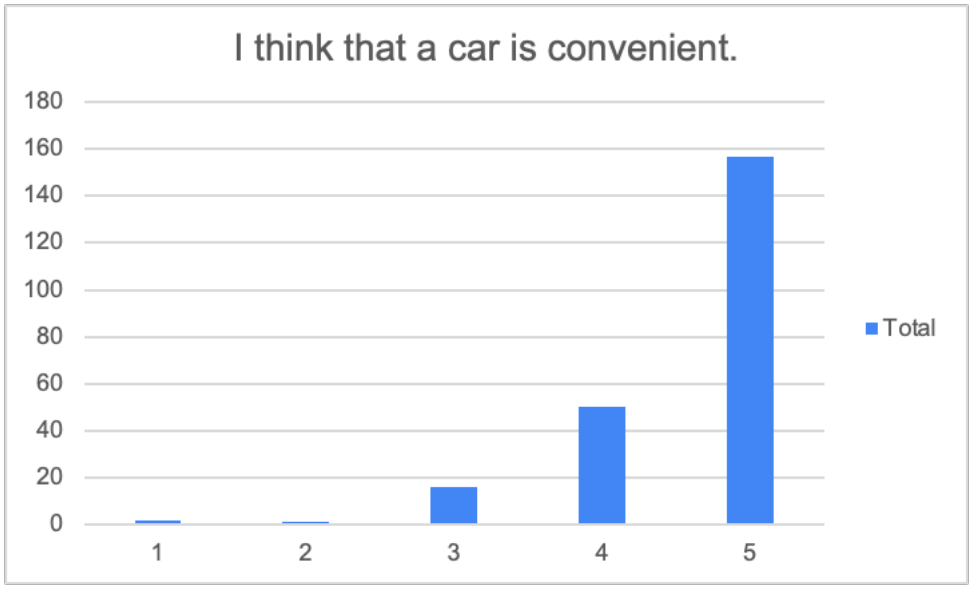

FIGURE 31 - CONVENIENCE OF CARS DISTRIBUTION

This statement directly asked the participants to rank their opinion on convenience of cars in order to get a clear position and insight into the beliefs of car drivers in Luxembourg. Figure 31 shows that the overarching majority stated that they think that a car is convenient with 207 out of 226 or 91.6% of people. Only 1.3% of people disagreed to some extent with this statement which is a really low percentage. The mean score for this statement was 4.59.

4.1.2.9. Comfort of cars

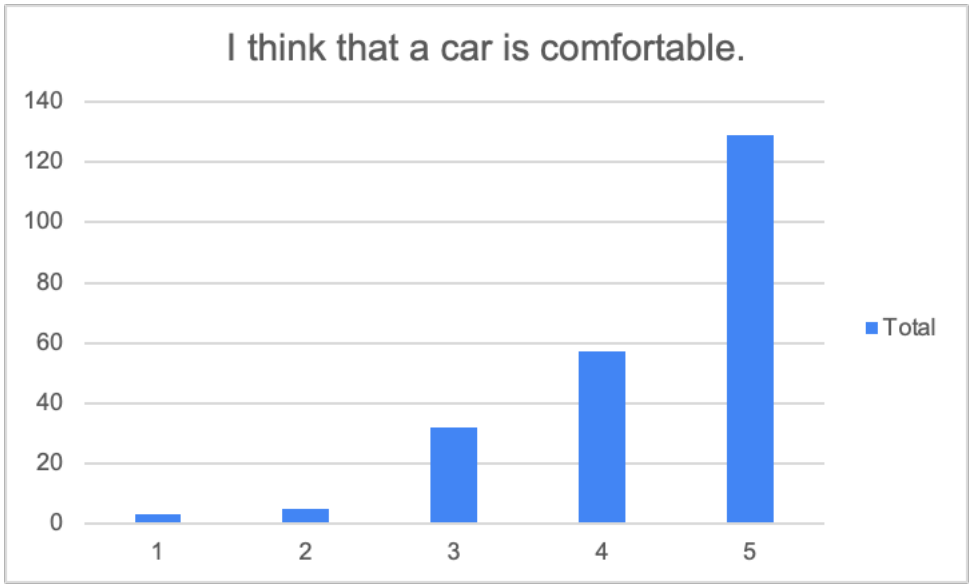

FIGURE 32 - COMFORT OF CARS DISTRIBUTION

While the majority of people still completely agree that a car is comfortable with 57% according to Figure 32, the percentage is smaller than for the perceived convenience statement. While the percentages for discomfort in cars are still comparatively low, this may give an insight into the ranking of the three main benefits of car use. It seems as convenience is seen as more important than comfort and prestige. The average score for this question was 4.35.

4.1.2.10. Traffic Congestion in Luxembourg

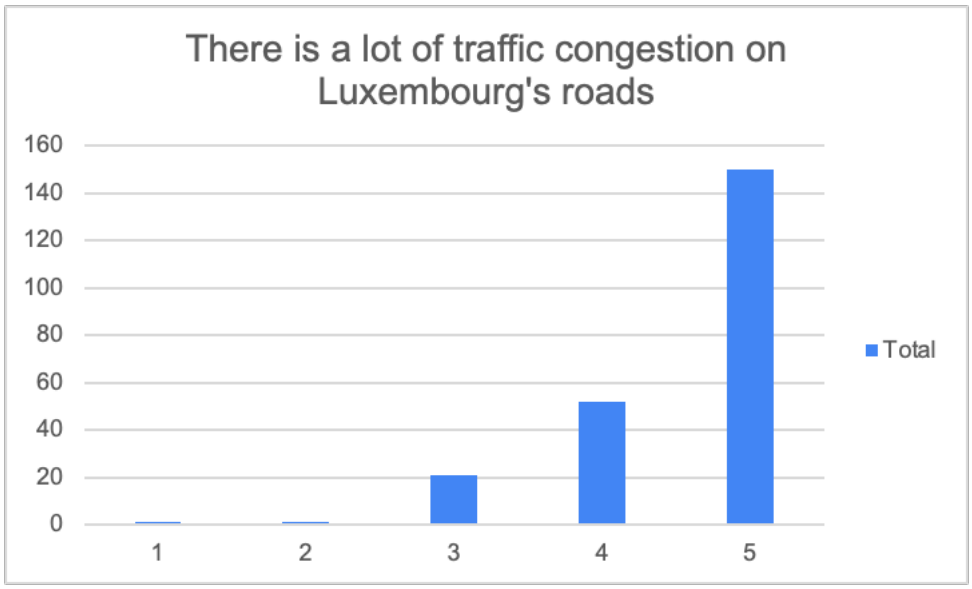

FIGURE 33 - TRAFFIC IN LUXEMBOURG DISTRIBUTION

This statement presented the participants with the first drawback of car use. Traffic congestion is one of the main points of stress and CO_2 emissions among cars and this question aimed to investigate the sentiment of drivers towards traffic congestion and the frequency of how often they encounter it. As seen numerous times under this car use section, Figure 33 shows that the overall sentiment of drivers in Luxembourg is that there a lot of traffic congestions, with ⅔ of drivers completely agreeing with this statement followed by another 23.1% that at least would partially agree. The average score for this statement was 4.55.

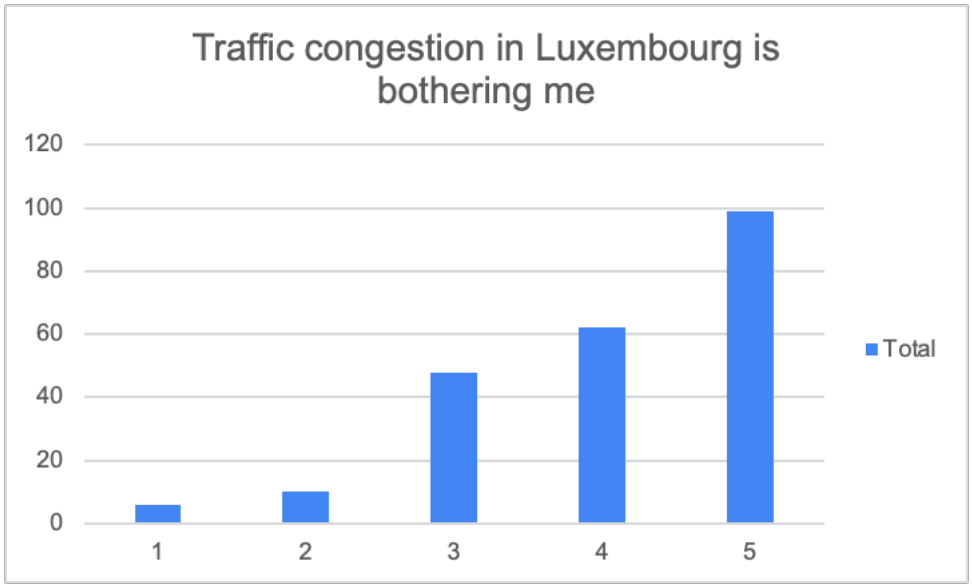

FIGURE 34 - OPINION ON TRAFFIC IN LUXEMBOURG DISTRIBUTION

Surprisingly, while it is true that the participants agreed that there is a lot of traffic congestion in Luxembourg, the overall sentiment towards traffic congestion is less severe. Still Figure 34 indicates that traffic congestion is bothering them with 44% but that is a 22% decrease in agreement than in Figure 33. Also the disagree option were more popular with 7.1% compared to 0.8%. It is possible that the assumption that people will try to avoid traffic congestion whenever possible may not hold true when the overall attitude towards traffic congestion is not as negative as initially expected. Still the mean score of this statement was 4.06.

4.1.2.11. Roadworks in Luxembourg

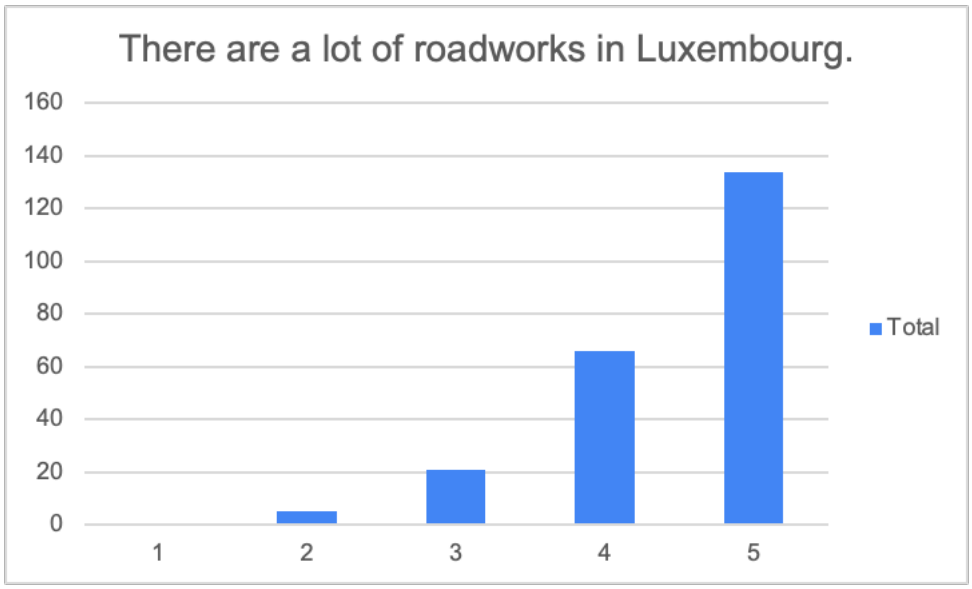

FIGURE 35 - ROADWORKS IN LUXEMBOURG DISTRIBUTION

People feel that there are a lot of roadworks in Luxembourg which is represented by the mean score of 4.46 of Figure 35. 59.2% of people completely agreed with this statement, indicating a strong sentiment towards the situation in Luxembourg. Interestingly, among the 226 answers on this question, not one did say that they completely disagree with it.

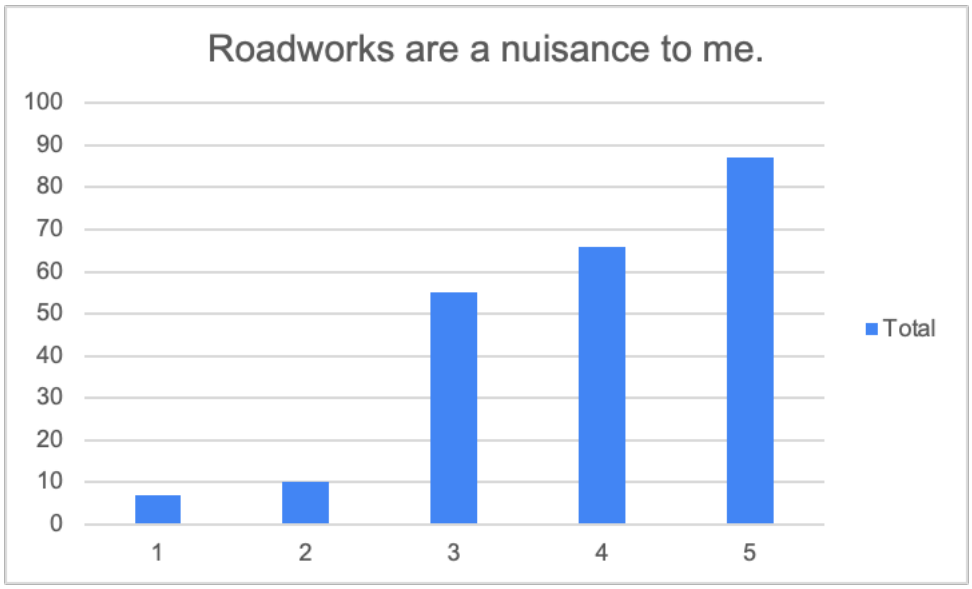

FIGURE 36 - OPINION ON ROADWORKS IN LUXEMBOURG DISTRIBUTION

Similarly to section 4.1.2.10. people agree that there are a lot of roadworks in Luxembourg, however their sentiment towards roadworks is not as strong. Also their opinion towards road-

works is also less negative than towards traffic congestion, with only 87 out of 225 compared to 98 out of 225 as portrayed by Figure 36. The mean score for this statement was 3.96.

4.1.2.12. Cars as Status Symbols

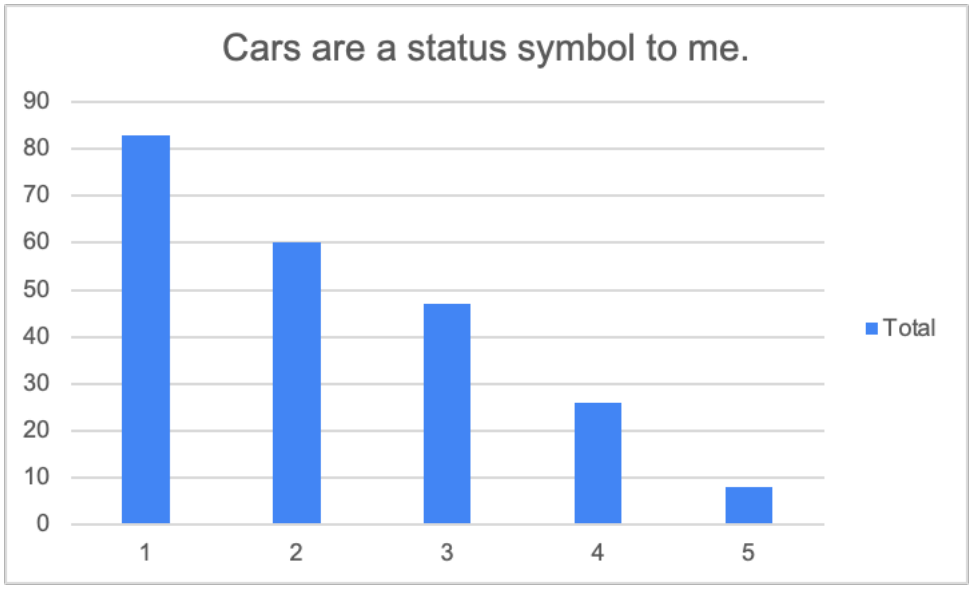

FIGURE 37 - CARS AS STATUS SYMBOLS DISTRIBUTION

Figure 27 shows that for this statement the overall consensus was disagreement, which is reflected by the mean score of 2.18. The majority of people, so 37% of people completely disagreed with the statement, which opposes the ideas of Hiscock et al. (2002) who argued that there is a certain aspect of prestige associated to car use and ownership. However they also argue that this only applies for more expensive or luxurious vehicles and that the prestige often stems from public transportation being perceived as “poor quality” and not because cars and especially cheaper vehicles are inherently more prestigious.

4.1.2.13. Driving is fun

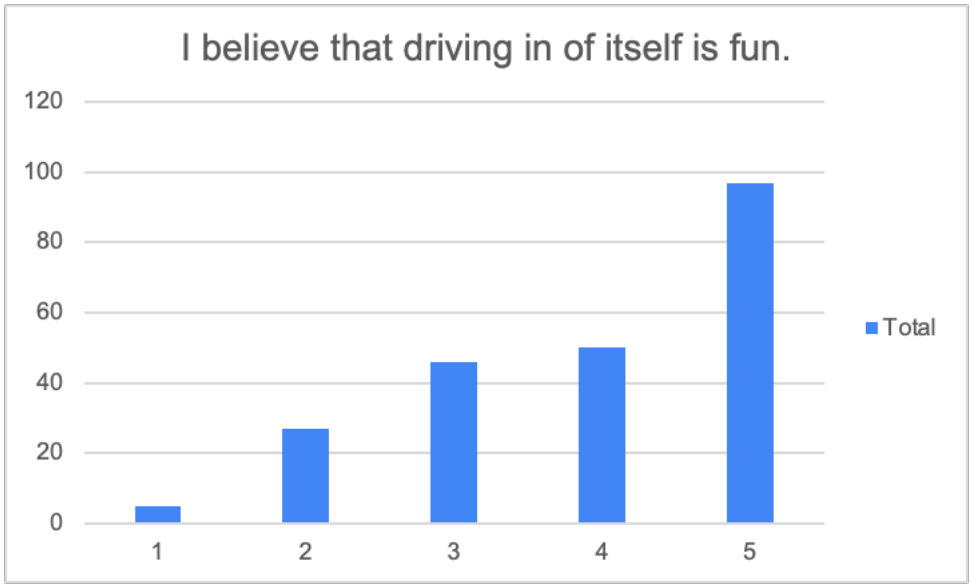

FIGURE 38 - DRIVING IS FUN DISTRIBUTION

This statement was used as a test of Anable's (2005) classification of travellers, where the "Malcontented Motorists" showed some desire to change their mobility patterns but still enjoyed driving altogether. Particularly this statement gives an insight into the probability of change since the higher the agreement with this statement, the less likely people will be to adopt an alternative to driving if they see the activity in itself as pleasant. Figure 38 displays that only 14.2% disagreed with this statement whereas 65.3% agreed to some extent. The mean score of this question was 3.92.

4.1.2.14. Opinion on the road network in Luxembourg

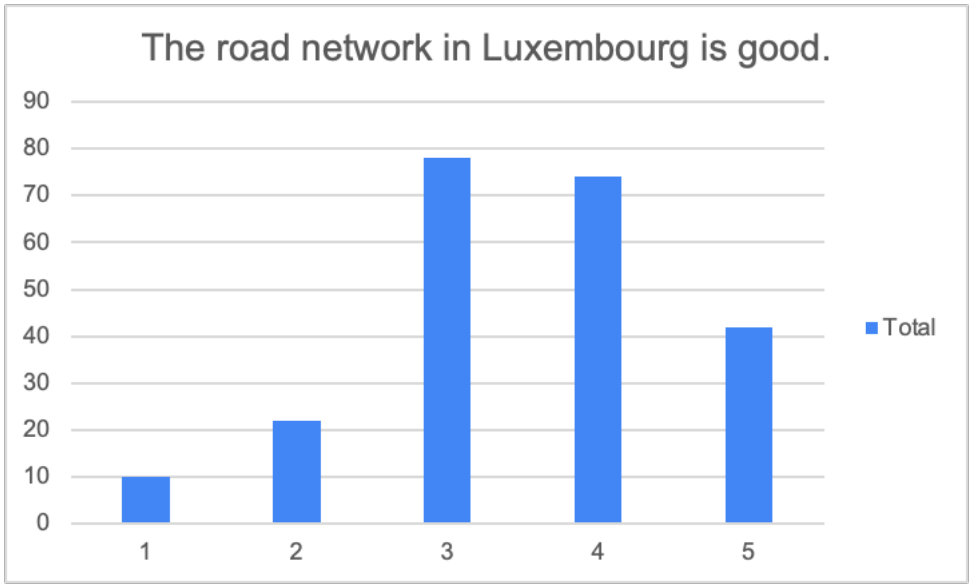

FIGURE 39 - OPINION ON ROAD NETWORK IN LUXEMBOURG DISTRIBUTION

While the majority of people agree with this statement, the mean score of 3.51 indicates that the people are not completely in accordance with this statement, indicating that there could be improvements made to the road network. The largest group of people answered 3 to this statement with 34.5% followed by 4 with 32.7% as evidenced by Figure 39.

4.1.2.15. Costs of driving

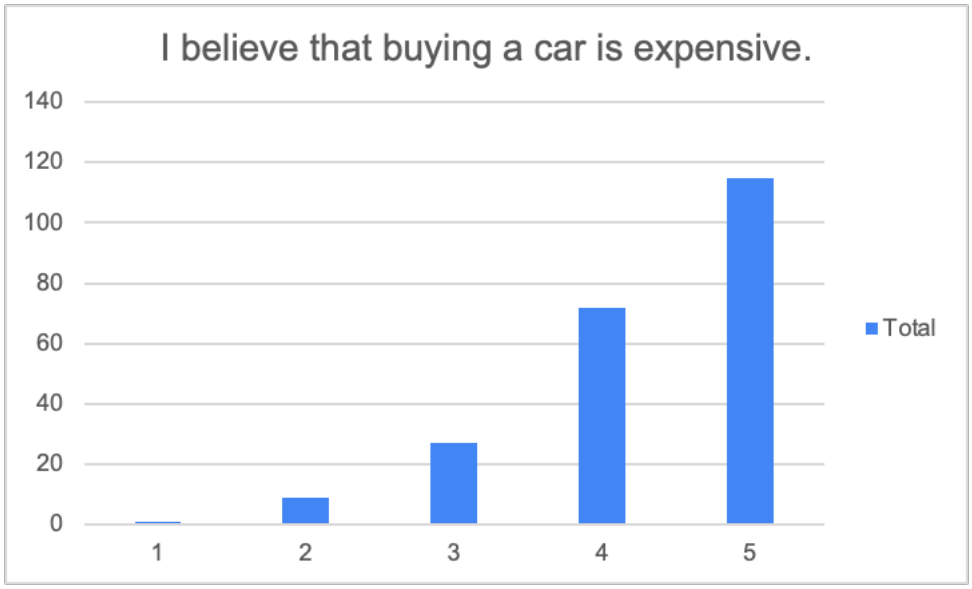

FIGURE 40 - COST OF BUYING A CAR DISTRIBUTION

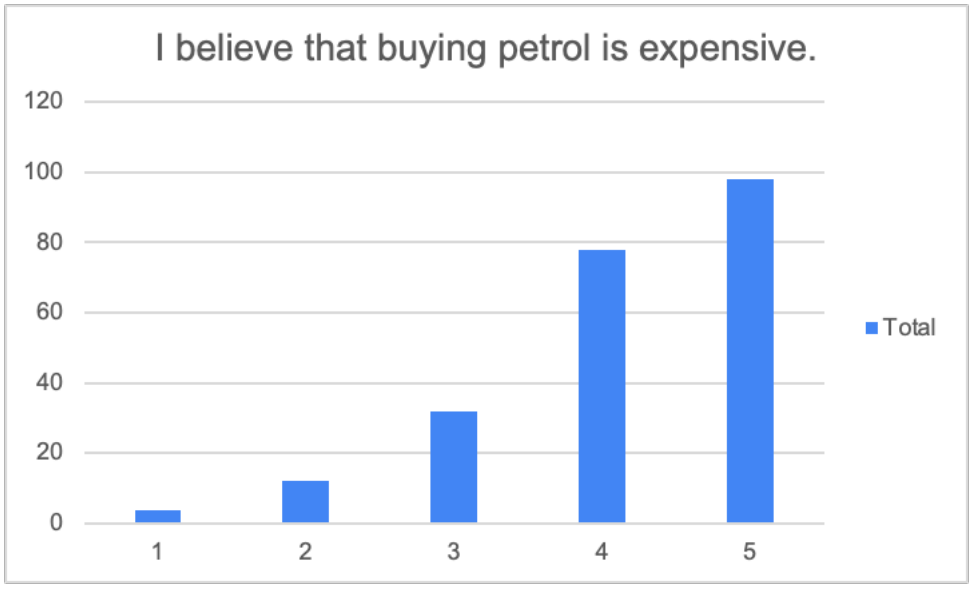

FIGURE 41 - COST OF FUEL DISTRIBUTION

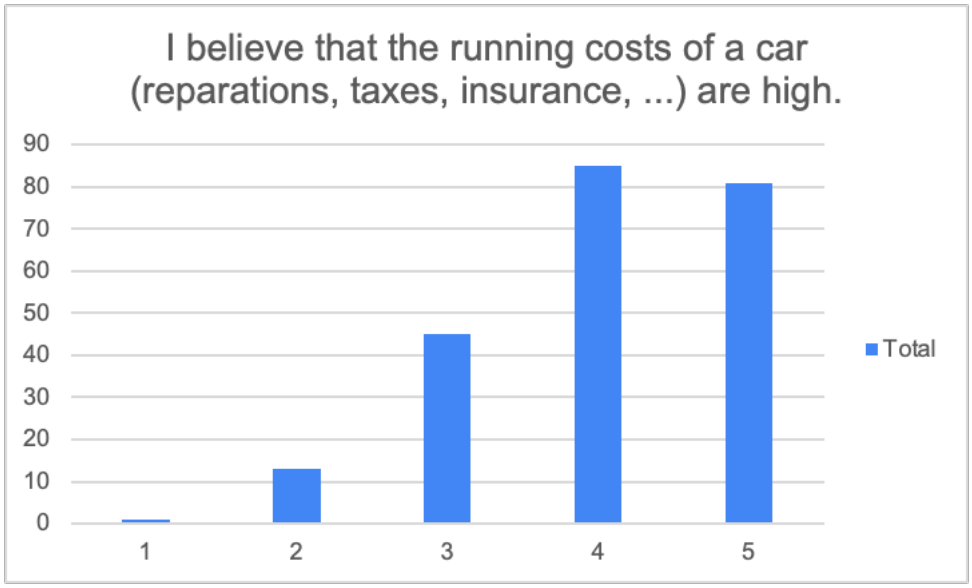

FIGURE 42 - COST OF RUNNING COSTS DISTRIBUTION

Figure 40, 41, and 42 show that while the answers for the opinion on prices for the acquisition of cars and petrol are largely the same regarding the distribution, the prices of the running costs do not seem to be perceived as negatively. Interestingly the majority of people answered 4 on this question compared to 5 on the previous two. A possible explanation for this may be the high salaries that offset the comparatively low fees for taxation compared to other European countries and insurance depending on car. Regarding petrol and the initial buying process of a car, the participants agreed that these are rather costly, which was to be expected. The mean scores of the three figures presented under this section were 4.3; 4.13; and 4.03 respectively.

4.1.2.16. Accident risk

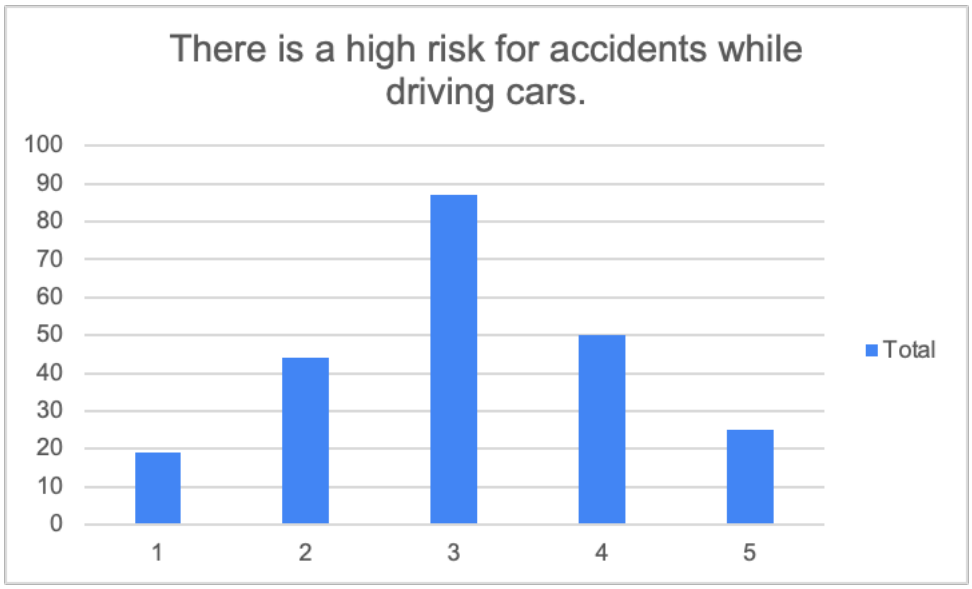

FIGURE 43 - ACCIDENT RISK DISTRIBUTION

Figure 43 shows that the curve of this figure follows a natural distribution, where the majority of people did not express any disagreement nor agreement with the above presented statement. While it is statistically proven that driving is the most dangerous form of mobility, the participants did not express a strong agreement towards this fact. However the mean score of 3.08 indicates that there is an ever so slightly trend towards agreeing with this statement.

4.1.2.17. Driving is stressful

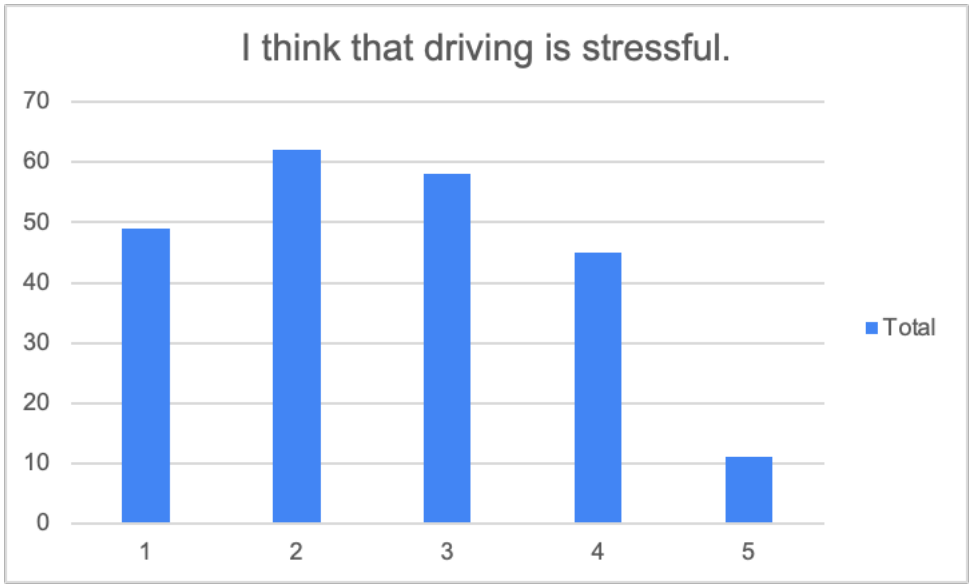

FIGURE 44 - DRIVING IS STRESSFUL DISTRIBUTION

This statement aimed to find out whether the findings by Novaco and Gonzalez (2009) regarding stress levels during driving hold for Luxembourg too. Figure 44 shows fairly diversified results, with the majority of people (27.6%) slightly disagreeing and the third biggest group completely disagreeing. This means that driving in Luxembourg is for many people not a stressful experience as maybe firstly thought with the slightly negative sentiment towards traffic congestion and roadworks. Therefore the findings of Novaco and Gonzalez (2009) regarding stress while driving do not hold for Luxembourg which is underlined by the mean score of 2.59.

4.1.2.18. Driving as a major contributor to climate change

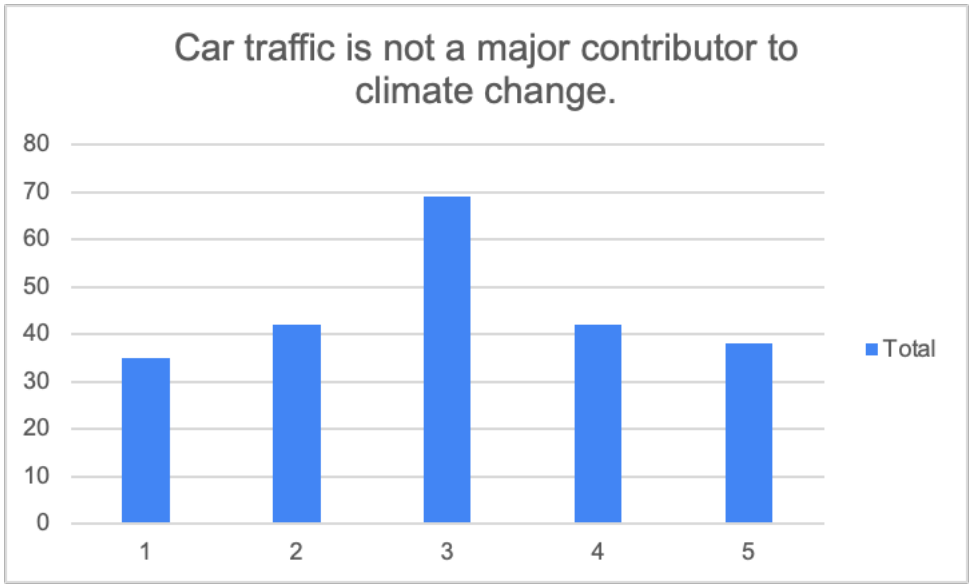

FIGURE 45 - DRIVING AS A CONTRIBUTOR TO GLOBAL WARMING DISTRIBUTION

This statement was purposefully stated in the way it was in order to avoid any potential perceived judgement from the researcher by the participants. Since topics such as climate change and the reasons for it are often emotionally and politically loaded, it was important to state this question in a way that was neutral. Interestingly, however the results of this statement suggest a diversified set of answers following a natural distribution. According to Figure 45, 34.1% answered that they disagree to at least some extent with this statement, which is a significant portion of all respondents. To be clear, more than ⅓ of people that completed this survey do not believe that car traffic is a major contributor to climate change, further hinting at some major restrictions to changes in mobility behaviour, similar to the statements fun and stress for driving. A slight majority of people agreed with the statement, but these results are still rather surprising. The average score was 3.03.

4.1.2.19. Aggressive Driving

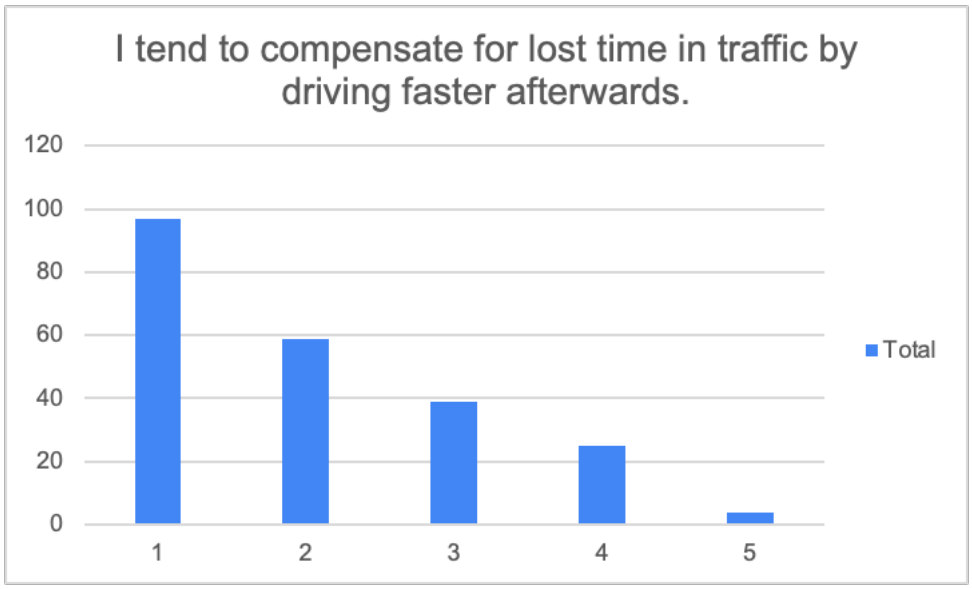

FIGURE 46 - AGGRESSIVE DRIVING DISTRIBUTION

This question was used in order to find out whether people in Luxembourg truly employ faster driving styles after traffic congestion, since that has been established to be one of the main contributors to higher GHG emissions and fuel-related costs. Figure 46 suggests that people would not agree with this statement with 43.3% completely disagreeing. However these numbers have to be taken with a grain of salt due to the nature of the question. People are less likely to self-report or admit to more dangerous or even illegal actions even if they may engage in such behaviour. However this is speculation as the researcher cannot be entirely sure about the answers of the participants. Therefore these results will be taken at face-value, but a small reminder to the limitation of the validity was given. The average score was 2.02.

4.1.2.20. Parking

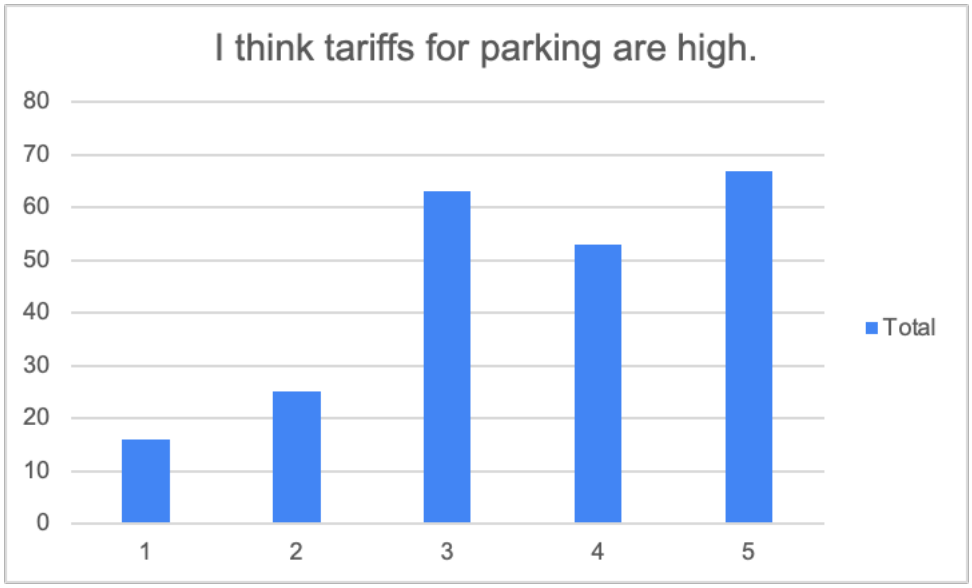

FIGURE 47 - PARKING TARIFFS DISTRIBUTION

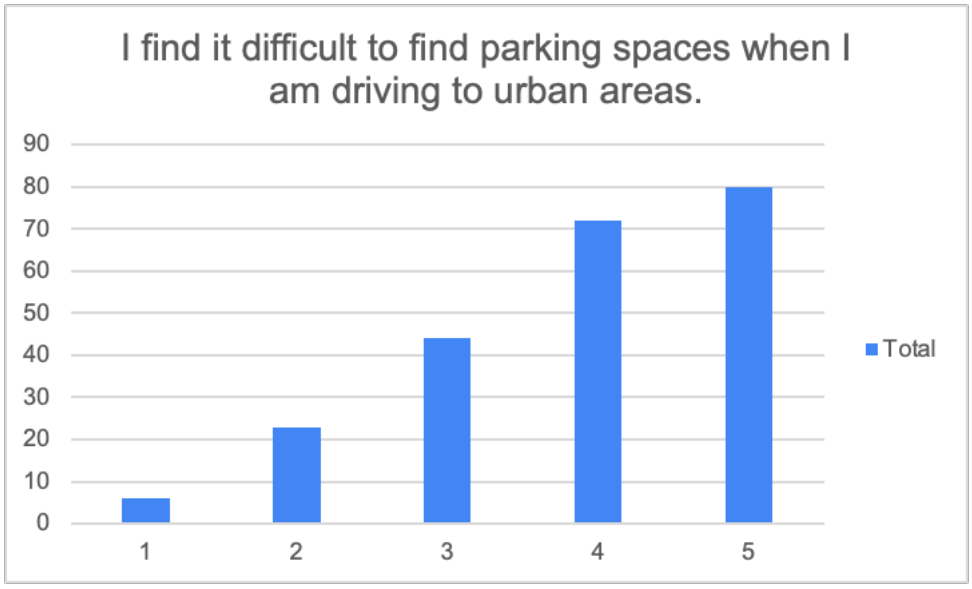

FIGURE 48 - PARKING AVAILABILITY IN URBAN AREAS DISTRIBUTION

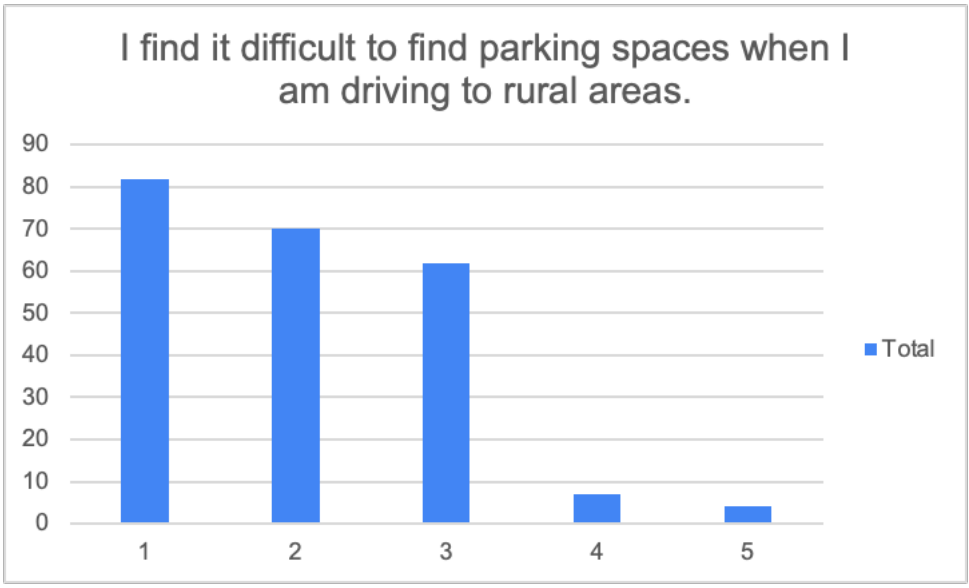

FIGURE 49 - PARKING AVAILABILITY IN RURAL AREAS DISTRIBUTION

The findings regarding parking suggest a few things. Firstly, people in Luxembourg find parking tariffs rather expensive, since 53.6% agree to some extent with this statement. This indicates that the findings of Parmar et al. (2020) hold true that people are more preoccupied with in-vehicle costs as they have explained it than with out-vehicle costs. The cost factor of parking is seen as more severe than the impact that driving has on the environment altogether as can be seen by comparing the absolute numbers of Figure 47 and Figure 45. The mean score for the cost of parking was 3.58. Regarding the availability of parking spaces, people expressed that they have trouble finding a spot in urban areas, whereas in rural regions that was not the case. In urban areas this search for parking spots can lead to dangerous and inattentive driving as explained by Ponnambalam and Donmez (2020). 80 out of 225 completely agreed with this statement while another 72 slightly agreed. This problem seems to be less prevalent in rural areas where the numbers are almost flipped. 82 out of 225 participants completely disagree with the statement that it is difficult to find parking spaces in rural areas while another 70 disagreed slightly. Since parking is an essential part of driving, it may be interesting to test whether even higher parking tariffs would have an impact on driving intent. Increasing the prices of parking tariffs even further could turn people away from driving by car since there is evidence to support the claim that drivers are already dissatisfied with the parking prices. However similarly to the example presented in the theory section regarding a certain Jevon's paradox if public transportation becomes more attractive than driving, a similar rebound effect could be observed where parking spaces become more freely available, especially in urban regions, which could encourage people to drive again. The average score for the urban region was 3.88 and for the rural region 2.03.

4.1.2.21. The car is essential

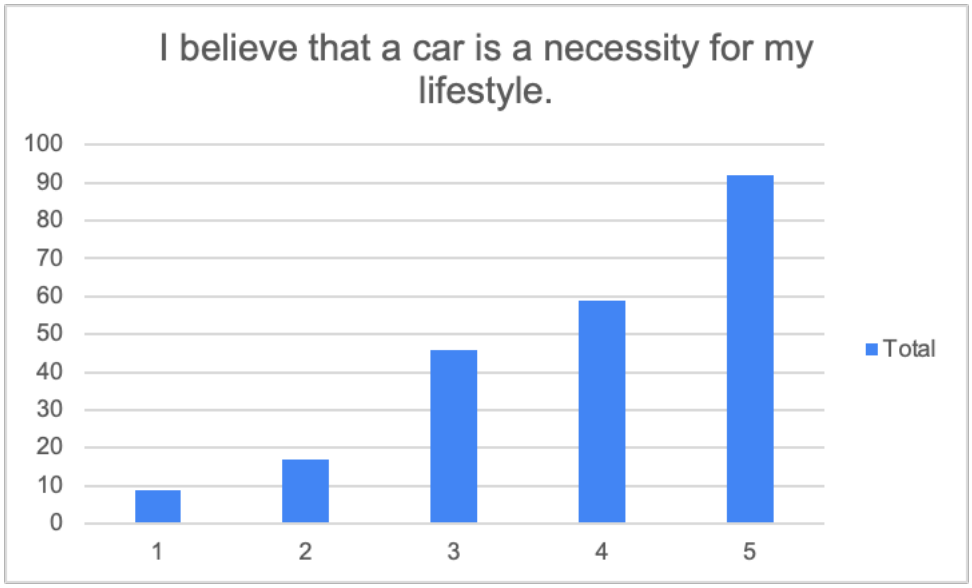

FIGURE 50 - THE CAR IS ESSENTIAL DISTRIBUTION

After expressing the benefits of car use and despite all the drawbacks regarding financials, sustainability, and stress, the majority of participants indicated that a car is a necessity for their lifestyle. This could be because the reasons for car use are plentiful and very personal in most cases. Another possible explanation could be due to reinforcing feedback loops and the formation of habits such as doing grocery shopping by car or commuting to work in a car that people see their car as a necessity for their life. The importance of habits should be kept in mind as argued by Havlíčková and Zamecnik (2020), since they can lead to scripts that are difficult to break. Figure 50 shows that 41.3% of the participants indicated that they completely agree with the statement above and a further 26.5% slightly agreed. Astonishingly, only 4.04% of all people completely disagreed with the statement, a surprisingly low number in a country that is rather small in size with easy to reach destinations. The mean score was 3.93.

4.1.3. Public transportation use in Luxembourg

Similar in design to the last section regarding car use, this section deals with the results of the statements about public transportation in Luxembourg. Again, the participants were presented with certain statements and needed to indicate to what degree they agree or disagree with a given statement. They were again given a 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree) with which they could rate the statements. The statements themselves stem from the literature as they are common reasons for and against public transportation such as the low cost or punctuality. The goal was to see whether the people in Luxembourg agree with these common arguments or not and to find out what the participants think about public transportation and what they dislike about it or where they see the advantages of car use in comparison to public transportation.

4.1.3.1. Price of public transportation

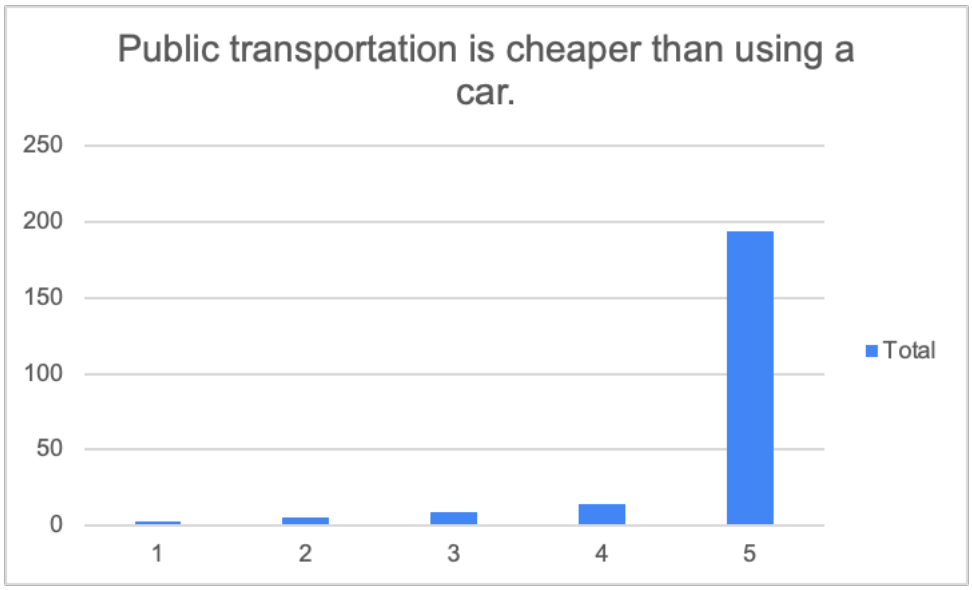

FIGURE 51 - PRICE OF PUBLIC TRANSPORTATION DISTRIBUTION

Figure 51 shows that 86.2% of the participants indicated that they agree with the statement that public transportation is cheaper than using a car. Since it was a rather generalised statement and not particularly about Luxembourg, the remaining percentages can be explained, since 100% of the participants indicated that they know about public transportation being free of charge for consumers in Luxembourg as seen in point 4.1.1.9. The mean score here was 4.74.

4.1.3.2. Environmental impact of public transportation

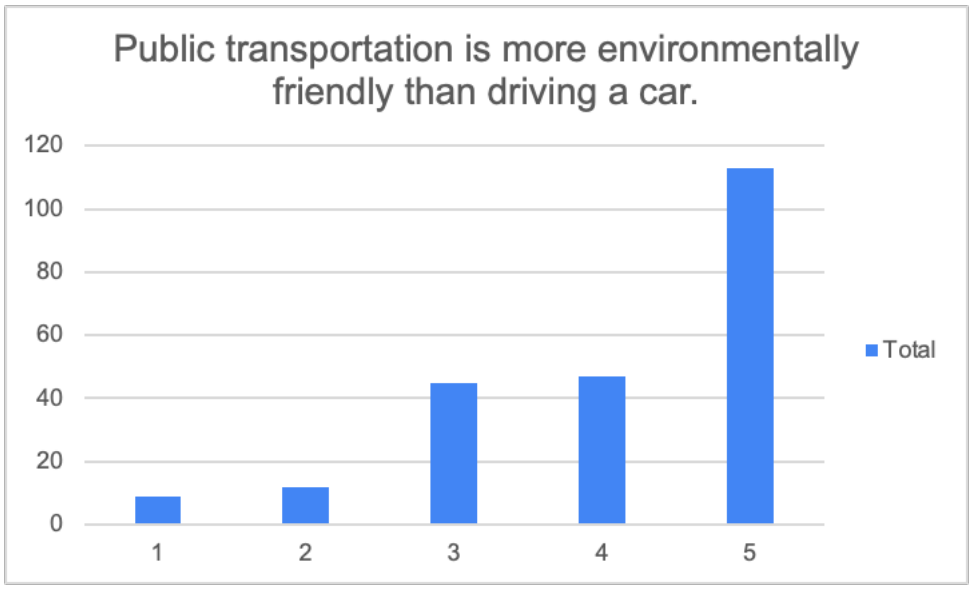

FIGURE 52 - ENVIRONMENTAL IMPACT OF PUBLIC TRANSPORTATION DISTRIBUTION

While exactly 50% completely agree with the statement above, around 9.3% would rather disagree or completely disagree with public transportation being more environmentally-friendly than driving a car as evidenced by Figure 52. Also the 20% that answered 3 (essentially neutral) are interesting to observe, possibly indicating that a portion of car drivers are not aware of the impact that they and their mobility behaviour have on the environment. The mean score for this statement was 4.08.

4.1.3.3. Access to jobs and education through public transportation

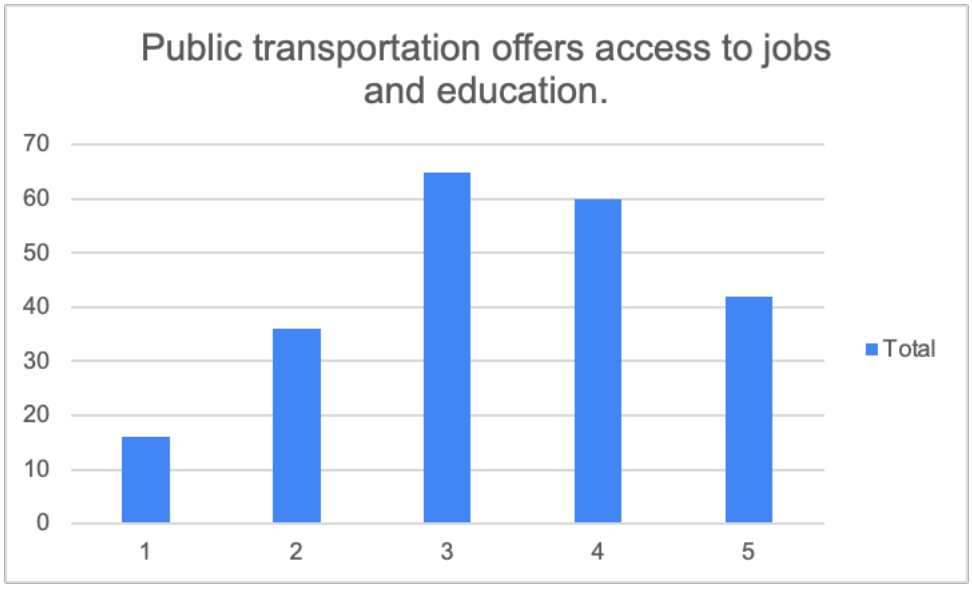

FIGURE 53 - ACCESS TO JOBS AND EDUCATION THROUGH PUBLIC TRANSPORTATION DISTRIBUTION

This statement alluded to the fact that (free-fare) public transportation is a viable social policy that allows people with less disposable income to access jobs and education at an affordable price. The drivers in Luxembourg more or less agreed with the statement with the mean score being 3.35. The biggest groups of answers were 3, 4, and 5 in that order with 29.7%, 27.4%, and 19.2% respectively as shown by Figure 53.

4.1.3.4. Reliability

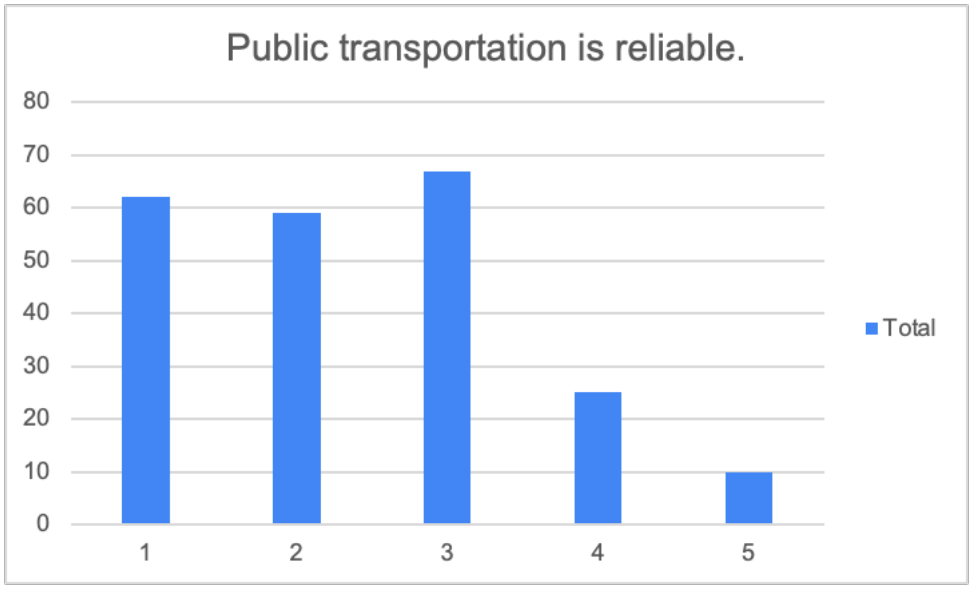

FIGURE 54 - RELIABILITY OF PUBLIC TRANSPORTATION DISTRIBUTION

Figure 54 indicates that he participants of the study explained that they do not particularly agree with public transportation being reliable, which is underlined by the Figure above and a mean score of 2.38. The largest proportion of people (30%) were neither agreeing nor disagreeing with the statement by answering 3, yet the second and third biggest section disagreed with the statement. Especially the 27.8% of people that answered 1 are concerning for public transportation and the envisioned mobility shift in the PNM 2035. This hints at severe structural problems when ¼ of people express that they think that public transportation is not reliable. In a broader sense, this may even prevent a lot of people to use public transportation due to previous bad experiences regarding reliability or shape the perception of public transportation from hearing that close family members or friends had negative experiences regarding reliability. The mean score was a surprisingly low 2.38.

4.1.3.5. Punctuality

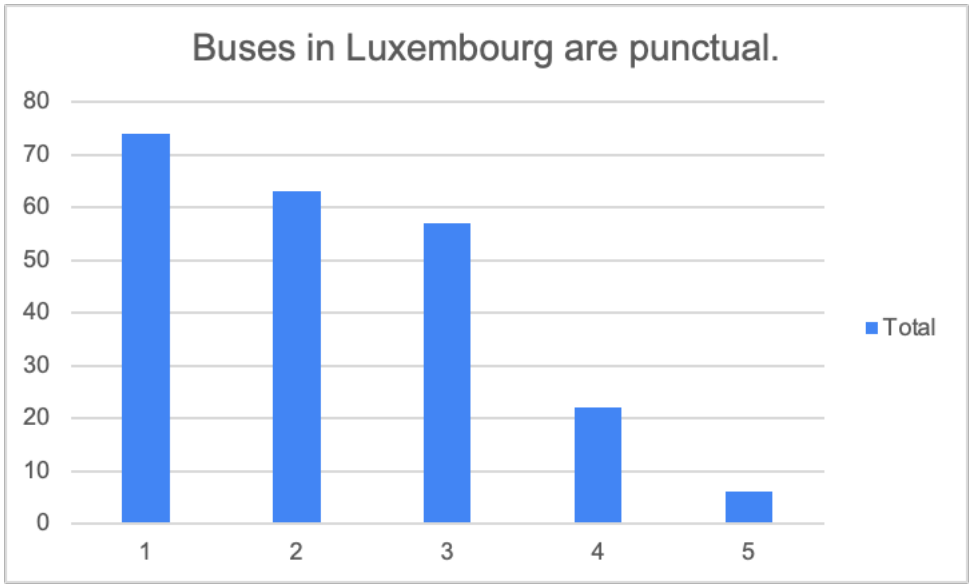

FIGURE 55 - PUNCTUALITY OF BUSES IN LUXEMBOURG DISTRIBUTION

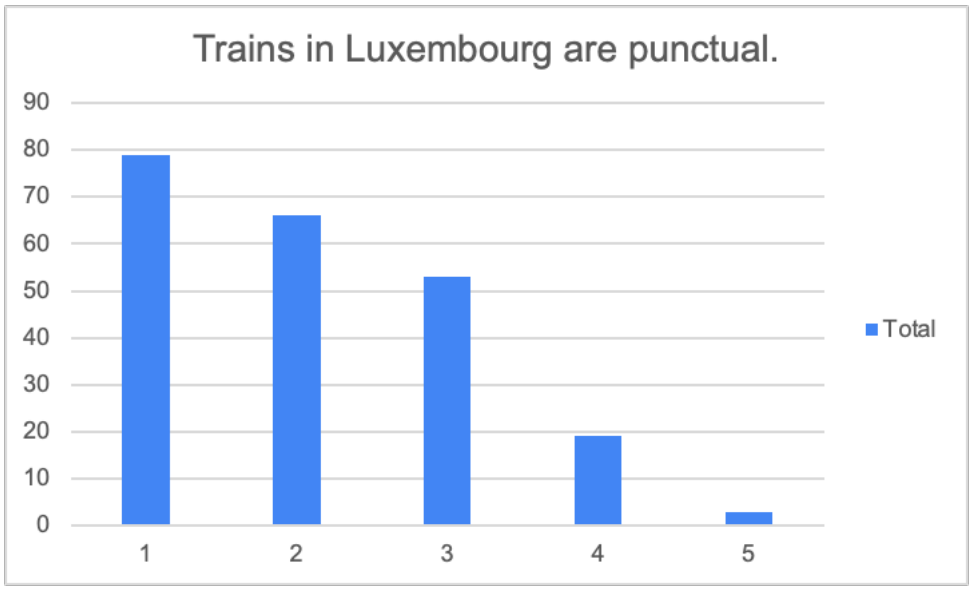

FIGURE 56 - PUNCTUALITY OF BUSES IN LUXEMBOURG DISTRIBUTION

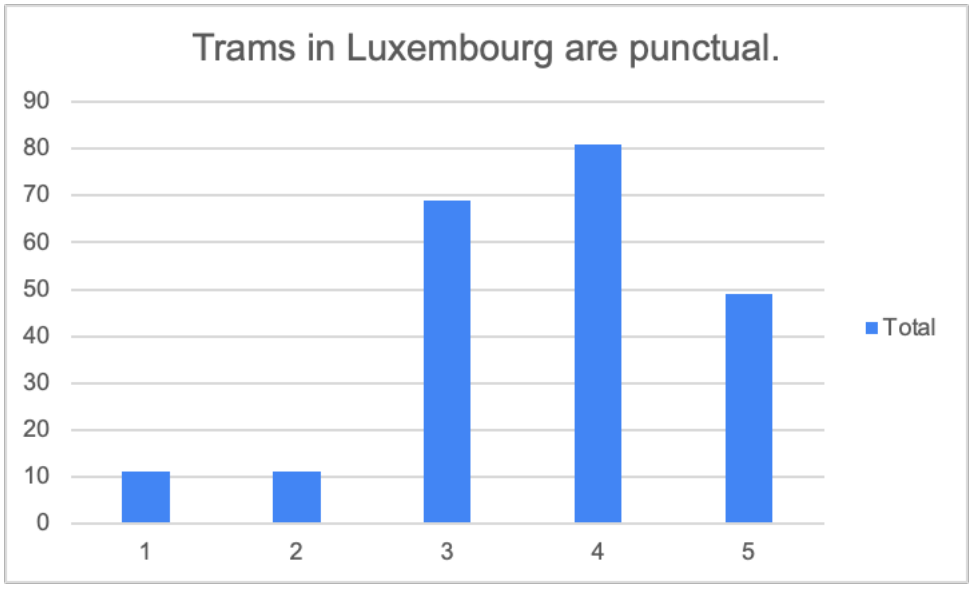

FIGURE 57 - PUNCTUALITY OF TRAMS IN LUXEMBOURG DISTRIBUTION

Figures 55 to 57 show an alarming situation. The results regarding punctuality suggest a similar negative public opinion on public transportation in Luxembourg than the point reliability. Especially for buses and trains, the participants largely agreed on them being not punctual at all. Average scores of 2.02 for buses and 2.1 for trains indicate a structural problem with punctuality. Precisely every third participant of the survey answered the question regarding the punctuality of busses with 1, similar to the punctuality of trains where it were even more with 35.9%. The dissatisfaction with the punctuality of trains and buses is apparent in Luxembourg and may be a deciding factor for the decision of people to choose cars instead of public transportation. However, trams were the exception to this trend with a mean score of 3.66. 58.8% of people indicated that they agree to some extent with the statement that trams are punctual which is a significant increase compared to buses with 12.6% and trains with 10%. The difference between trams and buses and trains however is that trams currently only operate in the city of Luxembourg from Kirchberg to Bonnevoie. There is currently also only one line, which makes the management of the infrastructure easier than for buses and trains. By adding more complexity in the future by expanding and developing the tram line, it will naturally become more susceptible to shocks, which can lead to similar problems in punctuality which can be observed currently for bus and train lines.

4.1.3.6. Railway Renovations

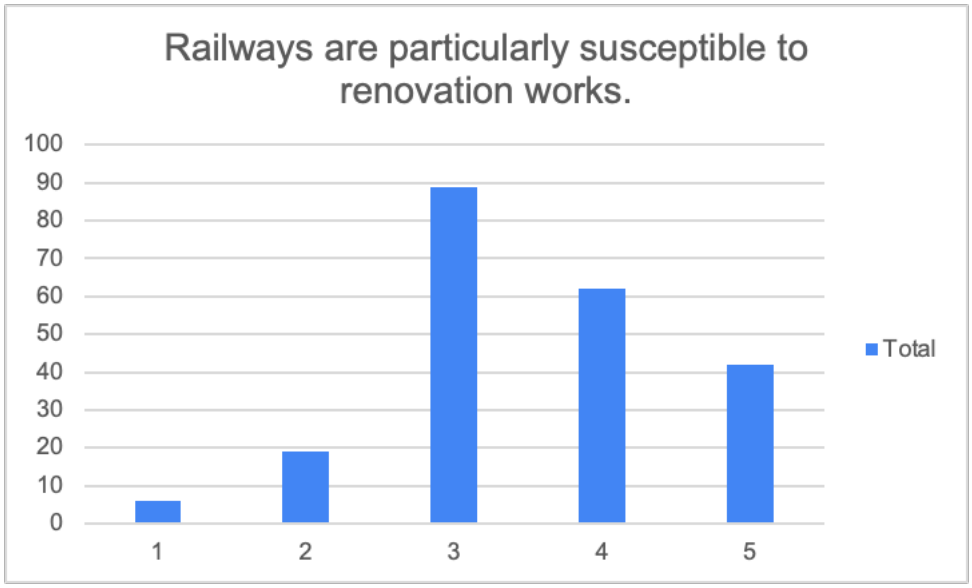

FIGURE 58 - RAILWAY RENOVATIONS DISTRIBUTION

This statement was used to have a comparable question to the one regarding roadworks for cars and see whether one of the two statements has a significantly different answer set. Furthermore, the collapsed tunnel and the current renovation works on the train line connecting Belgium and Luxembourg City have been rather prevalent in the news, and shape the perception of public transportation and reparation works. The mean score for Figure 58 was 3.53, indicating that the people would more or less agree with the statement. For comparison, the roadwork statement had a mean score of 4.46 which was still significantly higher than the mean score for railway renovations.

4.1.3.7. Free-fare public transport - a good policy?

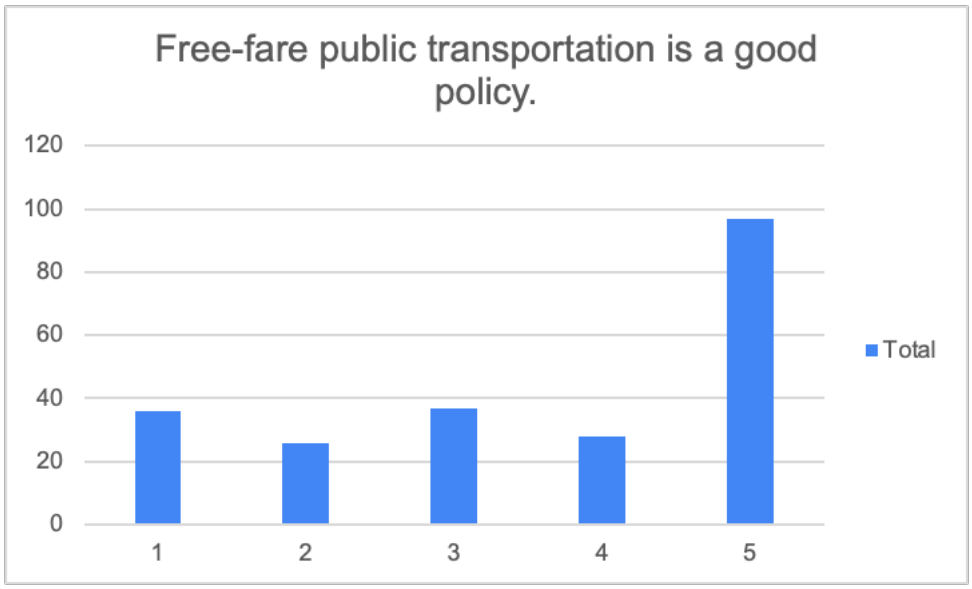

FIGURE 59 - OPINION ON FREE-FARE PUBLIC TRANSPORT POLICY DISTRIBUTION

The majority of people agree that free-fare PT is a good policy with 43.3% shown by Figure 59. Interestingly however, the other options were rather even. 16% even explained that they complete disagree with the statement. While the overall sentiment towards the policy is positive, it might be interesting to investigate the reasons for the dislike of the policy among the 16% of people that indicated so. The mean score for the opinion on the policy was 3.55.

4.1.3.8. Opinion on the railway network

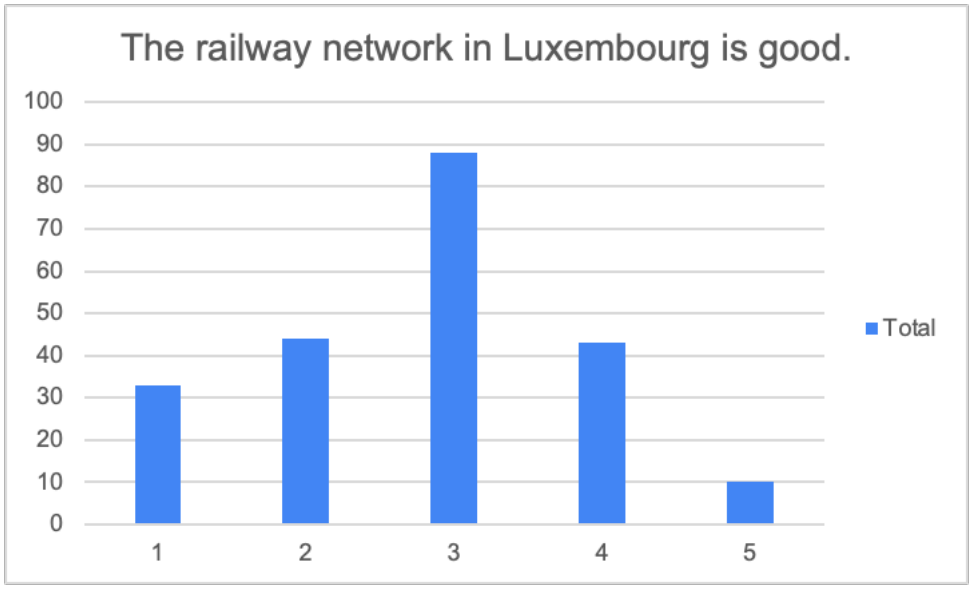

FIGURE 60 - OPINION ON THE RAILWAY NETWORK DISTRIBUTION

To be able to draw comparisons between road and public transport infrastructure, this statement was utilised. Directly comparable to the statement of Figure 39 regarding the opinion of the road network Figure 60 explains that people have a slightly more negative opinion on the railway network. The mean score here was 2.78 which was lower than the 3.51 of the road network. The largest group of answers was 3, the same as for the road network statement, however the distribution of the other answers is different. For the railway network, the second largest group of participants answered 2 instead of 4 which was the case for the road network. This indicates that people rather disagree with the railway network in Luxembourg being good and comparatively think that the road network in Luxembourg is better. This could potentially be another factor for the conscious choice of cars instead of public transportation, because people may not perceive the infrastructure to be up to par or inferior to the infrastructure that is already in place for driving. This is a noteworthy finding, since it underlines Dupuy's (1999) analysis regarding the car infrastructure functioning better the more people use it and reinforcing the positive feedback loop that is created. Furthermore, this comparison again shows limitations to the possible success of a mobility transition, since the public transportation infrastructure would need a competitive edge over the road network in order to be a viable option by reducing the speed limits or increasing the number of bus lanes or train lines for example (Hiscock et al., 2002).

4.1.3.9. Safety and public transportation

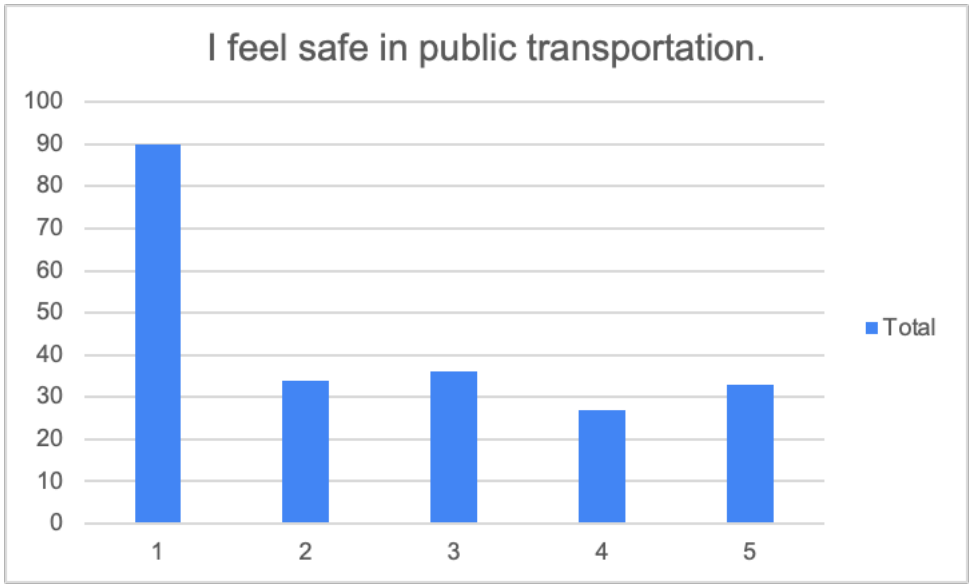

FIGURE 61 - SAFETY IN PUBLIC TRANSPORTATION DISTRIBUTION

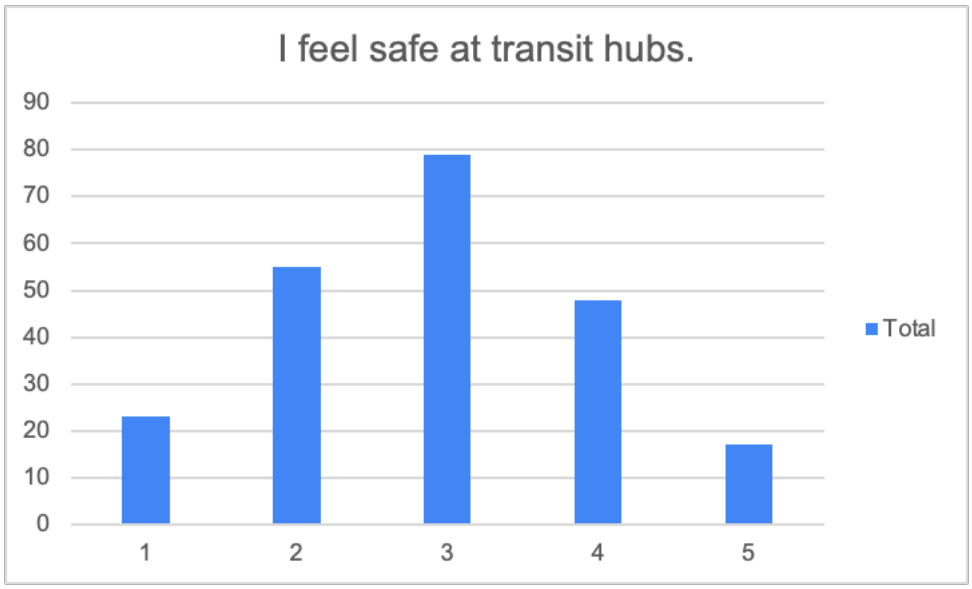

FIGURE 62 - SAFETY AT TRANSIT HUBS DISTRIBUTION

The question regarding safety in public transportation yielded some interesting results. In order to further probe the findings of Hiscock et al. (2002) regarding protection being one of the main factors in the choice of transport mode, this statement was utilised to see how the people feel about safety in public transportation itself. The majority of people (40.9%) indicated that they completely disagree with the statement above and only 27.3% in total agreed to some extent with this statement, indicated by Figure 62. A rather astonishing result, which indicates the need for increases in safety in public transportation according to the participants. This is also reflected by the mean score being 2.45. The safety at transit hubs was rated higher than the safety in public transportation itself however the mean score of 2.91 still indicates the need for safety improvements in order to become a more attractive option for people in Luxembourg. Since protection is one of the most important aspects of transport mode choice according to Hiscock et al. (2002), it is important for the infrastructure to ameliorate in the coming years if the PNM 2035 is to be achieved. Specifically linking these findings to the safety on the road, people do not necessarily think that car is inherently safer but argue that the safety in public transportation is comparatively worse.

4.1.3.10. Effects of the introduction of free-fare public transportation

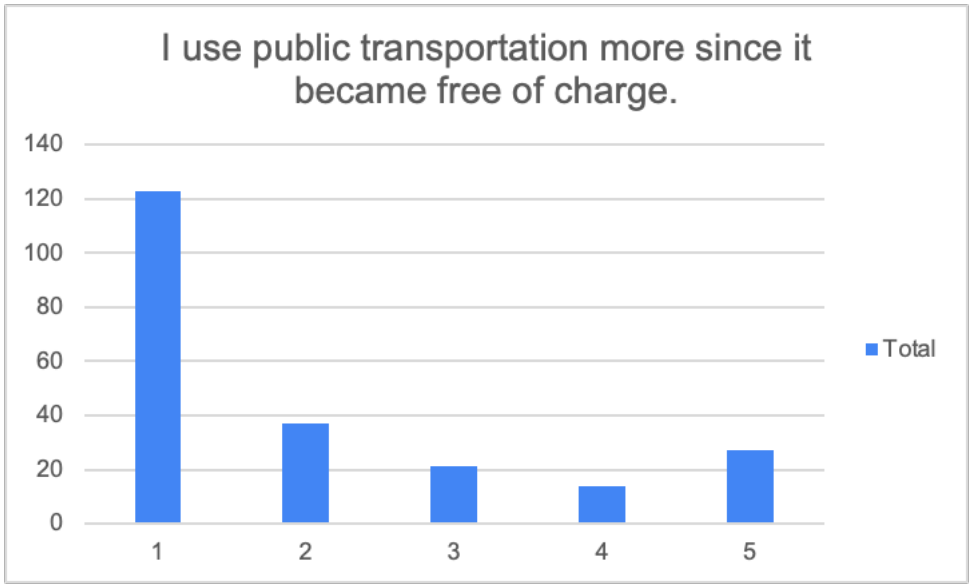

FIGURE 63 - USE OF PUBLIC TRANSPORTATION SINCE IT BECAME FREE DISTRIBUTION

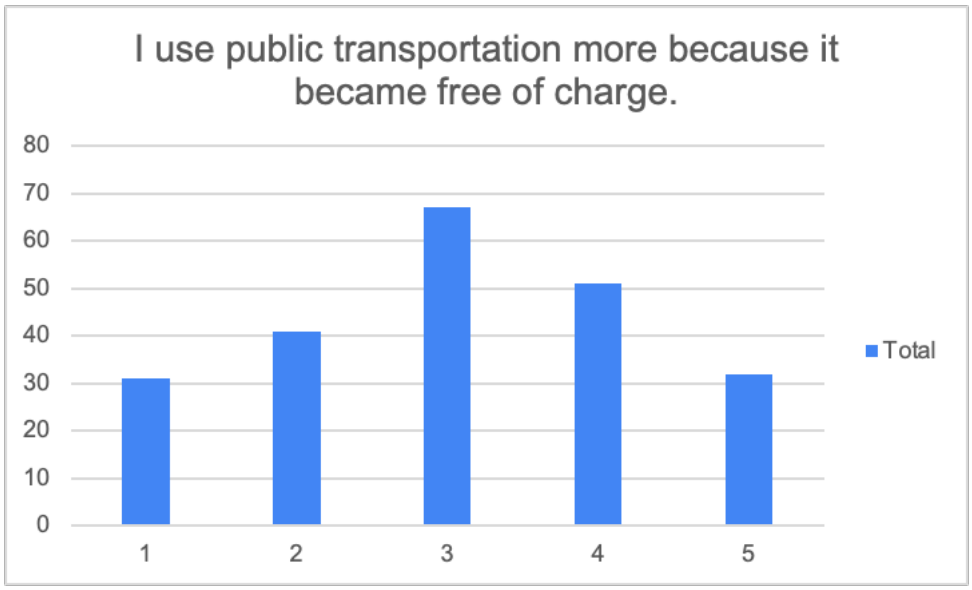

FIGURE 64 - USE OF PUBLIC TRANSPORTATION BECAUSE IT BECAME FREE DISTRIBUTION

Figures 63 and 64 show the impact that the introduction of the free-fare policy regarding public transportation has had on the travel behaviour of the participants of this study. Figure 64 clearly shows that the introduction of the policy did not have the desired effect. 55.4% of people indicated completely disagreed with the statement that they use public transportation

more since it became free in Luxembourg. Moreover, only 12.1% of people indicated that they completely agree with the statement, showing that the mobility patterns of people in Luxembourg are quite set with limited indication for sustainable change. While similar policies with reduction on prices such as the "9-Euro-Ticket" in Germany had tremendous success and saw increases of up to 56% in ridership numbers for trains (Statista, 2023), the same cannot be argued for Luxembourg which abolished all fares for buses, trains, and trams, which is further strengthened by the mean score of 2.03. Figure 64 shows that the elimination of fares had a small impact on ridership, with 37.4% agreeing to some extent but which may be under the initial expectation of the policy makers. The mean score was 3.05 showing some degree of agreement. Nonetheless the proportion of people disagreeing with the statement that indicated that they do not use public transportation more because it became free of charge is 32.4%. This group may be encompassing frequent public transportation users that used it even before the introduction of the free-fare policy, but still the number is remarkably high.

4.1.3.11. Accessibility of transit hubs

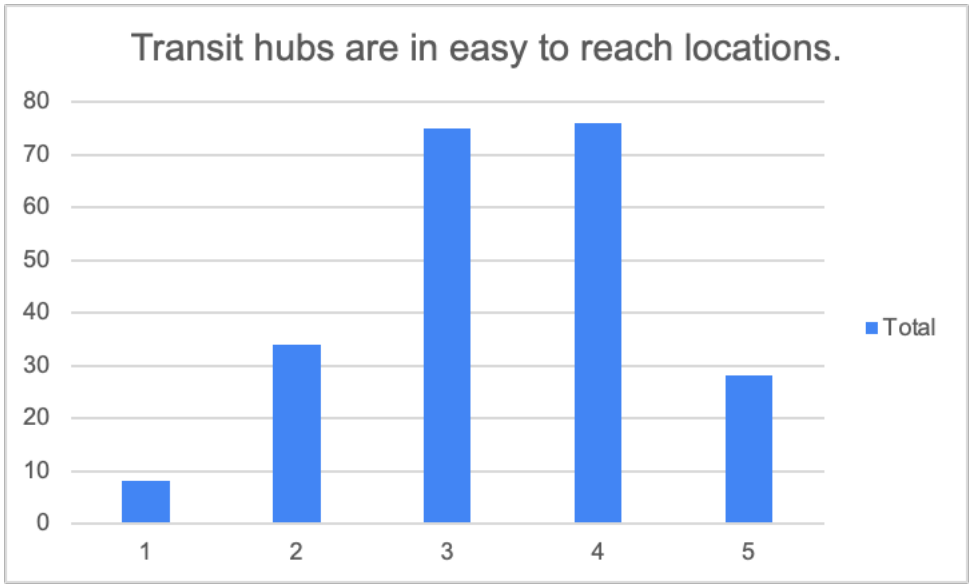

FIGURE 65 - ACCESSIBILITY OF TRANSIT HUBS DISTRIBUTION

Figure 65 presents that the two biggest answer groups for this question were 3 with 76 (34.4%) and 4 with 75 (33.9%) answers. While the consensus under this statement is that transit are rather in easy to reach locations, only 12.7% of the participants completely agreed with the statement, indicating some degree of hesitation. The mean score for this statement was 3.37.

4.1.3.12. Public transportation is time-intensive

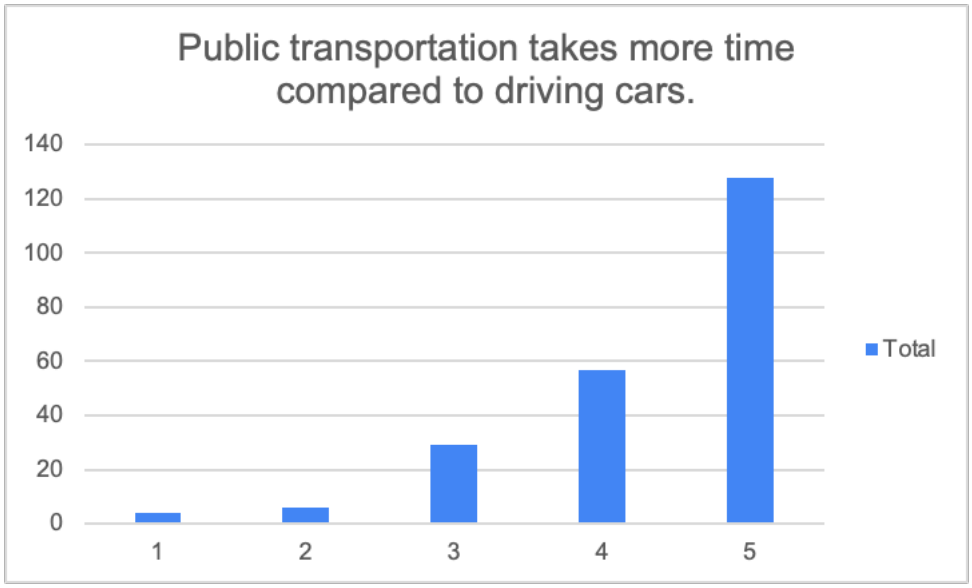

FIGURE 66 - TIME INTENSITY OF PUBLIC TRANSPORTATION DISTRIBUTION

In essence Figure 66 expresses the same situation than Figure 28. But since the wording was slightly altered, a small difference in answers can be observed. For this statement 82.6% of the participants agreed to some extent which 2.5% more than for Figure 28. The mean score however was lower with 4.33, 0.06 lower than for Figure 28.

4.1.3.13. Accessibility of public transportation in rural areas

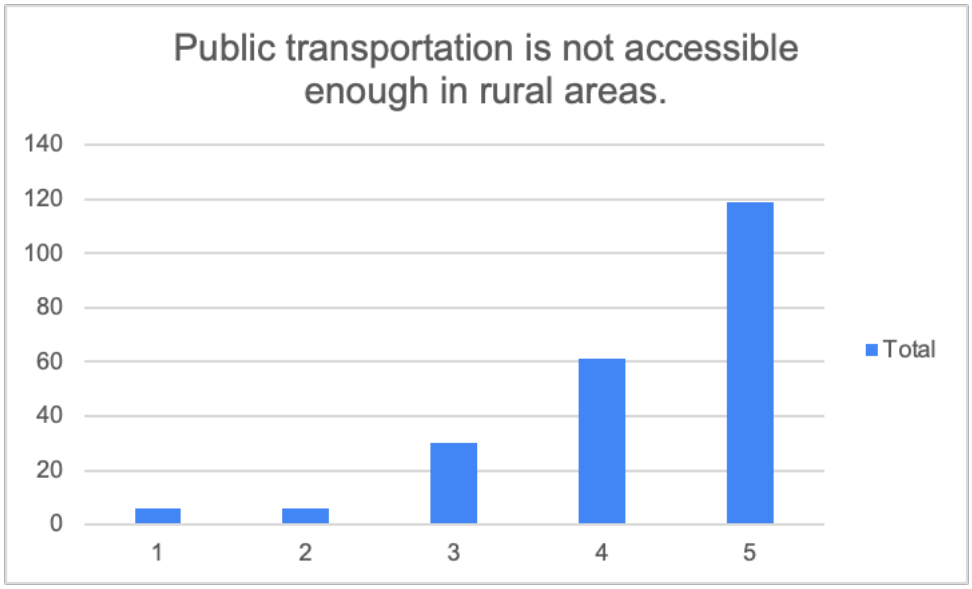

FIGURE 67 - ACCESSIBILITY OF PUBLIC TRANSPORTATION IN RURAL AREAS DISTRIBUTION

The accessibility of public transportation in rural areas was criticised by the majority of the participants of the study, as evidenced by Figure 67. 53.6% completely agreed with the statement while only 5.4% disagreed to any extent. This is also reflected by the mean score of 4.27 indicating a need for expansion of the public transportation network in more rural areas of the country in order to offer people from these regions better access to an alternative to car use. This clearly shows a point that needs to be improved in Luxembourg in order to achieve the envisioned modal shift towards sustainable mobility.

4.1.3.14. Convenience of public transportation

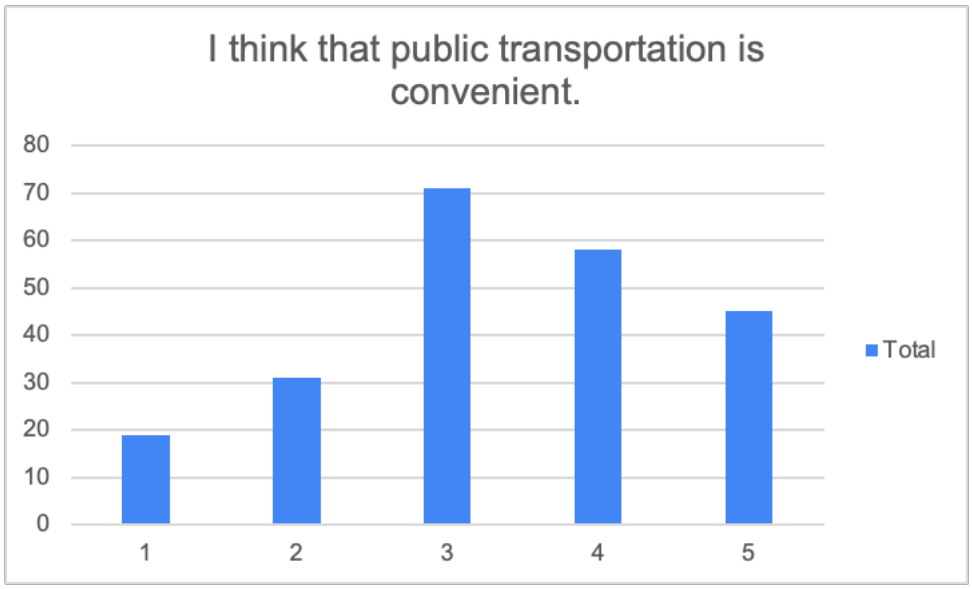

FIGURE 68 - CONVENIENCE OF PUBLIC TRANSPORTATION DISTRIBUTION

Figure 68 shows that the overall sentiment towards this statement was positive, which is reflected by the mean score of 3.35. 46% of the respondents agreed to some extent with the statement, while 22.3% disagreed. This indicates that the convenience of the public transportation is seen decently by the public and a point where the infrastructure is perceived as good. Compared to the convenience of cars however, where 91.6% of the participants agreed on cars being comfortable, public transportation is not up to par. Simply put, people believe that cars are more convenient than public transportation in Luxembourg.

4.1.3.15. Comfort of public transportation

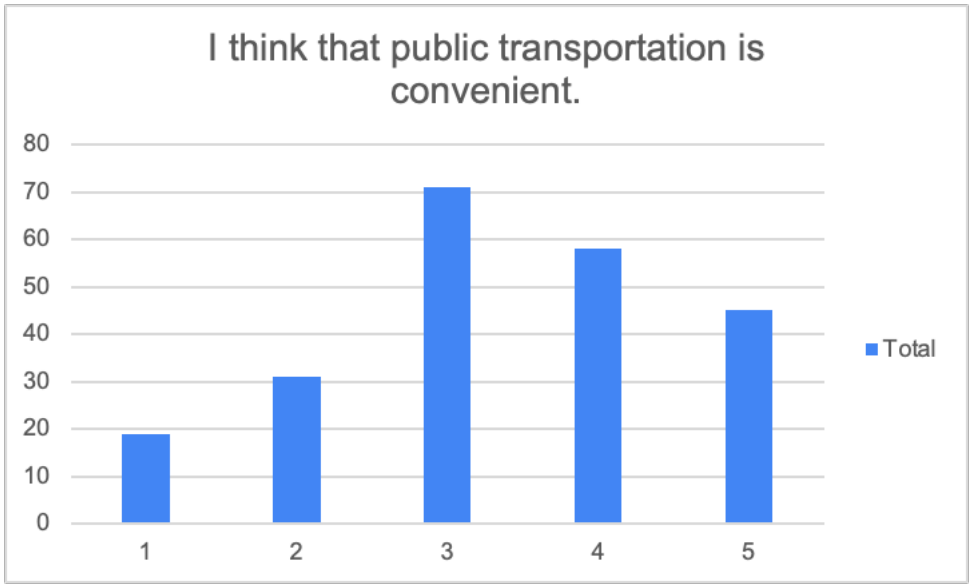

FIGURE 69 - COMFORT OF PUBLIC TRANSPORTATION DISTRIBUTION

Figure 69 follows a similar distribution to Figure 68, where the majority of participants agreed on PT being comfortable, but compared to cars, PT is seen as significantly less comfortable. With a mean score of 2.98 for PT and 4.35 for cars it becomes evident that people perceive cars as more comfortable. Again, people believe cars to be more comfortable than PT, which influences their mobility choices according to Hiscock et al. (2002).

4.1.3.16. Opinion on multiple changes in public transportation

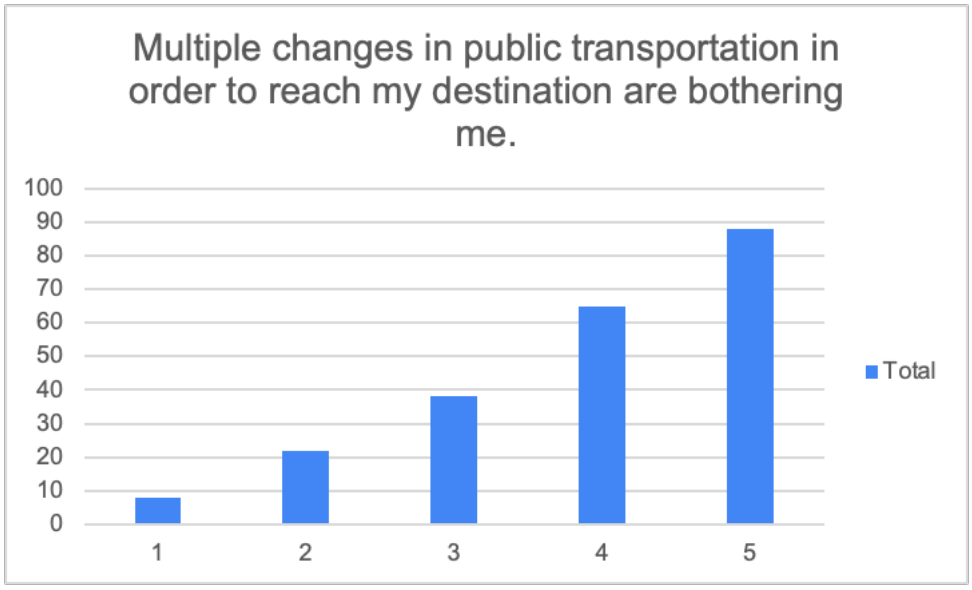

FIGURE 70 - OPINION ON MULTIPLE CHANGES IN PUBLIC TRANSPORTATION DISTRIBUTION

39.1% of participants completely agreed with this statement and only 13.6% disagreed to any extent and with a mean score of 3.92 the overall consensus is that people are annoyed with multiple changes in public transportation in order to reach their destination, underlined by Figure 70. This can lead to the avoidance of public transportation in rural areas for example since options for public transportation are often limited with often only a bus connecting these regions with more urban areas or larger transit hubs. Therefore, depending of destination, this can be a point that turns people way from using public transportation. However, this may not only be a problem in rural areas. Urban areas and especially the city of Luxembourg have been remodelled and restructured in a way that accommodates for the recently opened tramline as the main public transportation option in the capital city. Buses and trains arrive at certain transit hubs, connected to the tram line and oftentimes do not drive into the city centre. On one hand this is a great policy in order to reduce emissions and traffic congestion in the city centre, on the other hand however it may prevent people from using public transportation altogether, since it is now less practical or convenient to do so because they are forced to change from one public transportation option to another.

4.1.3.17. Overcrowdedness in public transportation

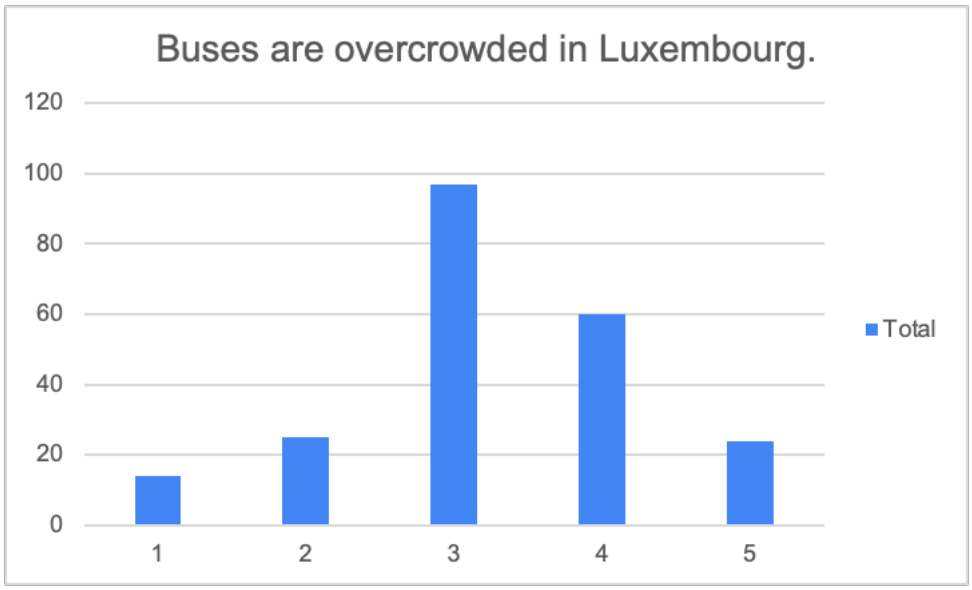

FIGURE 71 - OVERCROWDEDNESS IN BUSES DISTRIBUTION

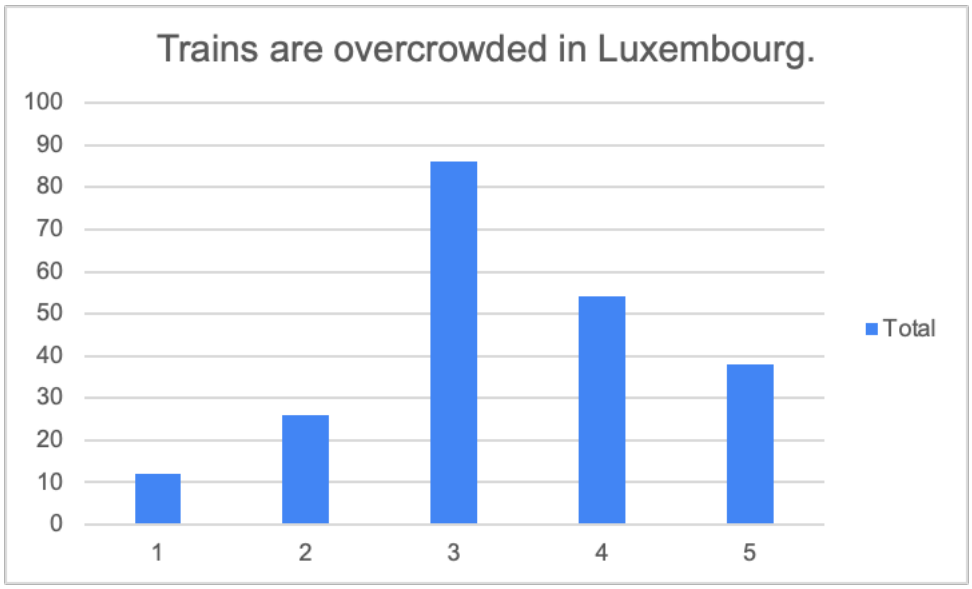

FIGURE 72 - OVERCROWDEDNESS IN TRAINS DISTRIBUTION

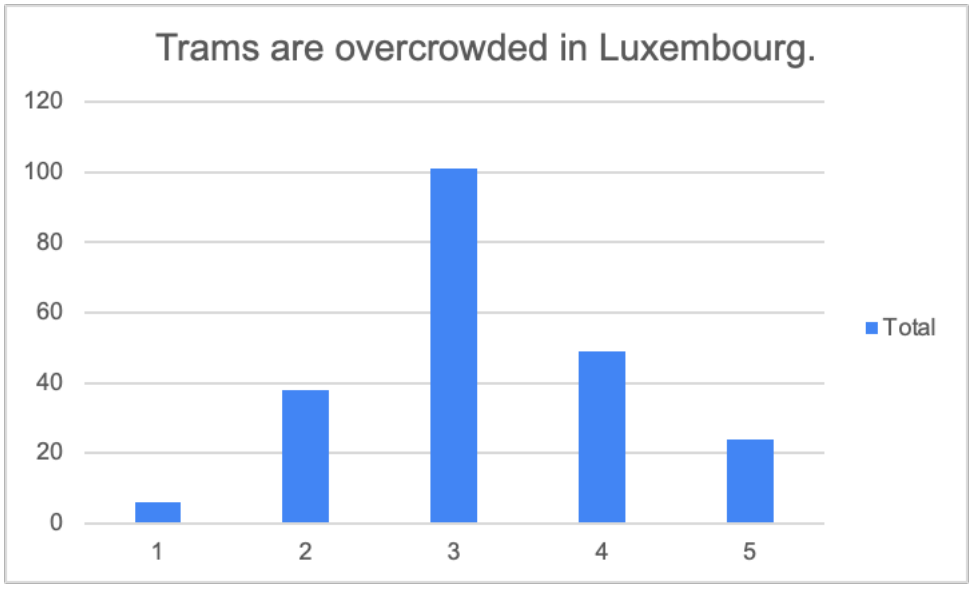

FIGURE 73 - OVERCROWDEDNESS IN TRAMS DISTRIBUTION

For all three forms of public transportation available in Luxembourg the most popular answer regarding overcrowdedness was 3, shown by Figures 71 to 73. This could be due to a couple of reasons however. One could be that people genuinely do not know how crowded the different forms of public transportation are due to the fact that they simply do not use them and therefore opted to not make a judgement about the situation. Another reason could be that this actually does represent their opinion and that overcrowdedness is not as much of a problem in

public transportation in Luxembourg as initially expected. However, for buses and trains 38.2 and 42.6% respectively the participants agreed with the statement that they are overcrowded. Only for trams the percentage was slightly lower with 33.5%. This could be due to the fact that the frequency in which the tram is operating is significantly higher than for buses and trains and the tram line has to cover a lot less distance, meaning that there are less stops where people can enter and exit. While overcrowdedness may not be the most pressing issue for public transportation and reached lower mean score of 3.25, 3.37, and 3.22 for bus, trains, and trams respectively than for example the safety concerns in public transportation, it is a noteworthy shortcoming of public transportation compared to personal car use nonetheless, where personal space is guaranteed.

4.1.3.18. Public transportation is stressful

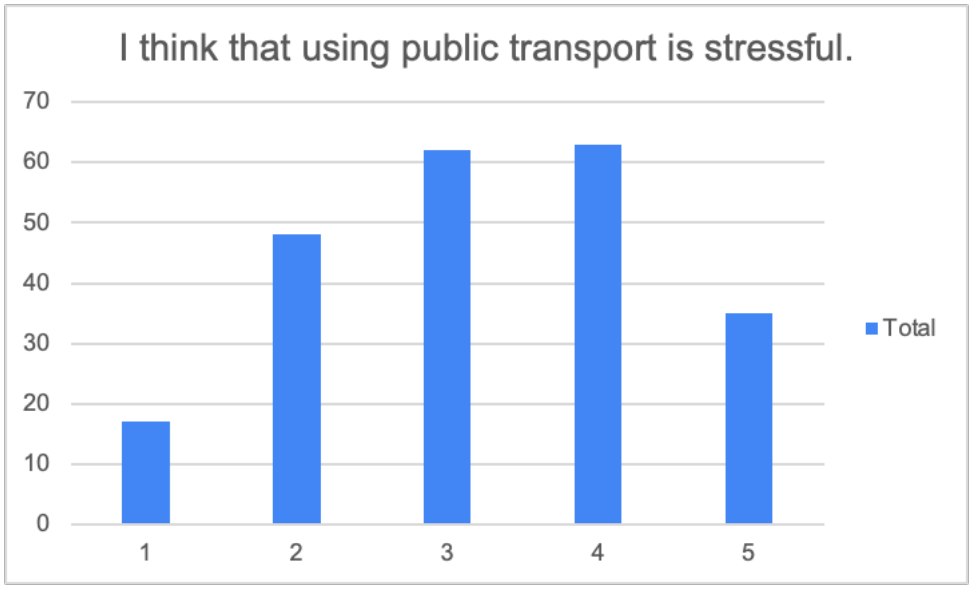

FIGURE 74 - PUBLIC TRANSPORTATION IS STRESSFUL DISTRIBUTION

Contrary to the sentiment about the stress factor of driving, the general sentiment towards public transportation is that is stressful, represented by Figure 74. With a mean score of 3.23, the comparison gives an insight into the attitudes of people towards car use and public transportation, since the score for car use was lower at 2.59. The biggest group of people for this statement slight agrees with 28%. For the stressfulness of car use the majority of people slightly disagreed with 27.6%. It seems like the people in Luxembourg would argue that the whole process of using public transportation, such as commuting to transit hubs and keeping up with pre-determined time schedules is more cumbersome than traffic congestion, roadworks, the search for parking spaces and more.

4.1.3.19. Night-time operation of public transportation

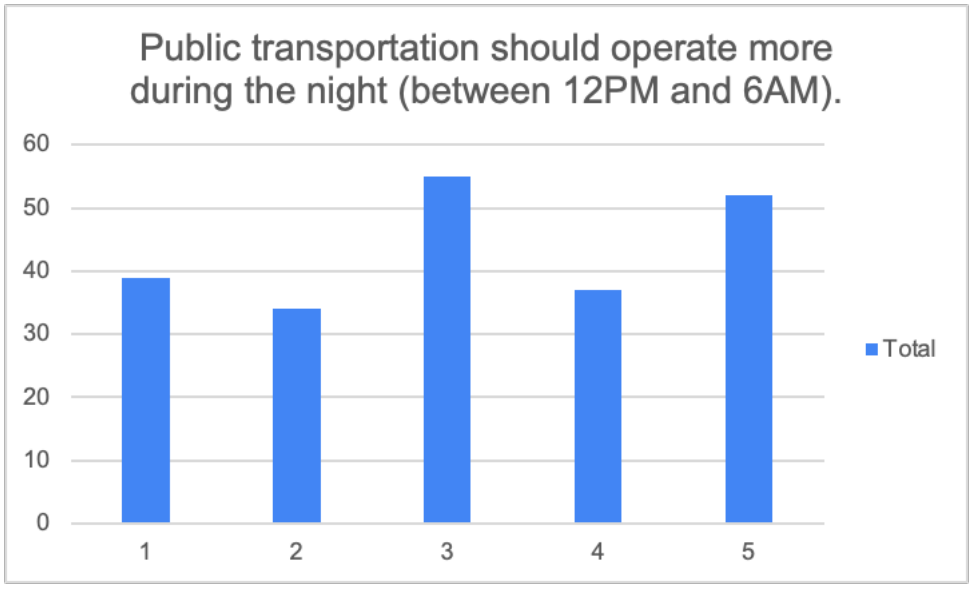

FIGURE 75 - NIGHT-TIME OPERATION OF PUBLIC TRANSPORTATION DISTRIBUTION

Another drawback of public transportation has always been that the access to it during night time especially between the hours of 12 PM and 6 AM for consumers is limited. This statement sought to find out what the general consensus on this issue is. While the majority of people were indifferent to the statement, the second largest proportion with 24% completely agreed. As evidenced by Figure 75. Easier access to public transportation during the night could help to reduce the need for cars among employees that need to commute to work at other hours than the typical 9 AM to 5 PM. Especially for shift workers for the police, ambulance, firefighters, or even public transportation operators, this could be a potential change that could be realised in order to increase the attractiveness or popularity of public transportation. The mean score for this statement was 3.13.

4.1.4. Future plans and proposed changes for public transportation in Luxembourg

This final section regarding the descriptive statistics of the results will deal with statements regarding proposed improvements to the public transportation infrastructure and the impact this may have on the mobility behaviour of the participants and specifically whether these changes may change the attitude towards public transportation and the intent to use it more in the future. The same 5-point Likert scale that was used for the previous two sections was again used to determine these results, except for the last two questions where the participants were presented with a 10-point scale to better see the intent of car use in the future.

4.1.4.1. Accessibility and Intent of using public transportation

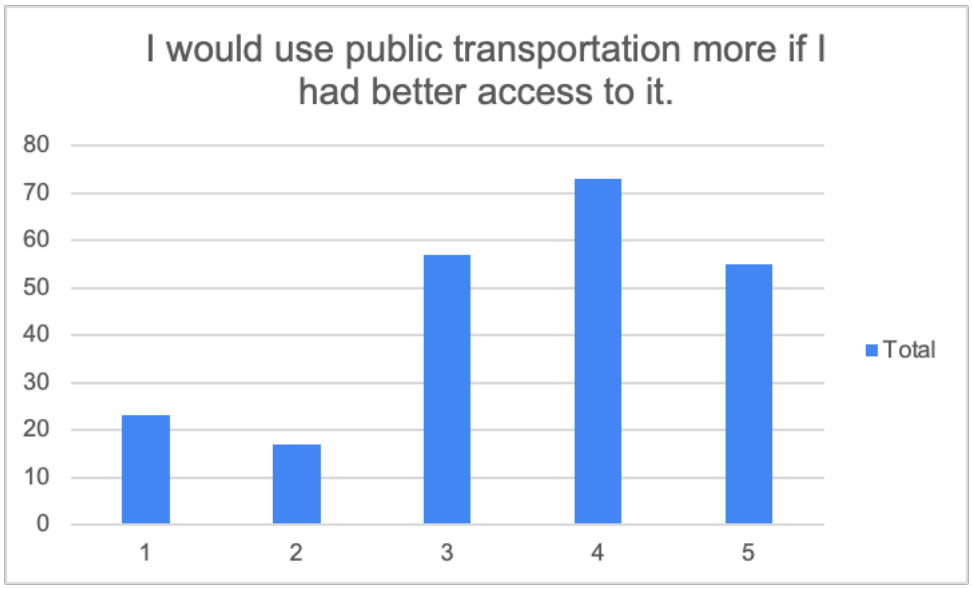

FIGURE 76 - ACCESSIBILITY AND INTENT DISTRIBUTION

According to Figure 76, this first improvement idea resonated with the majority of people in this study. Accessibility seems to be an area of improvement that people want. 56.9% of people agree with the statement above to some extent, showing that there is a possibility for behavioural change if the infrastructure expands and accustoms to the needs and wants of the people. With a mean score of 3.53, accessibility of public transportation seems to be a point that should be tackled in the near future in order to increase the attractiveness of public transportation.

4.1.4.2. Prices of car use and Intent of using public transportation

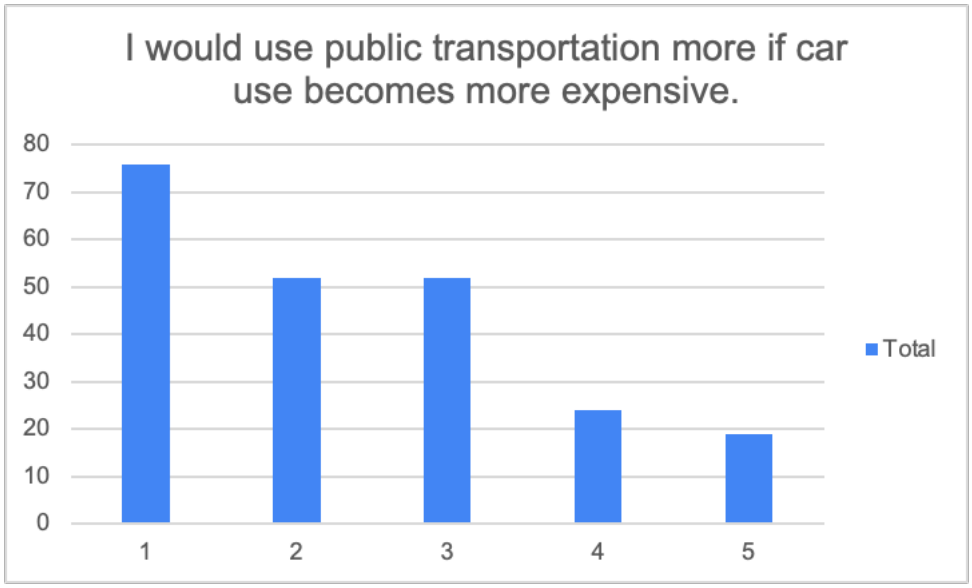

FIGURE 77 - PRICES OF CAR USE AND INTENT DISTRIBUTION

Generally, it can be observed that price-related statements do not hold the weight for the participants as initially expected and predicted by the classic economic theory of the homo oeconomicus. Regarding the use of public transportation if prices for car-related expenses increased further only 19,3% indicated that they would use public transportation more, whereas 57.4% would stick to their old ways, as shown by Figure 77. It becomes evident that expenses are considered as high as shown by Figures 40, 41, and 42 but are seen as “necessary evils” for the sake of convenience and comfort. This also indicates that regulations, such as higher taxation regarding car use may not have the desired impact such as an increase ridership in public transportation, but rather an investment into the infrastructure of public transportation and an improvement of the convenience of the network may be the way to go. The mean score for this statement was 2.36.

4.1.4.3. Speed and Intent of using public transportation

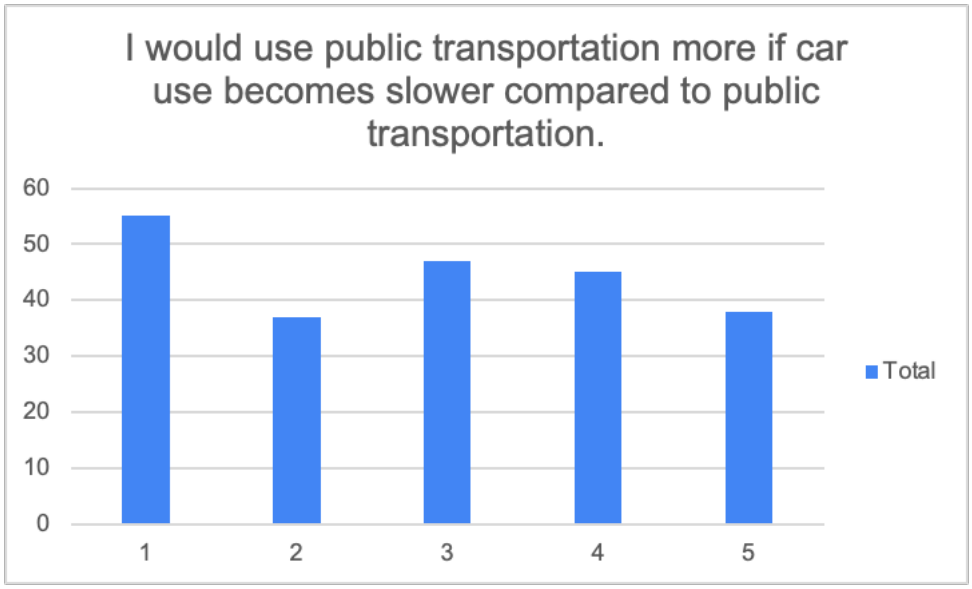

FIGURE 78 - SPEED AND INTENT DISTRIBUTION

Interestingly, Figure 78 shows that the majority of people (41.4%) disagree to at least some extent with the statement above, while 37.4% would agree. This indicates that the perceived advantage in time gain is not solely responsible for the use of cars instead of public transportation. This hints at other factors influencing the decision-making process such as the shelter, privacy, or comfort is provided or the ability to transport larger and heavier objects or the perceived increased safety. The mean score was 2.88.

4.1.4.4. Frequency and Intent of using public transportation

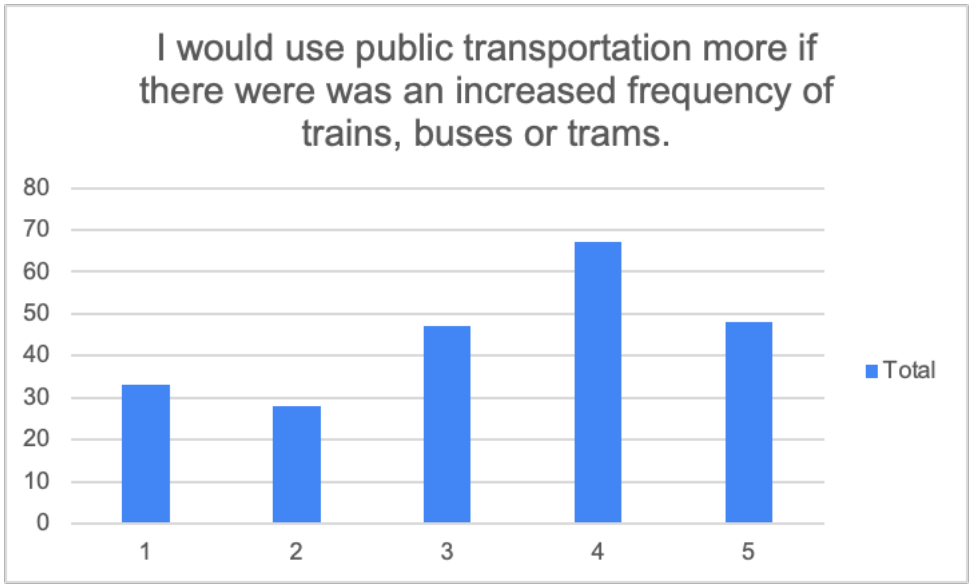

FIGURE 79 - FREQUENCY AND INTENT DISTRIBUTION

Frequency of PT options seems to be a factor that could increase the popularity. With 51.6% of people agreeing to some extent with the statement above, there is further evidence suggesting that there needs to be improvement in the convenience of the PT in Luxembourg, as evidenced by Figure 79. With a mean score of 3.31, the overall consensus on this statement was that PT is not operating enough to be a viable or convenient option for a majority of car drivers.

4.1.4.5. Security at transit hubs and Intent of using public transportation

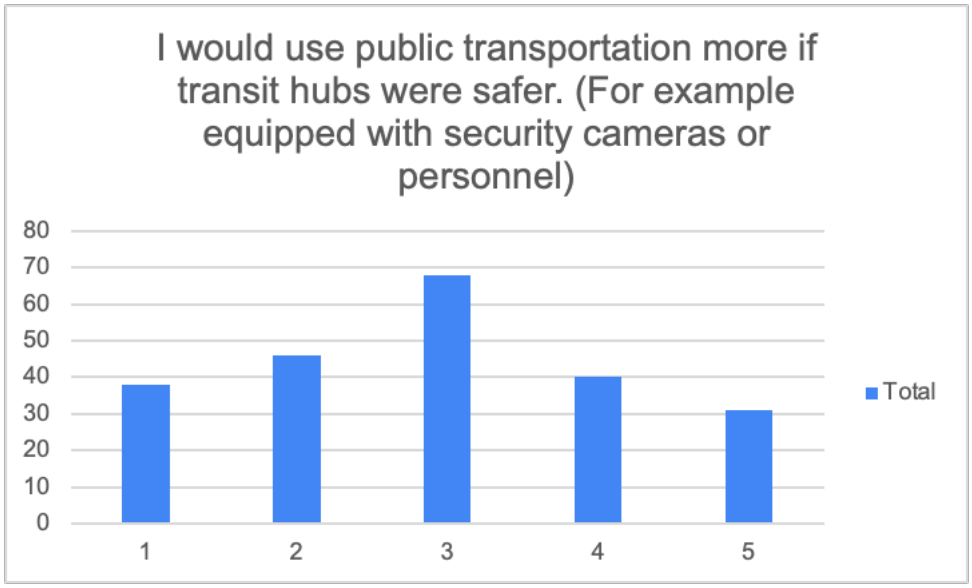

FIGURE 80 - SECURITY AT TRANSIT HUBS AND INTENT DISTRIBUTION

While it is true that safety is a major concern for many people in public transportation and Figure 80 shows that 31.8% of the participants agree with the statement, the focus of the question was possibly on the wrong aspect of safety in public transportation. As showed by Figure 61 and 62, the larger safety concern of people does not stem from the transit hubs but from public transportation itself. That is why the results of this statement are normally distributed with a slight inclination to disagreement with a mean score of 2.91. However an effort to make transit hubs safer, should not be disregarded nonetheless, since almost a third of people saw this as a motivator to use public transportation more. Efforts should however also be focused on making trips in public transportation safer as this was identified to be a major concern but a lot of people, by finding out what the reasons for this are.

4.1.4.6. Reliability and Intent of using public transportation

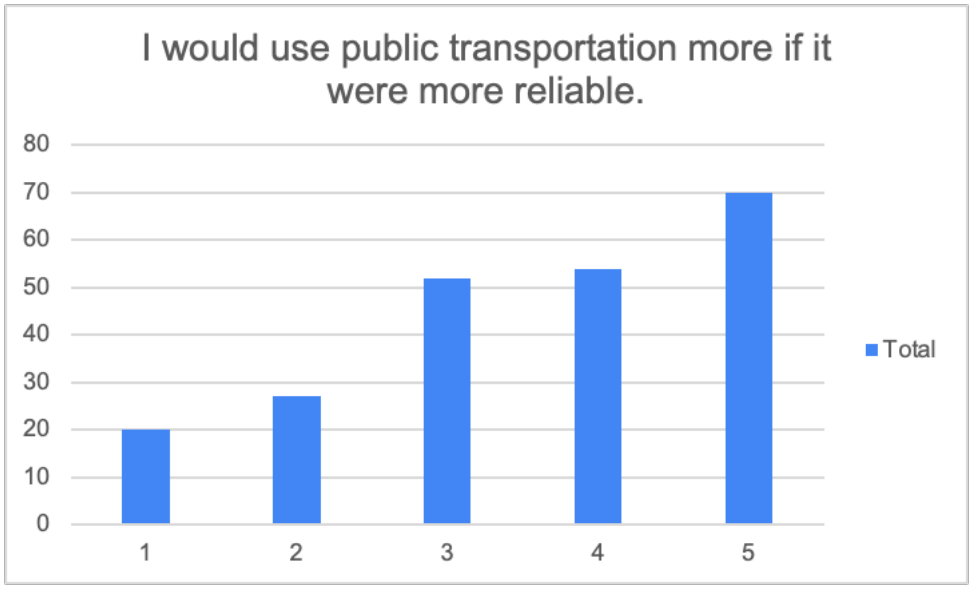

FIGURE 81 - RELIABILITY AND INTENT DISTRIBUTION

Regarding the reliability of public transportation and the intent to use it more, the majority of people agreed with the statement. Reliability in this context means that the users can expect the public transportation to operate normally at any given time. 31.4% completely and 24.2% slightly agreed with this and further shows that car drivers are willing to change their mobility behaviour if the infrastructure accommodates for it. An increase in reliability is desirable by the participants of the study and the average score therefore was 3.57 as evidenced by Figure 81.

4.1.4.7. Punctuality and Intent of using public transportation

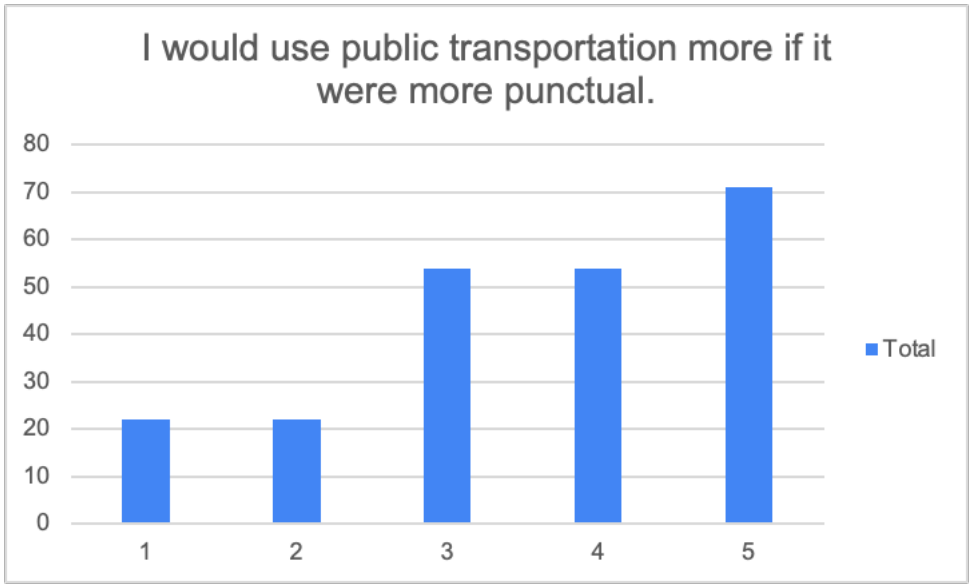

FIGURE 82 - PUNCTUALITY AND INTENT DISTRIBUTION

Similar to the last section regarding reliability, punctuality is another point that the people wished would improve. Figure 82 explains that 31.8% completely and 24.2% slightly agreed with the statement, showing a very comparable picture than the one regarding reliability. Punctuality means here that users can expect that their option, whether that be train, bus, or tram arrives on time. Punctuality seems to be ever so slightly more a deciding factor than reliability with a mean score of 3.58.

4.1.4.8. Intent of driving

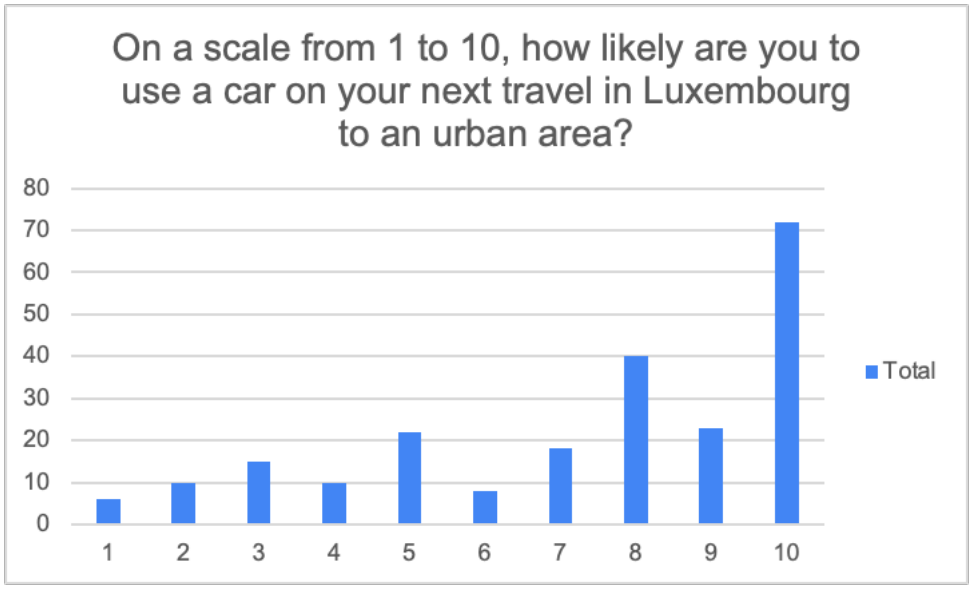

FIGURE 83 - INTENT OF DRIVING TO URBAN AREAS DISTRIBUTION

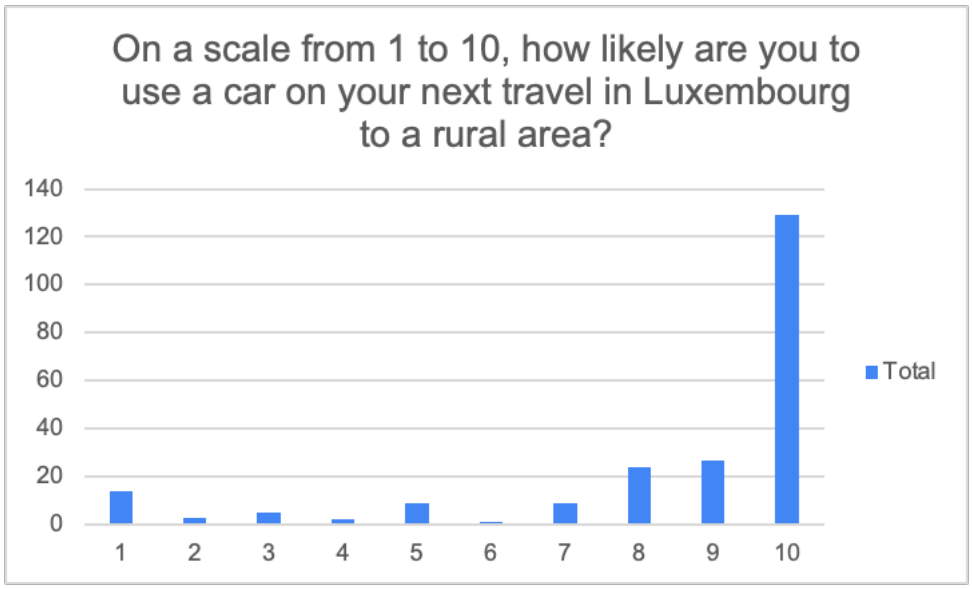

FIGURE 84 - INTENT OF DRIVING TO RURAL AREAS DISTRIBUTION

Figures 83 and 84 underline that the intent of driving in Luxembourg among the participants is relatively high. For their next travel into an urban area meaning into larger cities such as, for example, Esch-sur-Alzette, Diekirch, or Luxembourg City, 32.1% of the participants indicated that they will certainly drive with a personal vehicle. For their next travel into a rural area, meaning for examples the Northern, Eastern, or Western most part of Luxembourg, with smaller towns 57.8% of the participants indicated that they will certainly drive. Surprisingly also, the group with least responses regarding the intent to driving into urban areas was 1, meaning that only 2.7% of the participants explained that it is not at all likely that they will drive into an urban area. The mean scores for both statements were 7.33 for urban areas and 8.44 for urban areas. With the overall sentiment being that public transportation is not accessible enough in rural areas, a high score for rural areas was to be expected, but the comparatively high score for urban areas is rather surprising.

4.1.5. Summary of the descriptive statistics

Having presented all the answers to the 79 questions, a few statements showed some interesting results. The demographics showed a diversified set of answers regarding social and economic factors as well as diverse set of places of residence and work/education. While every participant knew about the introduction of free-fare public transport a vast majority of them chooses the car as their main mode of transportation for work, shopping, and leisure. Most people also consider themselves as environmentally-conscious people while not necessarily frugal at the same time. The questions regarding car use revealed that factors such as convenience as defined by terms such as “freedom” and “flexibility” and comfort such as shelter, safety, and privacy are the most important for car drivers in Luxembourg as well as the per-

ceived time savings compared to public transportation. While drivers admit that driving and the associated costs for acquisition, fuel, maintenance, and parking are high and that roadworks and traffic congestion are plentiful in Luxembourg, these are drawbacks of car use that the drivers did not see as deterring factors for their mobility behaviour. Also aspects such as the environmental impact of driving or the induced stress were factors that were ranked by the drivers as not that important as the perceived benefits of convenience, comfort and freedom. This is in line with the findings of Hagman (2003) who argued that the perceived benefits of car use are often defended by drivers to be non-negotiable while aspects such as environmental impact are abstract and insignificant in the grand scheme of things. They also hypothesised that costs may be a factor that drives people away from driving, which however does not hold for the case of Luxembourg. Even with high car-related expenses and the access to free-fare public transport, the majority of people still drive cars and will continue to do so for various different reasons, such as the poor public image of public transportation in Luxembourg. While it is true that everyone is aware that it is free of charge for users, the infrastructure seems to be inferior to the road network. Concerns such as safety, convenience, accessibility, punctuality, overcrowdedness, and stress were all expressed by the respondents of this study. These are all points that need to be addressed by the responsible institutions in order to ameliorate the public transportation infrastructure and in turn make it more attractive to reach the goals set by the PNM 2035. There is an argument to be made that people in Luxembourg do not necessarily see cars as the superior option per se, besides a few convenience exceptions such as the shelter, comfort, or the ability to transport larger and heavier things easier, but rather see the public transportation as sub-par. This assumption is underlined by the questions regarding the future and the intent to utilise public transportation more, where people expressed that they were willing to use public transportation more if the necessary improvements in the infrastructure were to be made. If concerns such as frequency, access, safety, reliability, and punctuality were to be addressed and resolved, people would be willing to take it more often.

4.2. Reliability - Cronbach's Alpha

According to Gliem and Gliem (2003), it is essential to report "Cronbach's alpha coefficient for internal consistency reliability for any scales or subscales one may be using". The use of Cronbach's Alpha coefficient lies in its ability to test the internal reliability of a survey (Raykov & Marcoulides, 2019). According to George and Mallery (2003) a scored below 0.5 is deemed as "unacceptable" ranging up to "excellent" for score over 0.9. Due to the largely nominal nature of the variables under demographics there are only three items under this section which can be controlled for reliability. Cronbach's Alpha indicated for the three questions regarding the importance of sustainability, the environment, and frugality a score of 0.63, which would be a questionable result according to George and Mallery (2003). However interestingly, if the questions regarding frugality is omitted, Cronbach's Alpha would increase to 0.85. The questions

regarding car use yield a more reliable result. With the 27 questions/statements regarding car use a Cronbach's Alpha of 0.73 can be computed. Only the statements regarding stress and car use and the road network are considered to be outliers. With 0.73 the reliability is considered to be acceptable. The reliability of the public transportation statements is 0.7. The 25 questions yield a reliable result that can be trusted with no real outlier that could significantly increase the score. Regarding future intent, Cronbach's Alpha computes a score of 0.83, meaning a good result. Even if the score for the demographics was relatively low with only 0.63, in general however it can be argued that the result hold sufficient reliability.

4.3. Factor Analysis

Factor analysis is used in order to reduce the number of variables into underlying themes called factors. In this study the different sections regarding car and public transportation use of the questionnaire will be further broken down into smaller subsections such as the advantages and disadvantages of both, where factor analysis will be conducted in order to find the underlying themes of the reasons for car use despite access to free-fare public transportation in Luxembourg. In a first stage, the Kaiser-Meyer-Olking (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity are run to see whether factor analysis is indeed meaningful. For the KMO test the value should be above 0.7 and for the Bartlett test the p-value should be below 0.05. A second step calls for the extraction of the number of factors. One can on one hand look at factors with an Eigenvalue larger than 1, the so-called Kaiser criterion or look at a scree plot and count the factors beyond the inflexion point. Due to the problem that it can be difficult sometimes to read scree plots and their curve does not always follow a readable shape, the Kaiser criterion will be used in this research. After the factor number has been established it is up to the researcher to use rotation in order to find a meaningful table that indicates the underlying factors which solely remain to be named.

4.3.1. The benefits of car use

For the benefits of car use the KMO was 0.84 and the Bartlett test yielded a result of 0, which signifies that factor analysis should be conducted. The Kaiser criterion indicated 3 distinct factors among the statements, with the Eigenvalues of 4.09, 1.34, and 1.2 which lead to the following rotated component matrix:

TABLE 1 - ROTATED COMPONENT MATRIX - BENEFITS OF CAR USE

	1	2	3
I feel safer on the road when I am driving compared to being driven around by public transport.	0.61	-0.09	0.27
Cars allow for more freedom than public transportation.	0.76	-0.13	-0.05
I value the privacy a car offers me.	0.75	0.1	0.14
I value the shelter a car offers me from bad weather.	0.71	0.08	0.25
I believe using a car shortens my travel time compared to using public transportation.	0.57	-0.25	-0.12
I believe that I can transport heavy objects better in my car.	0.35	0.4	-0.55
I believe that travelling with children is done easier by car compared to public transport.	0.59	-0.16	-0.08
I think that a car is convenient.	0.71	0.21	-0.32
I think that a car is comfortable.	0.67	0.26	-0.12
Cars are a status symbol to me.	0.13	0.2	0.77
I believe that driving in of itself is fun.	0.47	0.61	0.1
The road network in Luxembourg is good.	-0.12	0.77	0.08

In Table 1, Factor 1 can be attributed to the functionality of cars, with variables such as perceived freedom, shelter provided, or privacy offered. Factor 2 has high scores for the road network, and fun aspect, so it could named infrastructure and thirdly prestige as only status scored high there.

4.3.2. The drawbacks of car use

For the drawbacks of car use the KMO was 0.76 and again a Bartlett test result of 0, indicating that there are hidden factors. The Kaiser criterion showed 6 factors to be found with Eigenvalues of 3.83, 1.58, 1.3, 1.16, 1.08, and 1, presenting the following table:

TABLE 2 - ROTATED COMPONENT MATRIX - DRAWBACKS OF CAR USE

	1	2	3	4	5	6
There is a lot of traffic congestion on Luxembourg's roads.	0.59	0.08	-0.05	0.21	-0.11	0.39
Traffic congestion in Luxembourg is bothering me.	0.4	0.11	-0.56	0.39	-0.2	0.11
There are a lot of roadworks in Luxembourg.	0.76	0.14	0.02	0.13	0.17	0.18
Roadworks are a nuisance to me.	0.72	0.08	-0.32	0.25	-0.06	0.07
The road network in Luxembourg is good.	-0.33	0.1	-0.38	-0.35	-0.33	-0.32
I believe that buying a car is expensive.	0.08	0.78	0.08	0.2	-0.07	0.13
I believe that buying petrol is expensive.	0.19	0.78	-0.25	-0.03	0.01	0.15
I believe that the running costs of a car (reparations/taxes/insurance) are high.	0.02	0.8	-0.13	0.21	0.09	0.03
There is a high risk for accidents while driving cars.	-0.05	0.19	0	0.75	-0.03	0.2
I think that driving is stressful.	0.06	0.14	-0.21	0.78	0.17	-0.09
Car traffic is not a major contributor to climate change.	0.33	-0.09	0	-0.33	0.66	-0.13
I tend to compensate for lost time in traffic by driving faster afterwards.	-0.15	-0.17	-0.83	0	0.16	0.13
I think tariffs for parking are high.	0.05	0.18	-0.19	-0.09	0.16	0.82
I find it difficult to find parking spaces when I am driving to urban areas	0.23	0.12	-0.04	0.23	0.02	0.75
I find it difficult to find parking spaces when I am driving to rural areas	-0.01	0.08	-0.15	0.32	0.74	0.13

In Table 2, the first factor can be described as time loss, with roadworks and traffic congestions being the main themes for this factor. The second factor is the price of car use. The third factor seems to be non definable. The fourth factor is emotional stress, as shown by high scores for

stress and high accident risk. The fifth factor is parking in rural areas while the sixth seems to be parking in urban areas and the associated high fees.

4.3.3. The benefits of public transportation use

The KMO and Bartlett test indicate 0.83 and 0 for the benefits of public transportation use so factor analysis is relevant. According to the Kaiser criterion there are 3 factors with the Eigenvalues of 5.14, 1.36, and 1.3 to be identified and the following table has been established:

TABLE 3 - ROTATED COMPONENT MATRIX - BENEFITS OF PUBLIC TRANSPORTATION USE

	1	2	3
Public transportation is cheaper than using a car.	-0.1	-0.8	0.0
Public transportation is more environmentally friendly than driving a car.	0.24	-0.74	0.05
Public transportation offers access to jobs and education.	0.59	-0.2	0.3
Public transportation is reliable.	0.4	-0.1	0.7
Buses in Luxembourg are punctual.	0.23	-0.1	0.7
Trains in Luxembourg are punctual.	0.13	-0.1	0.7
Trams in Luxembourg are punctual.	0.2	-0.3	0.4
Free-fare public transportation is a good policy.	0.04	-0.5	0.3
The railway network in Luxembourg is good.	0.13	0.07	0.6
I feel safe in public transportation.	0.35	-0.4	0.1
I feel safe at transit hubs.	0.65	-0.2	0.1
Transit hubs are in easy to reach locations.	0.67	-0.2	0.1
I think that public transportation is convenient.	0.79	-0.0	0.2
I think that public transportation is comfortable.	0.77	-0.0	0.2

In Table 3, the first factor can be summarised as the accessibility and ease of use of public transportation. The second factor is the environmental impact and the third factor is the punctuality.

4.3.4. The drawbacks of public transportation use

With a Bartlett test of 0 and a KMO result of 0.64 the significance of factor analysis can be questioned for the drawbacks of public transportation use. The Kaiser criterion however indicates the presence of 3 factors with the Eigenvalues 2.6, 1.77, and 1.3, and the following table can be presented:

TABLE 4 - ROTATED COMPONENT MATRIX - DRAWBACKS OF PUBLIC TRANSPORTATION USE

	1	2	3
Railways are particularly susceptible to renovation works.	0.43	-0.08	-0.03
Public transportation takes more time compared to driving cars.	0.83	-0.01	-0.1
Public transportation is not accessible enough in rural areas.	0.54	0.07	0.46
Multiple changes in public transportation in order to reach my destination are bothering me.	0.57	0.1	0.53
Buses are overcrowded in Luxembourg.	0.13	0.84	-0.03
Trains are overcrowded in Luxembourg.	0.03	0.86	0.01
Trams are overcrowded in Luxembourg.	0.01	0.78	0.1
I think that using public transport is stressful.	0.64	0.29	0.14
Public transportation should operate more during the night (between 12PM and 6AM).	-0.04	-0.03	0.89

The three main factors that can be identified in Table 4 are firstly the time intensive nature of public transportation, secondly the overcrowdedness and thirdly the limited accessibility.

4.3.5. Intent to use public transportation more

The intent for change towards sustainable travel behaviour indicates a KMO of 0.71 and again a Bartlett test result of 0. The Kaiser criterion shows 3 factors with the Eigenvalues of 3.59, 1.53, and 1.23, and the following table has been established:

Table 5 - Rotated Component Matrix - Intent to use public transportation more

	1	2	3
I would use public transportation more if I had better access to it.	0.48	0.13	0.35
I would use public transportation more if car use becomes more expensive.	0.12	0.12	0.85
I would use public transportation more if car use becomes slower compared to public transportation.	0.12	0.05	0.87
I would use public transportation more if there were was an increased frequency of trains buses or trams.	0.6	0.08	0.53
I would use public transportation more if transit hubs were safer. (For example equipped with security cameras or personnel)	0.71	-0.01	0.11
I would use public transportation more if it were more reliable.	0.9	0.14	0.12
I would use public transportation more if it were more punctual.	0.89	0.15	0.1
On a scale from 1 to 10 how likely are you to use a car on your next travel in Luxembourg to an urban area?	0.08	-0.83	-0.13
On a scale from 1 to 10 how likely are you to use a car on your next travel in Luxembourg to a rural area?	0.03	-0.85	0.07

In Table 5, the first factor that can be identified is the desire for more reliability and punctuality or simply put an increase in trust into the infrastructure. The second factor describes the negative intent towards using public transportation for the next trip and finally thirdly the last factor describes negative changes towards the use of cars.

While some factors could be found along this analysis, in general, an argument can be made that the factor analysis did not reveal any meaningful underlying themes that help in the investigation of the research question. The Eigenvalue criterion shows that there is often one dominant factor, which could be characterised as either positive or negative feelings towards the

topic of the questions set, followed by Eigenvalues around 1 that only account for 1 statement and therefore holds limited potential regarding factor analysis. The values indicate that, while there are factors, many of them are not specific and that they are unevenly distributed. A possible conclusion from this may be that the participants do not have an open view on the topic, due to the highly personal and subjective nature of car use in Luxembourg. As the descriptive statistics and literature suggested, benefits of car use are seen as immediate and irrefutable, while the drawbacks are only minor and do not greatly effect the transport mode choice. This does not hold true for the advantages and disadvantages of PT, because exactly the opposite could be observed. Drawbacks of PT are seen as large obstacles and the advantages are seen as nice but not noteworthy. It can be speculated that the car drivers in Luxembourg do not weigh up the individual positives and negatives of car and PT use but rather reaffirm their transport mode choice with the arguments that they were presented with, which may explain the results of this factor analysis.

4.4. Hypotheses Testing

4.4.1. Hypothesis 1: Driving/using public transport matches with the subjective perception of benefits/disadvantages of the respective transport mode in Luxembourg.

In order to test this hypothesis, logistic regression was utilised. Firstly the results of the preferred choice of transport mode were summarised in 2 groups, namely majority car users and majority PT users, according to the answers given for the 3 questions regarding choice of transport mode for shopping, commutes to work/education, and leisure trips. The factor analysis of the benefits of car use, was utilised to identify the most significant variables, hence the shortened table. The perceived benefits of car use that were stated to the participants match with the intent to be using PT or cars more as demonstrated by the following table:

TABLE 6 - REGRESSION MODEL - BENEFITS OF CAR USE AND CAR USE

	Coefficient B	Std error	z	p	Odds Ratio	95% conf. interval
Safety	-0.23	0.21	1.07	.284	0.8	0.52 - 1.21
Freedom	0.36	0.31	1.18	.239	1.44	0.79 - 2.64
Privacy	0.14	0.27	0.54	.591	1.15	0.68 - 1.94
Shelter	-0.12	0.25	0.49	.624	0.88	0.54 - 1.44
Time savings	0.54	0.25	2.18	.03	1.71	1.05 - 2.78
Easier Child Travel	0.04	0.26	0.14	.892	1.04	0.62 - 1.73
Convenience	0.75	0.34	2.23	.026	2.13	1.1 - 4.13
Comfort	-0.1	0.3	0.32	.746	0.91	0.5 - 1.64
Constant	-4.18	1.36	3.07	.002		

In Table 6, logistic regression analysis shows that the model as a whole is significant (Chi2(8) = 24.88, p .002, n = 221). Notably, the results of the model match with the hypothesis. The results suggest that convenience and time savings are the major determinants of car use in Luxembourg. While it is true that the notion of freedom also seems to be a determining factor due to the comparatively high odds ratio of 1.44, it is not statistically relevant with a p-value above 0.05. On the other hand convenience and time savings have high odds ratios with 2.13 and 1.71 and are both under the significance level of 0.05, meaning that they are relevant.

The perceived drawbacks of car use were compared to the use of public transportation:

TABLE 7 - REGRESSION MODEL - DRAWBACKS OF CAR USE AND PT USE

	Coefficient B	Standard error	z	p	Odds Ratio	95% conf intv.
Congestion	0	0.4	0	.999	1	0.46 - 2.17
Annoyed by congestion	0.19	0.3	0.63	.528	1.21	0.67 - 2.19
Roadworks	-0.05	0.4	0.13	.897	0.95	0.43 - 2.08
Annoyed by roadworks	-0.43	0.28	1.51	.131	0.65	0.37 - 1.14
Car is expensive	0.11	0.4	0.29	.775	1.12	0.52 - 2.43
Petrol is expensive	-0.25	0.32	0.78	.436	0.78	0.41 - 1.46
Running costs are high	0.4	0.38	1.06	.29	1.49	0.71 - 3.14
High accident risk	-0.5	0.26	1.9	.058	0.61	0.36 - 1.02
Stress	0.3	0.24	1.25	.212	1.35	0.84 - 2.18
Environmental Impact	-0.59	0.22	2.68	.007	0.55	0.36 - 0.85
Aggressive driving	0.12	0.23	0.52	.601	1.13	0.71 - 1.79
Parking is expensive	-0.16	0.23	0.68	.499	0.85	0.54 - 1.35
Difficulty finding parking (Urban)	0.28	0.29	0.96	.336	1.33	0.75 - 2.36
Difficulty finding parking (Rural)	0.25	0.28	0.89	.375	1.28	0.74 - 2.22
Constant	-1.27	2.2	0.57	.566		

In Table 7, logistic regression analysis shows that the model as a whole is not significant (Chi2(14) = 19.47, p .148, n = 219). The results suggest that the hypothesis could again be generally accepted if the model was significant. However interestingly factors such as accident risk and environmental impact do not seem to be indicators for increased PT use, with the p-value of "Environmental Impact" even suggesting that the influence is statistically significant.

The perceived advantages of PT were then compared to PT use:

TABLE 8 - REGRESSION MODEL - BENEFITS OF PT USE AND PT USE

	Coefficient B	Standard error	z	p	Odds Ratio	95% conf intv.
Cheap	-0.01	0.5	0.02	.984	0.99	0.37 - 2.63
Environmentally Friendly	0.03	0.29	0.12	.907	1.03	0.58 - 1.84
Inclusive access to work/education	0.47	0.23	2.02	.043	1.61	1.01 - 2.54
Good policy	0.39	0.2	1.91	.056	1.48	0.99 - 2.21
Constant	-5.53	2.27	2.44	.015		

In Table 8, the logistic regression analysis reveals a significant model (Chi2(4) = 12.15, p .016, n = 216), where interestingly the price advantage of PT in Luxembourg has a negative relationship with the use of PT, which is however not statistically significant. The main benefit of PT in Luxembourg was identified to be the inclusivity with a coefficient of 0.47, which is also relevant with a p-value below 0.05. The table only shows the benefits of PT use that were also perceived as such. While there were other positives such as comfort or convenience that participants could indicate, the descriptive statistics showed that these were majorly perceived as not as advantageous as initially thought, meaning that they were dropped for this table and logistic regression.

The perceived drawbacks of PT and intent of car use yielded the following results:

TABLE 9 - REGRESSION MODEL - DRAWBACKS OF PT - CAR USE

	Coefficient B	Standard error	z	p	Odds Ratio	95% conf intv.
Renovation Works	-0.27	0.26	1.05	.293	0.76	0.46 - 1.26
Time loss	0.45	0.28	1.62	.105	1.58	0.91 - 2.73
Not accessible in rural areas	-0.5	0.3	1.66	.098	0.61	0.34 - 1.1
Changing mode is annoying	0.12	0.24	0.5	.617	1.13	0.7 - 1.81
Buses overcrowded	-0.53	0.36	1.47	.141	0.59	0.29 - 1.19
Trains overcrowded	0.34	0.35	0.96	.336	1.41	0.7 - 2.81
Trams overcrowded	-0.03	0.3	0.09	.927	0.97	0.54 - 1.75
Stress	0.5	0.26	1.93	.054	1.65	0.99 - 2.75
Constant	2.12	1.63	1.3	.195		

The model for the disadvantages of PT and car use is not statistically significant ($Chi2(8) = 13.97$, p .083, n = 208) Interestingly, stress for the use of PT seems to be the most dominant coefficient, however the significance is not relevant given a level of 5% as presented in Table 9.

Regarding the hypothesis in general it can be argued that the use of car/PT match with the benefits of car use and PT use and the hypothesis is partially accepted. The disadvantages do not match with the intent to use the other mobility option, which can be explained due to the fact that there may be other factors playing a role that were not investigated or asked by the researcher.

4.4.2. Hypothesis 2: The reasons for car use in Luxembourg are rather functional in nature than emotional.

In order to find an answer to this hypothesis another logistic regression analysis was used. Since it was determined that the reasons for car use are more linked to the perceived benefits

of car use than the drawbacks of PT, the analysis focuses on the nature of the benefits in order to find out which is more significant. The benefits can be divided into 2 groups: functionality and emotion. Using Table 6 as the backbone of this analysis, it can be deduced that the functional factors meaning safety, privacy, shelter, and easier child travel, and comfort are lesser indicators for the use of cars than emotional factors. Safety (Odds ratio = 0.8), shelter (Odds ratio = 0.88), and comfort (Odds ratio = 0.91) have comparatively low odds ratios. This means that an increase in these variables. is associated with a decrease in the probability that the dependent variable is "Car". Only the perceived time savings of car use indicated a high coefficient for car use for functionality. On the other hand, the emotional factors such as the notion of freedom and convenience showed high odds ratios all around, indicating that the reasons for car use in Luxembourg may be rather emotional than functional. Interestingly the highest odds ratio among the benefits of car use can be attributed to the notion of convenience, followed by time savings and freedom. The notion of freedom is an interesting concept in this study, because it indicates a certain reluctance to adopt change towards sustainable mobility behaviour as argued by Anable (2005). What is meant by freedom is the flexibility of cars and the independence of time schedules and often criticised delays and concerns with punctuality and reliability for PT in Luxembourg as evidenced by Figure 54 to Figure 57. With only 2 variables being under the p-value of 0.05, namely convenience and time savings, the more influential one is convenience as an emotional factor. So Hypothesis 2 needs to be rejected, since the reasons for car use in Luxembourg appear to be rather emotional than functional.

4.4.3. Hypothesis 3: Convenience is the most important factor for car use in Luxembourg.

Again focusing on the data of Table 6, it can be deduced that the most important variables are convenience and time savings compared to PT. Convenience (Odds ratio = 2.13) is the most important variable. So the hypothesis needs to be accepted, or it can be said that convenience is the most important factor for car use in Luxembourg followed by time savings as a close second.

4.4.4. Hypothesis 4: The stronger the habit to drive in Luxembourg, the lower the intention to use public transportation.

Since habit has been identified to be a determining factor of the choice of transport mode, it was noteworthy to test the assumption and whether it also holds true for drivers in Luxembourg. A preliminary Kolmogorov-Smirnov Test of Normality was conducted indicating a non-normal distribution due to the p-value of < 0.01 for both statements regarding the intent to use cars for their next trip. A result that is in line with the visual result in Figure 83 and 84. That is why a non-parametric correlation test, namely the Eta Correlation is employed in order to test

the hypothesis whether the habit of driving, or the increased weekly use of cars has a relationship with the intent to use cars again for the next trip due to the multichotomous nature of the habit of driving and the interval nature of the intent to use cars for the next trip.

Table 10 - Habit and Intent to use cars (Urban) - Descriptive

	N	Mean	Std. Deviation
Never	9	4.89	3.3
1 - 2 times a week	34	6.35	2.83
3 - 4 times a week	33	6.7	2.58
5 - 6 times a week	78	7.85	2.36
Everyday	70	7.84	2.74
Total	224	7.33	2.72

Table 11 - Habit and Intent to use cars (Urban) - Eta

Eta (η)	0.29
Eta2 (η2)	0.08

The descriptive statistics in Table 10 indicate increased mean scores for high habit of car use (5 - 7 times a week), while less frequent drivers have less intent to use cars into urban areas with mean scores significantly lower than those of frequent drivers. Interestingly, the mean scores also seem to increase with more frequent car use, further strengthening the hypothesis. The Eta squared shows a level of 0.08, which is regarded as a medium to large size effect as shown in Table 11.

Table 12 - Habit and intent to use cars (Rural) - Descriptive

	N	Mean	Std. Deviation
Never	9	6.89	3.1
1 - 2 times a week	34	8.68	2.07
3 - 4 times a week	33	8.42	2.18
5 - 6 times a week	78	8.64	2.62
Everyday	69	8.3	3.01
Total	223	8.44	2.64

Table 13 - Habit and intent to use cars (Rural) - Eta

Eta (η)	0.13
Eta2 (η2)	0.02

For the intent to use cars into rural areas there is no significant difference between the frequent drivers and the less frequent drivers as seen by the largely comparable mean scores as evidenced by Table 12. The Eta squared also indicates that there is only a small effect with 0.02, meaning that there is a difference between travelling to urban and rural areas by car in regards to habit of driving as shown in Table 13. In urban areas there is a bigger correlation between habit and not using PT but lower intent to use cars overall, while in rural areas there is a smaller correlation between the variables, but higher intent to use cars in general.

4.4.5. Hypothesis 5: There is a difference between the residents of the different mobility zones in Luxembourg regarding intent to use public transportation and seeing cars as a necessity for their lifestyle

This hypothesis was used to test whether there is a significant difference between people residing in rural and urban areas as defined by the MMTP regarding car and public transportation use. Often people in rural areas feel alienated from good public transportation infrastructure, which is reflected by their elevated car use compared to other regions. Similar to Hypothesis 4, the Kolmogorov-Smirnov Test of Normality indicated a non-normal distribution for the statement whether a car is essential for the participants. With a value inferior to 0.001, and a visual match to the assumption, a non-parametric Kruskal-Wallis test was conducted, yielding the following results:

Table 14 - Residence in different Mobility zones and Essentiality of cars - Mean Rank

Groups	N	Mean Rank
Urban South	63	99.05
Rural South	55	111.02
Esch & Belval	14	88.64
City of Luxembourg	13	108.85
Suburban Ring	22	87.68
Abroad	12	115.33
Rural North	35	143.43
Nordstad	3	106
Total	217	

TABLE 15 - RESIDENCE IN DIFFERENT MOBILITY ZONES AND ESSENTIALITY OF CARS - CHI-SQUARED AND P-VALUE

	Values
Chi2	18.12
df	7
p	.011

TABLE 16 - RESIDENCE IN DIFFERENT MOBILITY ZONES AND ESSENTIALITY OF CARS - KRUSKAL-WALLIS TEST

	Test Statistic	Std. Error	Std. Test Statis-tic	p	Adj. p
Urban South - Rural South	-11.97	10.99	-1.09	.276	1
Urban South - Esch & Belval	10.4	17.6	0.59	.554	1
Urban South - City of Luxembourg	-9.8	18.14	-0.54	.589	1
Urban South - Suburban Ring	11.37	14.75	0.77	.441	1
Urban South - Abroad	-16.29	18.76	-0.87	.385	1
Urban South - Rural North	-44.38	12.56	-3.53	<.001	.011
Urban South - Nordstad	-6.95	35.2	-0.2	.843	1
Rural South - Esch & Bel-val	22.38	17.83	1.26	.209	1
Rural South - City of Lux-embourg	2.17	18.37	0.12	.906	1
Rural South - Suburban Ring	23.34	15.02	1.55	.12	1
Rural South - Abroad	-4.32	18.98	-0.23	.82	1
Rural South - Rural North	-32.41	12.88	-2.52	.012	.332
Rural South - Nordstad	5.02	35.31	0.14	.887	1

TABLE 16 - RESIDENCE IN DIFFERENT MOBILITY ZONES AND ESSENTIALITY OF CARS - KRUSKAL-WALLIS TEST - CONTINUED

Esch & Belval - City of Luxembourg	-20.2	22.94	-0.88	.378	1
Esch & Belval - Suburban Ring	0.96	20.36	0.05	.962	1
Esch & Belval - Abroad	-26.69	23.43	-1.14	.255	1
Esch & Belval - Rural North	-54.79	18.83	-2.91	.004	.102
Esch & Belval - Nordstad	-17.36	37.89	-0.46	.647	1
City of Luxembourg - Suburban Ring	21.16	20.84	1.02	.31	1
City of Luxembourg - Abroad	-6.49	23.84	-0.27	.786	1
City of Luxembourg - Rural North	-34.58	19.34	-1.79	.074	1
City of Luxembourg - Nordstad	2.85	38.15	0.07	.941	1
Suburban Ring - Abroad	-27.65	21.37	-1.29	.196	1
Suburban Ring - Rural North	-55.75	16.2	-3.44	.001	.016
Suburban Ring - Nordstad	-18.32	36.66	-0.5	.617	1
Abroad - Rural North	-28.1	19.92	-1.41	.158	1
Abroad - Nordstad	9.33	38.44	0.24	.808	1
Rural North - Nordstad	37.43	35.83	1.04	.296	1

P-values adjusted with Bonferroni correction.

The test indicated again a clear difference between the nominal categories in regards to seeing a car as a necessity. Table 16 shows that, while urban centres such as the city of Luxembourg and Esch & Belval but also the Suburban Ring and to some extent the Urban South, show similar results regarding seeing a car only to some extent as a necessity, the Northern most parts of the country, meaning the Rural North and the Nordstad and abroad build massive differences. The most striking differences regarding the attitude towards the necessity of car use are pre-

sented between the Suburban Ring, Esch & Belval as well as the Urban but also Rural South and the Rural North. If the centres of Luxembourg are considered to be the capital city, meaning Luxembourg City and Esch & Belval, there is an argument to be made that people living in the Rural North have to travel further than people living in the Suburban Ring for example, possibly explaining the difference in the data. This is underlined by the fact that people from abroad seem to have similar views than those from the Rural North. It can therefore be concluded that hypothesis 5 is true: There is a difference between the residents of the different mobility zones in Luxembourg regarding intent to use public transportation and seeing cars as a necessity for their lifestyle. A further analysis regarding place of residence and the intent to using public transportation more if it were more accessible yielded no significant differences between the mobility zones, however showed the interest of people in rural areas of the Grand-Duchy to use public transportation more if it were more accessible.

TABLE 17 - RESIDENCE IN DIFFERENT MOBILITY ZONES AND INTENT TO USE PT - DESCRIPTIVE

	N	Mean	Std. Deviation
Urban South	64	3.39	1.14
Rural South	55	3.78	1.1
Esch & Belval	14	3.71	1.14
City of Luxembourg	13	3.38	1.19
Suburban Ring	22	3	1.54
Abroad	12	3.58	1.16
Rural North	35	3.77	1.33
Nordstad	3	2.67	1.53
Total	218	3.53	1.23

4.4.6. Hypothesis 6: The introduction of free-fare public transport in Luxembourg was particularly met with an increase of ridership from lower-income citizens and sustainable travellers.

Regarding the income in relationship with using public transportation more since or because it became free in Luxembourg, there is no big difference between the income groups as evidenced by the tests used to analyse this hypothesis. For the statement whether the participants of this study actually use the public transit more often since it became free a normal distribution was not present as shown by Figure 63 and a Kolmogorov-Smirnov test of less than 0.001. Therefore a Kruskal-Wallis test was done to test the hypothesis but a p-value of 0.626 clearly indicates that there is no major difference between the income groups regarding the

increase in ridership, hinting at the rejection of the hypothesis. Moreover, the increased use of public transit because it became free showed a normal distribution on Figure 64. To be sure however, another Kolmogorov-Smirnov test was executed in order to verify the visual representation and indicated an a-normal distribution. So a Kruskal-Wallis test was run again, to verify the hypothesis and the p-value of 0.056 ever so slightly indicates that there is no significant difference between income groups. However if the significance level is increased to 0.06 and a post hoc test is made, a significant difference between the income groups of 0 - 1000€ and 2501€ - 4000€ can be observed (p-value = 0.001) as shown in Table 18.

TABLE 18 - INCREASE IN RIDERSHIP AND LOWER-INCOME CITIZENS - POST HOC TEST

	Test Statistic	Std. Error	Std. Test Statistic	p	Adj. p
2501 - 4000€ - 0 - 1000	-48.92	14.92	-3.28	.001	.029

As to the second part of the hypothesis that the increase in ridership not only stems from lower-income citizens but also people that engaged in sustainable travel behaviour anyway, the answers of the participants were further divided into majorly car users and majorly public transit users according to their answers regarding their transport mode of choice for work/studying, shopping, and leisure, precisely as for Hypothesis 1. Due to the fact that the same metric variables are being analysed, the results of the previous distribution tests can be used, resulting in a non-parametric test. Due to the nature of the hypothesis that it can be expected that the PT group has higher values than the car group regarding the increase in ridership in public transportation, a one-tailed Mann-Whitney U-test was conducted.

TABLE 19 - INCREASE IN RIDERSHIP AND SUSTAINABLE TRAVELLERS - DESCRIPTIVE

		N	Mean	Median	Standard deviation
I use public transportation more since it became free of charge.	Car	199	1.96	1	1.38
	PT	22	2.5	2	1.57

The descriptive statistics in Table 19 indicate that the assumption holds true for this study, the Mann-Whitney U-test presented in Table 20 yields a result where the null hypothesis that the car group has lower or equal values as the PT group regarding the increased use of public transit is accepted.

Table 20 - Increase in ridership and sustainable travellers - Mann-Whitney U test

	Values
Mann-Whitney U	1752
Z	-1.7
Asymptotic Significance (1-tailed)	.955
Exact Significance (1-tailed)	.937

The p-value is 0.937, meaning that the result is not significant and therefore the null hypothesis of the expected outcome is accepted, essentially meaning that there is no significant proof of the hypothesis that the increase in ridership stems rather from people that engaged in sustainable travel anyway than car drivers. An explanation for the really high significance level may be that the power of the sustainable travellers suffers from the small group size compared to the car drivers.

Also the statement regarding the increased use of public transit because it became free, supports the hypothesis. Following the same logic and reasoning as before the following results have been found:

Table 21 - Increase in ridership because PT became free and sustainable travellers - Descriptive

		N	Mean	Median	Standard deviation
I use public transportation more because it became free of charge.	Car	198	2.99	3	1.21
	PT	23	3.52	4	1.44

Table 22 - Increase in ridership because it became free and sustainable travellers - Mann-Whitney U test

	Values
Mann-Whitney U	1729
Z	-1.94
Asymptotic Significance (1-tailed)	.974
Exact Significance (1-tailed)	.97

With a p-value of 0.97 in Table 22 the null hypothesis of the expected outcome, the previous conclusion is supported, further speaking against the hypothesis. Generally it can be argued that the data suggests no connection between an increase in ridership from lower-income citizens but that there is an indication between sustainable travellers and an increase in ridership,

which is however not statistically relevant due to the power inequality yielded by the small sample of sustainable travellers. The hypothesis cannot be accepted in its entirety.

4.4.7. Hypothesis 7: The improvement of the public transportation infrastructure is more convincing for car drivers to incentivise mobility change than inconveniencing car use

TABLE 23 - IMPROVEMENTS IN INFRASTRUCTURE VS. INCONVENIENCING CAR USE - DESCRIPTIVE

	Punc-tual	Reli-able	Safe Hubs	More	Cars slow-er	Cars more exp.	Better a c-cess
Mean	3.58	3.57	2.91	3.31	2.88	2.36	3.53
Medi-an	4	4	3	4	3	2	4
Modal	5	5	3	4	1	1	4
Std. Devia-tion	1.29	1.29	1.27	1.34	1.43	1.28	1.23
Vari-ance	1.68	1.66	1.62	1.79	2.04	1.65	1.51

The descriptive statistics in Table 23 indicate that there is a clear tendency to confirm the hypothesis. With mean scores of 2.88 and 2.36 respectively, inconveniencing car use has lower scores among the participants regarding using PT more than improving the infrastructure. Especially points such as punctuality and reliability are the biggest concerns among the participants that could, if improved lead to higher ridership numbers.

TABLE 24 - IMPROVEMENT IN INFRASTRUCTURE VS. INCONVENIENCING CAR USE - CHI SQUARED AND P-VALUE

	Values
Chi 2	163.13
df	6
p	<.001

TABLE 25 - IMPROVEMENT IN INFRASTRUCTURE VS. INCONVENIENCING CAR USE - PAIRWISE COMPARISON

	Test stats	Std. error	Std. test stats	p	Adj. p
Better Access - Cars more exp.	1.87	0.21	9.05	<.001	<.001
Better Access - Cars slower	0.96	0.21	4.66	<.001	<.001
Better Access - More	0.36	0.21	1.75	.081	.564
Better Access - Safer	1.11	0.21	5.39	<.001	<.001
Better Access - Reliable	-0.12	0.21	-0.56	.573	1
Better Access - Punctual	-0.14	0.21	-0.69	.493	1
Cars more exp. - Cars slower	-0.91	0.21	-4.39	<.001	<.001
Cars more exp. - More	-1.51	0.21	-7.3	<.001	<.001
Cars more exp. - Safer	-0.76	0.21	-3.66	<.001	.002
Cars more exp. - Reliable	-1.98	0.21	-9.61	<.001	<.001
Cars more exp. - Punctual	-2.01	0.21	-9.73	<.001	<.001
Cars slower - More	-0.6	0.21	-2.91	.004	.025
Cars slower - Safer	0.15	0.21	0.73	.465	1
Cars slower - Reliable	-1.08	0.21	-5.22	<.001	<.001

TABLE 25 - IMPROVEMENT IN INFRASTRUCTURE VS. INCONVENIENCING CAR USE - PAIRWISE COMPARISON - CONTINUED

Cars slower - Punctual	-1.1	0.21	-5.34	<.001	<.001
More - Safer	0.75	0.21	3.64	<.001	.002
More - Reliable	-0.48	0.21	-2.31	.021	.146
More - Punctual	-0.5	0.21	-2.43	.015	.105
Safer - Reliable	-1.23	0.21	-5.95	<.001	<.001
Safer - Punctual	-1.25	0.21	-6.07	<.001	<.001
Reliable - Punctual	-0.03	0.21	-0.12	.903	1

In each row, the null hypothesis is tested if both samples are the same, the "Adj. p-value" is obtained by multiplying the p-value by the number of tests.

The Friedman test in Table 24 shows that there was a significant difference between the dependent variables, since p = <.001 and therefore a post hoc pairwise comparison was conducted to find out which variables are significantly different from each other, which can be found in Table 25. Interestingly all the p-values comparing the price and the speed of car use to other variables yielded statistically significant scores of below 0.05, meaning that it appears that the results for the inconveniencing car use have significantly different results than improvements to the infrastructure. The only improvement of infrastructure that yielded similar results was the safety at transit hubs, which was already identified to be less of a concern to users than the safety in PT in itself. The hypothesis however is accepted.

4.5. Target demographic for marketing campaign

In order to achieve the goals set by the PNM 2035, it becomes evident that the mobility in Luxembourg needs to change, therefore this section will try to identify a target demographic that showed the greatest interest in using PT more under given circumstances.

4.5.1. Gender Identity

TABLE 26 - MEAN SCORES - GENDER IDENTITY

		Gender		
		Man	Woman	Prefer not to say
	Frequency	135	85	4
Better Access	Mean	3.53	3.6	3
Cars more exp.	Mean	2.24	2.55	2.75
Cars slower	Mean	2.83	2.92	4.25
More	Mean	3.22	3.42	4.5
Safer	Mean	2.79	3.13	3.25
Reliable	Mean	3.49	3.72	4.25
Punctual	Mean	3.47	3.78	4.5

The participants of the study identified as male, female, or preferred not to say. A non-binary option was given but no participant identified as such. Through the mean scores in Table 26 one can see that the female gender has higher mean scores than the male gender regarding future use of PT. Therefore it could be argued that the focus of a marketing campaign for the PNM 2035 should be on the female gender. Interestingly, safety at transit hubs was a major concern for women in this study and showed the largest discrepancy between women and men.

4.5.2. Age

A phenomenon that has been observed more and more in recent years is the decrease in intent to buy and subsequently drive cars by younger generations. Numerous studies in different countries by Zhou et al. (2019), Kuhnimof et al. (2012), and Kroesen and Handy (2013) as well as Belgiawan et al. (2014) have shown that especially in developed countries, younger people have significantly less desire to be owning and driving cars. This is particularly interesting for this study as it could indicate whether this firstly holds true for Luxembourg as well and secondly it could indicate a direction for future marketing purposing regarding sustainable mobility and which age groups are the most receptive for such ideas. For this study the “younger generations” are defined as the age groups 18 - 20, 21 - 25, and 26 - 30. The different age groups indicated a foreseeable outcome. Among the under 30 year olds, the intent to use PT more was the highest as indicated by consistently higher mean scores for any given statement than other (older age groups). Interestingly however, for the age groups between 26 and 30

punctuality and reliability were bigger wishes than for the age group of 21 - 25 (mean scores of 4.05 and 4.05 compared to 3.97 and 4), who would prefer a higher frequency of PT options (mean score of 3.86 compared to 3.68). Targeting the age group under 30 could therefore prove the most successful, if their concerns or wishes are addressed. A table representing the mean scores of each age group can be found in Appendix E.

4.5.3. Level of education

The descriptive analysis indicates that the participants who frequented a university tend to be more receptive for using more PT. Whether a Bachelor's, Master's, or Doctorate degree made no significant difference in the mean scores for the most statements, except for the safety aspect. Master's Degree participants averaged the lowest score out of all groups for this variable with 2.58. In order to achieve the goals set by the PNM 2035, a possibility could be to address sustainability and mobility issues in high school to strengthen the knowledge about these topics. A table representing the mean scores of the different levels of education can be found in Appendix F.

4.5.4. Residence - Mobility Zone

TABLE 27 - MEAN SCORES - RESIDENCE - MOBILITY ZONE

	Mobility Zone Place of Residence							
	US	RS	RN	SR	E&B	CL	A	NS
	64	56	35	22	14	13	12	3
Better access	3.39	3.78	3.77	3	3.71	3.38	3.58	2.67
Cars more exp.	2.2	2.18	2.03	3.27	2.71	2.69	2.58	2.33
Cars slower	2.71	2.65	2.8	3.71	3.36	3.08	2.5	3
More	3.06	3.28	3.51	3.09	3.86	3.23	3.58	3
Safer	3	2.83	2.69	3.09	2.79	3.08	2.75	3
Reliable	3.48	3.36	3.71	3.95	3.79	3.69	3.25	3
Punctual	3.58	3.3	3.66	3.91	3.86	3.85	3.33	3

Table 27 shows that the rural regions of the country would be inclined to use PT more if they had better access to it with mean scores of 3.78 for the Rural South and 3.77 for the Rural North. The Suburban ring region had the highest mean scores to use PT more if car use became

more inconvenienced with 3.27 and 3.71 and if points such as safety, reliability, and punctuality were addressed. Interestingly the Esch & Belval region, an urban centre, wishes for more and more reliable and punctual PT options. For a marketing campaign, targeting the Suburban Ring would probably yield the highest results as of right now, due to the fact that the general intent to use PT more is the highest there. However addressing accessibility issues and improving the infrastructure in rural areas of the country may show similar results, would however necessitate significantly more investment than a simple marketing campaign.

The descriptives show that the target person for a successful marketing campaign according to this study is most likely a woman under the age of 30, with an academic background living in the Suburban Ring in Luxembourg due to the fact that overall these groups of people showed the greatest intent to use PT more across different changes that should be made. Notably, reliability and punctuality are points that should be improved in order to reduce the car use in Luxembourg and make PT more attractive. Precisely for a marketing campaign aiming at increasing the use of PT among academic young female residents, an improvement to the safety at transit hubs could be very beneficial.

4.6. Discussion of findings

This section will discuss the main findings of the result section. Firstly a review of the descriptive statistics will be given, pointing out important and surprising results, before explaining the highlights of the factor analysis and hypothesis testing, concluding with the target profile for a possible sustainable mobility marketing campaign in Luxembourg.

At the beginning of this research, the aim was to answer the question: *What are the motivational factors or reasons for individual car use in Luxembourg, despite the access to free public transport?* The literature suggested various different reasons for car use that people perceive as benefits over PT as demonstrated by Hiscock et al. (2002). On the other hand, there are also drawbacks to car use, which however seem to be less indicative factors to the choice of transport mode, since these disadvantages are perceived as rather negligible compared to the advantages a car offers as explained by Hagman (2003). The status quo in Luxembourg with 6 to 7 out of 10 people driving by car underline a worrying trend regarding environmental protection, that did not change even after the introduction of free-fare PT. This begs the question whether people see cars as inherently the better option or if the PT in Luxembourg is not up to par. This is a difficult question to answer, since the descriptive statistics suggest a clear favouritism for car over PT use among the participants of this study. The demographics indicated a diverse sample with ages ranging between 18 to 71+, who mostly had a high school degree and were currently employed, with a monthly income of around 4001 - 5500€. Most of the participants lived in the Urban South region, closely followed by the Rural South, as defined by the MMTP,

which seems logical due to the large size of these two mobility zones. As expected, most of the participants commute for work or education to either the capital Luxembourg City or Esch & Belval, which are the main socio-economic hubs of the country. While every participant is aware that PT is free of charge, 7 out 10 commute to work/education by car, 8 out of 10 undertake leisure trips by car, and 9 out of 10 use cars to do their shopping. While the majority of participants indicated that they see the environment and sustainability as important, the majority also indicated that they use their cars around 5 - 7 times a week, while never using PT. Interestingly frugality is not that important for the drivers in Luxembourg, which could be an explanation for the continuous high car use in Luxembourg and the comparatively low increase In PT ridership despite the introduction of free-fare PT. Regarding car use, the participants indicated that their opinion on car use is generally positive with the statements presenting the benefits of car use reaching high mean scores, while the drawbacks were met with more mixed opinions. For example, statements regarding the perceived freedom or convenience reached high mean scores among the drivers while drawbacks such as the pollution through GHG emissions or stress-related statements averaged low scores. The descriptive statistics also show that people agree that the costs for car use are high but the necessity of car use is still indisputable. While people agreed that free-fare PT is a good policy, they heavily criticised factors such as reliability, punctuality, safety, and accessibility in rural areas. The infrastructure is seen as not competitive enough to car use, indicating that people do not use car use as inherently better but because PT is not up to par, regarding important mobility related factors. This is underlined by the future intent to use PT that showed an interest in more PT use, if the infrastructure addresses the present issues and concerns of the car drivers.

The factor analysis of the different statement sets yielded no significant underlying themes but rather showed one dominant factor which could be interpreted as either positive or negative feelings towards a given set. Statements regarding the benefits of car use are seen as true while the drawbacks are seen as false, while the exact opposite for PT statements could be observed. An argument can be made that the drivers do not weigh up the positives and negatives of the respective transport mode, but rather reaffirm or explain their habit with the statements they were presented with.

The hypothesis testing indicated that the general attitude towards benefits of car use match with the intent to use it, while the disadvantages do not match with the intent to use another option such as PT, meaning that hypothesis that Hagman (2003) has explained, holds some validity in Luxembourg. Furthermore, it could be concluded that the reasons for car use in Luxembourg are rather emotional than functional and that convenience is the most important factor for car use. The increased habit of driving also seems to correlate with the intent to use cars for the next trip into urban areas, while this does not hold true for the next trip into rural areas. This means that people who drive less frequently have less intention to use a car to

commute to an urban area, while people who have a stronger habit of driving have a stronger intention to use a car for the next trip into an urban area. However there is no difference to be made regarding a travel into a rural area. Urban areas are naturally more accessible through the means of PT, which could explain this result and further hinting at the restricted accessibility of PT in rural areas. Also there is a clear difference between the residents of the different mobility regarding the necessity of a car. While people in urban areas, such as the city of Luxembourg or Esch & Belval only see cars as a necessity to an extent, people that live in the Rural North or abroad see it more as imperative. Due to the fact that work commutes often entail travel towards urban centres, and the access to PT is limited in rural areas and PT takes more time, people residing in rural areas see cars as essential for different reasons, possibly explaining these findings. It could also be concluded that there is no significant difference between the income of the participants and the increase in ridership of free-fare PT. This was an assumption made by Cats et al. (2016), where in Tallinn the introduction of free-fare PT yielded a significant increase in ridership numbers from lower income citizens. Also the hypothesis that the increase in ridership in free-fare PT stems from sustainable travellers such cyclists or pedestrians as argued by Volinski (2012) could not be proven to be statistically relevant. While the descriptive statistics indicated that this is true, the power of the sample size of sustainable travellers was too small in order to prove the hypothesis. Finally the last assumption that was made was that improving the infrastructure of PT in Luxembourg would increase the attractiveness of it better than inconveniencing car use. This hypothesis was accepted, since the mean scores of inconveniencing car use were lower than the scores for the improvements to PT and because there was a significant difference between the variables and a post hoc test indicated that the results for the inconveniencing of car use have significantly different results than improvements to the infrastructure.

Finally, in order to reach the goals of the PNM 2035, a behavioural change towards sustainable mobility in Luxembourg is of essence. That is why in a last step, a target demographic was identified to model a marketing campaign around. The results indicate that women under the age of 30 with an academic background in the Suburban Ring would be the most receptive demographic for using PT more and therefore a concentration on this group could be beneficial. Also people in rural areas show interest to use PT more, if it were more accessible, which could mean that an improvement in the accessibility in these regions may also yield positive results in regards to the goals of the PNM 2035 and the envisioned sustainable mobility improvements in Luxembourg.

5. CONCLUSION

5.1. Summary

The introduction of free-fare PT in Luxembourg did not have the desired effect of reducing the use of cars significantly, which is the reason why this study has been conducted. The reasons for car use are plentiful and deeply personal in many cases, but some reappearing factors such as convenience, time savings, or the flexibility and independence from set time schedules of PT of "freedom" for short, are major deciding factors for the choice of transport mode. PT is nonetheless perceived as cheaper and notably favourable for the environment as evidenced by the literature, however these benefits are often not significant enough for incentivising the use of PT as argued by Hagman (2003). The discrepancy stems from a general awareness of people regarding the drawbacks of car use, which are however then outweighed by the immediate benefits. In simple terms, personal momentary convenience is seen as more tangible and "real" than long term effects on the environment, which then leads to the use of cars rather than the use of PT. Also regarding the intent to change transport mode, people will need to perceive the switch as generally favourable and not linked to decreases of QoL, since this could lead to a negative predisposition towards the change and reduce the intent for doing so (Steg & Gifford, 2005). By utilising a questionnaire with statements that the participants could rate with a 5-point Likert scale (1 - Completely Disagree to 5 - Completely Agree) based on the literature regarding benefits and drawbacks of car use and PT, seven distinct hypotheses were tested in order to answer the question: *What are the motivational factors or reasons for individual car use in Luxembourg, despite the access to free public transport?* The results suggest a clear favouritism for car use in Luxembourg, where the benefits that were presented to the participants such as convenience, time savings, of "freedom" were identified to be the most significant. Furthermore PT was heavily criticised for factors such as safety, convenience, accessibility, punctuality, overcrowdedness, and stress, hinting at the argument that the infrastructure is not up to par or is not attractive enough for people in Luxembourg to be a viable option for mobility. The results also suggest that the reasons for car use are rather emotional in nature than functional, evidenced by the biggest factor in the decision-making for car use being the perceived convenience compared to PT. Moreover, residents of rural regions were more likely to see a car as a necessity due to their longer journeys to work and worse access to PT options compared to urban areas. Nonetheless, there is a clear indication that residents of this mobility zone would use PT more if the necessary amendments to the infrastructure, such as increased frequency or more transit hubs, were to be made. Finally the results suggest that the drivers in Luxembourg would be willing to use PT more if the infrastructure of PT became better, while inconveniencing car use would not be an influential strategy. In general it can be argued that introducing free-fare PT was a concept that was adored by many people in Luxembourg for its

innovative approach, yet did not have the significant effect in reducing car use that was expected/hoped for. The reason for that may be that the prices of PT were not that significant before the introduction of free-fare PT anyway, and that it addressed the wrong concern for people in Luxembourg. Would concerns such as frequency, accessibility, safety, reliability, and punctuality be addressed and resolved, people would be willing to take it more often and the goals of the PNM 2035 could be achieved more easily. The benefits of car use outweigh the drawbacks of car use and the benefits of free-fare PT for many individuals in the Grand-Duchy, which explains the rather not intuitive behaviour of people in Luxembourg that drive cars while a more economic and sustainable option is available, especially in regards to current concerns for financial and environmental situations. The problem here lies that PT in Luxembourg is not as available and convenient for people as a car. If presented the option to choose between the two modes of transportation, the decision is made by the perceived higher convenience of car use compared to PT and justified by the drawbacks of PT. For this to change and for a marketing strategy to incentivise more sustainable mobility, the PT infrastructure needs to improve and become attractive enough to rival car use. This study can help to pin-point the biggest concerns of people for using PT in Luxembourg and direct the improvement of PT infrastructure in a way that it addresses the major drawbacks of PT according to the participants of the study, since there is a clear indication of people to use PT more if certain changes were to be made. The most receptive audience for using PT more would be women under the ages of 30 with an academic background, residing in the Suburban Ring, while it is noteworthy that people in rural regions of the country would also be interested in using PT more if it were more accessible. This is a rather important finding, since this mobility zone is responsible for the majority of car travel in the country.

5.2. Contribution to knowledge

This research aided to better understand the feelings of car drivers in Luxembourg in regards to their attitudes towards car use and what the defining factors for it are. By utilising common reasons for and against car and PT use stemming from established literature, different hypotheses regarding car use in Luxembourg despite access to free-fare PT could be tested. The results give valuable insights into the reasonings behind the status quo or the favouritism of car use by Luxembourgish people and can therefore help to improve the PT infrastructure in a way that it directly employs the advantages people perceive for using cars while simultaneously being able to mitigate for some shortcomings of PT as assessed by the public in Luxembourg. Additionally, further insight was given into the novel concept of free-fare public transportation and how this policy only saw limited success in creating a modal shift in travelling behaviour. A deeper insight into the reasons for car use and the underutilisation of free-fare PT in Luxembourg was given, explaining why the status quo in the Grand-Duchy is the way it is. Significant emotional or psychological factors were found that explain the unorthodox behaviour of peo-

ple in Luxembourg regarding car use despite a free alternative being available and points of improvement of the PT infrastructure were presented in order to further guide the development of sustainable mobility in Luxembourg.

5.3. Limitations

Relying solely on the data of this study in order to make large generalisations about the mobility situation in Luxembourg is difficult due to the limited sample size of 228. While sufficient for the scope of this analysis, large scale conclusions on the whole population of the country are rather difficult. This would however be necessary to make the right decisions regarding the mobility in the Grand-Duchy and adapt the necessary improvements and changes to the PT infrastructure to make it more attractive for users, in order to reach the goals of the PNM 2035. Further limitations to this research include the sampling method, which was not randomised but relied on convenience and snow-balling, which can subsequently lead to certain biases that need to be accounted for. Certain results may therefore not be accurate or represent the opinions of only the sample and not the entire population. Moreover, certain flaws in the design of the questionnaire have been identified. Firstly, it was pointed out by participants that there was an option missing for people that use cars/PT less than once a week. There were only options between 1-2 times a week and never, which lead to some confusion among participants. Secondly, the statement regarding the compensation of lost time in traffic congestion led to inconclusive results since people are unlikely to self-report on “negative” actions. Due to the false judgement of the researcher a valuable addition to the questionnaire could have been a question along the lines of: I would use public transportation more, if PT in itself were safer. It was expected that transit hubs would be places that the participants would feel less at ease or would have concerns for safety, however as it turns out, the safety in PT itself was a larger concern. A question regarding future intent of using PT if this would be addressed could have potentially aided in the analysis of this study. Finally, some participants reported that they wished to have been able to add a personal comment, which was not possible. Therefore a comment box, could have given some deeper insights into the opinions of people regarding car use in Luxembourg.

5.4. Future research

Due to the very broad nature of the underlying themes of this thesis, namely sustainable mobility, behaviour, and behavioural change, the future research that can be done on these subjects is vast. Specifically focusing on Luxembourg however and the symbiosis of free-fare PT and car use, the first recommendation for future research would be to increase the sample size in order to obtain more reliable and generalisable data. With only 228 participants, this thesis is not representative of the whole country and could lead to inaccurate predictions, which

should be avoided given the fact that the PNM 2035 is at the heart of sustainable development of the Grand-Duchy. Furthermore certain notions, that have been found to be key factors in the choice of transport mode, should be further explored. Notions such as “freedom” and “safety” are determining factors for car use, but have not been fully explored in this research. Freedom was the main reason for car use according to this study and thought to be a combination of the independence of time schedules of PT and possible delays and disruptions and the perceived flexibility of car use, but could be further researched in a future study. Also safety in public transportation was a major concern for the participants of this study and further research could paint a clearer picture of what these safety concerns in PT in Luxembourg precisely are. Having established that there is a lack of accessibility of PT in rural areas but an intent for more PT use is also present, research regarding the improvement of accessibility in these regions should naturally also be conducted.

6. BIBLIOGRAPHY

ACEA - European Automobile Manufacturers' Association (2023a, May 25). *Per capita new car registrations, by EU country*. https://www.acea.auto/figure/per-capita-new-car-registrations-by-eu-country/#:~:text=21%20new%20passenger%20cars%20were,the%20European%20Union%20in%202022.

ACEA - European Automobile Manufacturers' Association. (2023b, May 26). *Motorisation rates in the EU, by country and vehicle type*. https://www.acea.auto/figure/motorisation-rates-in-the-eu-by-country-and-vehicle-type/

Acharya, A. S., Prakash, A., Saxena, P., & Nigam, A. (2013). Sampling: why and how of it? Indian Journal of Medical Specialities, 4(2). https://doi.org/10.7713/ijms.2013.0032

Afrin, T., & Yodo, N. (2020). A Survey of Road Traffic Congestion Measures towards a Sustainable and Resilient Transportation System. *Sustainability*, *12*(11), 4660. https://doi.org/10.3390/su12114660

Ajzen, I. (1991). The theory of planned behavior. Organizational Behavior and Human Decision Processes, 50(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-t

American Public Transportation Association. (2008). Public Transportation Reduces Greenhouse Gases And Conserves Energy [Press release]. https://www.apta.com/wp-content/uploads/Resources/resources/reportsandpublications/Documents/greenhouse_brochure.pdf

Anable, J. (2005). 'Complacent Car Addicts' or 'Aspiring Environmentalists'? Identifying travel behaviour segments using attitude theory. Transport Policy, 12(1), 65–78. https://doi.org/10.1016/j.tranpol.2004.11.004

Barth, M., & Boriboonsomsin, K. (2008). Real-World Carbon Dioxide Impacts of Traffic Congestion. *Transportation Research Record*, *2058*(1), 163–171. https://doi.org/10.3141/2058-20

Beirão, G., & Cabral, J. S. (2007). Understanding attitudes towards public transport and private car: A qualitative study. Transport Policy, 14(6), 478–489. https://doi.org/10.1016/j.tranpol.2007.04.009

Belgiawan, P. F., Schmöcker, J. D., Abou-Zeid, M., Walker, J., Lee, T. C., Ettema, D. F., & Fujii, S. (2014). Car ownership motivations among undergraduate students in China, Indonesia, Japan, Lebanon, Netherlands, Taiwan, and USA. Transportation, 41(6), 1227–1244. https://doi.org/10.1007/ s11116-014-9548-z

Bhandari, P. (2022). What Is Quantitative Research? | Definition, Uses & Methods. Scribbr. https://www.scribbr.com/methodology/quantitative-research/

Bhandari, P. (2023). What Is Qualitative Research? | Methods & Examples. Scribbr. https://www.scribbr.com/methodology/qualitative-research/

Brög, W., Erl, E., & Mense, N. (2002, December). Individualised marketing changing travel behaviour for a better environment. In OECD Workshop: Environmentally Sustainable Transport Berlin (Vol. 5, pp. 6-12).

Cats, O., Susilo, Y. O., & Reimal, T. (2016). The prospects of fare-free public transport: evidence from Tallinn. Transportation, 44(5), 1083–1104. https://doi.org/10.1007/s11116-016-9695-5

CFL | Nationale Fahrkarten. (2023). https://www.cfl.lu/de-de/ticket/national

Creswell, J. W. (2012). Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research. Pearson.

Dupuy, G. (1999). From the "magic circle" to "automobile dependence": measurements and political implications. Transport Policy, 6(1), 1–17. https://doi.org/10.1016/s0967-070x(98)00028-6

Etikan, I. (2016). Comparison of Convenience Sampling and Purposive Sampling. American Journal of Theoretical and Applied Statistics, 5(1), 1. https://doi.org/10.11648/j.ajtas.20160501.11

European Conference of Ministers of Transport. (2005). ECMT Annual Report 2004. OECD Library. https://doi.org/10.1787/9789282103463-en

European Parliament. (2023). *CO2 emissions from cars: facts and figures (infographics) | News | European Parliament*. https://www.europarl.europa.eu/news/en/headlines/society/20190313STO31218/co2-emissions-from-cars-facts-and-figures-infographics

Evans, J. R., & Mathur, A. (2005). The value of online surveys. Internet Research, 15(2), 195–219. https://doi.org/10.1108/10662240510590360

Fontaras, G., Zacharof, N. G., & Ciuffo, B. (2017). Fuel consumption and CO 2 emissions from passenger cars in Europe – Laboratory versus real-world emissions. Progress in Energy and Combustion Science, 60, 97–131. https://doi.org/10.1016/j.pecs.2016.12.004

George, D., & Mallery, P. (2003). SPSS for Windows step by step: A simple guide and reference. 11.0 update (4th ed.). Boston: Allyn & Bacon.

George, T. (2022). Mixed Methods Research | Definition, Guide & Examples. Scribbr. https://www.scribbr.com/methodology/mixed-methods-research/

Gliem, J. A., & Gliem, R. R. (2003). Calculating, interpreting, and reporting Cronbach's alpha reliability coefficient for Likert-type scales. Midwest research-to-Practice Conference in Adult, Continuing, and community education.

Goertzen, M. (2017). Chapter 3. Introduction to Quantitative Research and Data. Library Technology Reports, 53(4), 12–18. https://journals.ala.org/index.php/ltr/article/download/6325/8274

Google Maps. (2023). Google Maps. google.com/maps. https://www.google.lu/maps/dir/Kayl/Hamilius+(Bus),+Luxemburg/@49.5489667,5.9531686,11z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1s0x4795342feb34409b:0x7d2c3e5e3edf5765!2m2!1d6.039528!2d49.4868207!1m5!1m1!1s0x479548d52aaed64f:0x38b74ce776aa051!2m2!1d6.1258781!2d49.6114658!3e3?hl=de

Hagman, O. (2003). Mobilizing meanings of mobility: car users' constructions of the goods and bads of car use. Transportation Research Part D-Transport and Environment, 8(1), 1–9. https://doi.org/10.1016/s1361-9209(02)00014-7

Havlíčková, D., & Zámečník, P. (2020). Considering Habit in Research on Travel Mode Choice: A Literature Review with a Two-Level Methodology. Transactions on Transport Sciences, 11(1), 18–32. https://doi.org/10.5507/tots.2020.004

Hergesell, A., & Dickinger, A. (2013). Environmentally friendly holiday transport mode choices among students: the role of price, time and convenience. Journal of Sustainable Tourism, 21(4), 596–613. https://doi.org/10.1080/09669582.2013.785555

Hiscock, R., Macintyre, S., Kearns, A., & Ellaway, A. (2002). Means of transport and ontological security: Do cars provide psycho-social benefits to their users? Transportation Research Part D-Transport and Environment, 7(2), 119–135. https://doi.org/10.1016/s1361-9209(01)00015-3

Holton, E. F., & Burnett, M. F. (2005). The Basics of Quantitative Research. Research in Organizations: Foundations and Methods of Inquiry (pp. 29-44).

Hunecke, M., Haustein, S., Grischkat, S., & Böhler, S. (2007). Psychological, sociodemographic, and infrastructural factors as determinants of ecological impact caused by mobility behavior. Journal of Environmental Psychology, 27(4), 277–292. https://doi.org/10.1016/j.jenvp.2007.08.001

Kuhnimhof, T., Buehler, R., Wirtz, M., & Kalinowska, D. (2012). Travel trends among young adults in Germany: increasing multimodality and declining car use for men. Journal of Transport Geography, 24, 443–450. https://doi.org/10.1016/j.jtrangeo.2012.04.018

Kroesen, M., & Handy, S. L. (2015). Is the Rise of the E-Society Responsible for the Decline in Car Use by Young Adults? Transportation Research Record, 2496(1), 28–35. https://doi.org/10.3141/2496-04

Lanka, E., Lanka, S. V., Rostron, A., & Singh, P. (2021). Why We Need Qualitative Research in Management Studies. *Revista De Administração Contemporânea*, *25*(2). https://doi.org/10.1590/1982-7849rac2021200297.en

LeasePlan. (2023). Car Cost Index 2022. leaseplan.com. https://www.leaseplan.com/en-ix/blog/tco/2022-car-cost-index/

Lovins, A. B., & Cramer, D. D. (2004). Hypercars, hydrogen, and the automotive transition. *International Journal of Vehicle Design*, *35*(1/2), 50. https://doi.org/10.1504/ijvd.2004.004364

Luxembourg City (n.d.). Besuchen Sie Luxemburg Stadt. Parken in Luxemburg Stadt: verfügbare Parkplätze in Echtzeit. https://www.luxembourg-city.com/de/planen-sie-ihren-aufenthalt/reiseinformationen/parkplatze

Ministère de l'Environnement, du Climat et du Développement durable. (2018). *Modu 2.0* [Press release]. https://transports.public.lu/dam-assets/publications/contexte/strategie/modu2-de-brochure.pdf

Ministère de l'Environnement, du Climat et du Développement durable. (2020). *Développement durable*. Portail De L'environnement - emwelt.lu - Luxembourg. https://environnement.public.lu/fr/developpement-durable.html

Ministère de l'Environnement, du Climat et du Développement durable. (2021). *3e Plan National pour un développement durable* [Press release]. https://environnement.public.lu/dam-assets/fr/developpement_durable/publications/PNDD-2021-Light-final.pdf

Ministère de l'Environnement, du Climat et du Développement durable. (2023, March 15). *Publication du bilan définitif des émissions de gaz à effet de serre de l'année 2021*. Ministère De L'Environnement, Du Climat Et Du Développement Durable // Le Gouvernement Luxembourgeois. https://mecdd.gouvernement.lu/fr/actualites.gouvernement%2Bfr%2Bactualites%2Btoutes_actualites%2Bcommuniques%2B2023%2B03-mars%2B15-bilan-emissions.html

Ministère de la Mobilité et des Travaux publiques. (2022). PNM 2035 - National mobility plan [Press release]. https://transports.public.lu/fr/publications/strategie/pnm-2035-brochure/pnm-2035-brochure-en.html

National Safety Council. (2023, May 4). *Deaths by Transportation Mode - Injury Facts*. Injury Facts. https://injuryfacts.nsc.org/home-and-community/safety-topics/deaths-by-transportation-mode/#:~:text=The%20death%20rate%20per%20100,dangerous%20motorized%20transportation%20option%20compared.

Novaco, R.W. and Gonzalez, O.I. (2009) 'Commuting and well-being', *Technology and Psychological Well-being*, pp. 174–205. doi:10.1017/cbo9780511635373.008.

Parker, C., Scott, S., & Geddes, A. (2019). Snowball sampling. SAGE research methods foundations

Parmar, J., Das, P., & Dave, S. M. (2020). Study on demand and characteristics of parking system in urban areas: A review. *Journal of Traffic and Transportation Engineering*, *7*(1), 111–124. https://doi.org/10.1016/j.jtte.2019.09.003

Polk, M. (2004). The influence of gender on daily car use and on willingness to reduce car use in Sweden. Journal of Transport Geography, 12(3), 185–195. https://doi.org/10.1016/j.jtrangeo.2004.04.002

Ponnambalam, C. T., & Donmez, B. (2020). Searching for Street Parking: Effects on Driver Vehicle Control, Workload, Physiology, and Glances. Frontiers in Psychology. https://doi.org/10.3389/fpsyg.2020.574262

Poortinga, W., Steg, L., & Vlek, C. (2004). Values, Environmental Concern, and Environmental Behavior. Environment and Behavior, 36(1), 70–93. https://doi.org/10.1177/0013916503251466

Prillwitz, J., & Barr, S. (2011). Moving towards sustainability? Mobility styles, attitudes and individual travel behaviour. Journal of Transport Geography, 19(6), 1590–1600. https://doi.org/10.1016/j.jtrangeo.2011.06.011

Raosoft Inc. (2004). *Sample Size Calculator by Raosoft, Inc.* http://www.raosoft.com/samplesize.html

Raykov, T., & Marcoulides, G. A. (2019). Thanks coefficient alpha, we still need you!. Educational and psychological measurement, 79(1), 200-210.

Research Luxembourg. (2022, February 25). Luxembourg Celebrates 1 Year of Free Public Transport. Researchluxembourg. https://www.researchluxembourg.org/en/luxembourg-celebrates-1-year-of-free-public-transport/

Smith, R. D. (1992). Tourism's role in the economy and landscape of Luxembourg. *Tourism Management*, *13*(4), 423–428. https://doi.org/10.1016/0261-5177(92)90010-5

STATEC. (2019). *Le luxembourgeois reste la langue la plus utilisée à domicile* [Press release]. https://statistiques.public.lu/dam-assets/catalogue-publications/regards/2019/regards-09-19.pdf

STATEC. (2023). *Luxembourg in Figures 2022* [Dataset]. https://statistiques.public.lu/dam-assets/catalogue-publications/luxembourg-en-chiffres/2022/statec-lux-in-figures-2022.pdf

Statista. (2023, April 12). Mobilitätsveränderung durch 9-Euro-Ticket in Deutschland nach Verkehrsmittel 2022. https://de.statista.com/statistik/daten/studie/1319694/umfrage/mobilitaetsveraenderung-in-deutschland-nach-verkehrsmittel/

Statistikaamet. (n.d.). Www.stat.ee. Income | Retrieved May 19, 2023, from https://www.stat.ee/en/find-statistics/statistics-theme/work-life/income

Stead, D., & Marshall, S. W. (2001). The Relationships between Urban Form and Travel Patterns. An International Review and Evaluation. DOAJ (DOAJ: Directory of Open Access Journals). https://doi.org/10.18757/ejtir.2001.1.2.3497

Steg, L. (2003). CAN PUBLIC TRANSPORT COMPETE WITH THE PRIVATE CAR? *Iatss Research*, *27*(2), 27–35. https://doi.org/10.1016/s0386-1112(14)60141-2

Steg, L., & Gifford, R. (2005). Sustainable transportation and quality of life. Journal of Transport Geography, 13(1), 59–69. https://doi.org/10.1016/j.jtrangeo.2004.11.003

Steg, L., Vlek, C., & Slotegraaf, G. (2001). Instrumental-reasoned and symbolic-affective motives for using a motor car. Transportation Research Part F-Traffic Psychology and Behaviour, 4(3), 151–169. https://doi.org/10.1016/s1369-8478(01)00020-1

TomTom. (n.d.). Traffic Index Luxembourg. https://www.tomtom.com/traffic-index/luxembourg-traffic/

United Nations. (n.d.). *Sustainable Development Goals*. https://www.un.org/sustainabledevelopment/news/communications-material/. https://www.un.org/sustainabledevelopment/wp-content/uploads/2019/08/E-SDG-2019-posters.zip

Vance, C., Buchheim, S., & Brockfeld, E. (2005). On the Role of Gender as a Determinant of Car Use: Evidence from Germany. Research on Women's Issues in Transportation Conference Proceedings.

Volinski, J. (2012). Implementation and Outcomes of Fare-free Transit Systems. Transportation Research Board.

White, K. M., Habib, R., & Hardisty, D. J. (2019). How to SHIFT Consumer Behaviors to be More Sustainable: A Literature Review and Guiding Framework. Journal of Marketing, 83(3), 22–49. https://doi.org/10.1177/0022242919825649

Worldometer. (n.d.). CO2 Emissions per Capita [Dataset]. https://www.worldometers.info/co2-emissions/co2-emissions-per-capita/

Yang, H., Liu, W., Wang, W., & Zhang, X. (2013). On the morning commute problem with bottleneck congestion and parking space constraints. Transportation Research Part B-Methodological, 58, 106–118. https://doi.org/10.1016/j.trb.2013.10.003

Zhou, M., & Wang, D. (2019). Generational differences in attitudes towards car, car ownership and car use in Beijing. Transportation Research Part D-Transport and Environment, 72, 261–278. https://doi.org/10.1016/j.trd.2019.05.008

7. APPENDIX

7.1. Appendix A - Questionnaire in English

Motivational factors for car ownership and use after free public transport in Luxembourg has been introduced

Dear Survey Participant,

In this survey, which plays a major role in my completion of my Master's Degree at MODUL University Vienna, I seek to investigate the reasons for car ownership and use in Luxembourg after the introduction of free-fare public transportation in 2020. The purpose of this survey is to get a deeper understanding of the feelings of drivers in Luxembourg towards public transportation and car use and what the deciding factors for the travel mode of choice are.

Please kindly consider that this survey is aimed at individuals that have driven in Luxembourg since the introduction of free-fare public transport in March 2020. Please also note that the participation in this survey is anonymous and confidential meaning that any answers given in this questionnaire will not be able to be traced back to you. A final note: You are free to skip any questions you do not wish to answer and optional questions will also be labeled as such.

The survey will take you around 5 to 7 minutes of your time!

Thank you so much for your participation!

Questions on Demographics

First of all, there will be a few questions regarding demographics. These will include questions regarding your gender identity, age, monthly income, education level, and place of residence among others. These answers will help to analyse the answers on public transportation and car use and paint a clearer picture of the situation in Luxembourg but if you do not feel comfortable disclosing some of this information, that is not a problem.

2. Gender: How do you identify?

Markieren Sie nur ein Oval.

- ◯ Woman
- ◯ Non-Binary
- ◯ Man
- ◯ Prefer not to say
- ◯ Sonstiges: _____

3. Age: How old are you?

Markieren Sie nur ein Oval.

- ◯ 18 - 20
- ◯ 21 - 25
- ◯ 26 - 30
- ◯ 31 - 35
- ◯ 36 - 40
- ◯ 41 - 45
- ◯ 46 - 50
- ◯ 51 - 55
- ◯ 56 - 60
- ◯ 61 - 65
- ◯ 66 - 70
- ◯ 71+

4. Education: Please indicate your highest level of education achieved.

Markieren Sie nur ein Oval.

- ◯ No degree
- ◯ Vocational training (Formation professionnelle initiale)
- ◯ High School Degree
- ◯ Bachelor's Degree
- ◯ Master's Degree
- ◯ Doctorate Degree
- ◯ Other (Please describe below)
- ◯ Sonstiges: _____

5. Work: What is your current employment status?

Markieren Sie nur ein Oval.

- ◯ Currently Unemployed
- ◯ Student
- ◯ Currently Employed
- ◯ Retired
- ◯ Other (Please describe below)
- ◯ Sonstiges: _____

6. Financial Situation: What is your current monthly income?

Markieren Sie nur ein Oval.

- ◯ 0 - 1000€
- ◯ 1001€ - 2500€
- ◯ 2501€ - 4000€
- ◯ 4001€ - 5500€
- ◯ 5501€ - 7000€
- ◯ 7001€ - 8500€
- ◯ 8501€ - 10000€
- ◯ 10001€ +

7. Place of **residence**: Where do you **live**? (Please indicate the town you are currently living in below, e.g.: Koerich, Esch-sur-Alzette, Metz, Trier, ...)

_____

8. Place of **work/education**: Where do you **work/study**? (Please indicate the town you are currently working in below, e.g.: Koerich, Esch-sur-Alzette, Metz, Trier, ...)

_____

9. Free Public Transport: I am aware that public transportation in Luxembourg is completely free of charge for users.

Markieren Sie nur ein Oval.

- ◯ Yes
- ◯ No

10. Choice of Transport Mode: Which of the following transportation modes do you personally use the most for **commutes to work** or similar?

Markieren Sie nur ein Oval.

- ◯ Private Vehicle
- ◯ Bicycle
- ◯ Walking
- ◯ Train
- ◯ Bus
- ◯ Tram

11. Choice of Transport Mode: Which of the following transportation modes do you personally use the most for **doing shopping**? This includes trips for grocery shopping, clothing shopping, or similar.

Markieren Sie nur ein Oval.

- ◯ Private Vehicle
- ◯ Bicycle
- ◯ Walking
- ◯ Train
- ◯ Bus
- ◯ Tram

12. Choice of Transport Mode: Which of the following transportation modes do you personally use the most for **leisure trips**? This includes trips for sports, pursuing hobbies, visiting friends, or meeting up for dinner for example.

Markieren Sie nur ein Oval.

- Private Vehicle
- Bicycle
- Walking
- Train
- Bus
- Tram

13. Distance Travelled: On average, how many kilometres do you travel daily?

Markieren Sie nur ein Oval.

- 0
- 1-10
- 11-20
- 21-30
- 31-40
- 41-50
- 51+

14. How many days per week do you drive a car in Luxembourg?

Markieren Sie nur ein Oval.

- Never
- 1 - 2 times a week
- 3 - 4 times a week
- 5 - 6 times a week
- Everyday

15. How many days per week do you use public transportation in Luxembourg?

Markieren Sie nur ein Oval.

- Never
- 1 - 2 times a week
- 3 - 4 times a week
- 5 - 6 times a week
- Everyday

16. I believe that sustainability is an important topic.

Markieren Sie nur ein Oval.

	Strongly Disagree					Strongly Agree
	1	2	3	4	5	

17. The environment is important to me.

Markieren Sie nur ein Oval.

	Strongly Disagree					Strongly Agree
	1	2	3	4	5	

18. I would describe myself as a frugal person.

Markieren Sie nur ein Oval.

	Strongly Disagree					Strongly Agree
	1	2	3	4	5	

Car-related questions

Now we will be moving on to car-related questions. These will include statements regarding car use and you will need to indicate if you agree or disagree with these statements on a scale from 1 (Strongly Disagree) to 5 (Strongly Agree).

19. I feel safer on the road when I am driving, compared to being driven around by public transport.

Markieren Sie nur ein Oval.

	Strongly Disagree					Strongly Agree
	1	2	3	4	5	

20. Cars allow for more freedom than public transportation.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

21. I value the privacy a car offers me.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

22. I value the shelter a car offers me from bad weather.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

23. I believe using a car shortens my travel time compared to using public transportation.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

24. I believe that I can transport heavy objects better in my car.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

25. I believe that travelling with children is done easier by car compared to public transport.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

26. I think that a car is convenient.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

27. I think that a car is comfortable.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

28. There is a lot of traffic congestion on Luxembourg's roads.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

29. Traffic congestion in Luxembourg is bothering me.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

30. There are a lot of roadworks in Luxembourg.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

31. Roadworks are a nuisance to me.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

32. Cars are a status symbol to me.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

33. I believe that driving in of itself is fun.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

34. The road network in Luxembourg is good.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

35. I believe that buying a car is expensive.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

36. I believe that buying petrol is expensive.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

37. I believe that the running costs of a car (reparations, taxes, insurance, ...) are high.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

38. There is a high risk for accidents while driving cars.

Markieren Sie nur ein Oval.

Strongly Disagree

1
2
3
4
5

Strongly Agree

39. I think that driving is stressful.

Markieren Sie nur ein Oval.

Strongly Disagree

1
2
3
4
5

Strongly Agree

40. Car traffic is **not** a major contributor to climate change.

Markieren Sie nur ein Oval.

Strongly Disagree

1
2
3
4
5

Strongly Agree

41. I tend to compensate for lost time in traffic by driving faster afterwards.

Markieren Sie nur ein Oval.

Strongly Disagree

1
2
3
4
5

Strongly Agree

42. I think tariffs for parking are high.

Markieren Sie nur ein Oval.

Strongly Disagree

1
2
3
4
5

Strongly Agree

43. I find it difficult to find parking spaces when I am driving to **urban** areas (Urban areas are larger cities such as, for example, Esch-sur-Alzette, Diekirch, or Luxembourg City)

Markieren Sie nur ein Oval.

Strongly Disagree

1
2
3
4
5

Strongly Agree

44. I find it difficult to find parking spaces when I am driving to **rural** areas (Rural areas are for examples the Northern, Eastern, or Western most part of Luxembourg, with smaller towns)

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

45. I believe that a car is a necessity for my lifestyle.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

Public transportation-related questions

The following section will present you with statements regarding public transportation. Similar to the last section, these will present a statement and present you with a scale from 1 to 5 meaning "Strongly Disagree" to "Strongly Agree".

46. Public transportation is cheaper than using a car.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

47. Public transportation is more environmentally friendly than driving a car.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

48. Public transportation offers access to jobs and education.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

49. Public transportation is reliable.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

50. Buses in Luxembourg are punctual.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

51. Trains in Luxembourg are punctual.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

52. Trams in Luxembourg are punctual.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

53. Railways are particularly susceptible to renovation works.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

54. Free-fare public transportation is a good policy.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

55. The railway network in Luxembourg is good.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

56. I feel safe in public transportation.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

57. I use public transportation more **since** it became free of charge.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

58. I use public transportation more **because** it became free of charge.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

59. I feel safe at transit hubs.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

60. Transit hubs are in easy to reach locations.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

61. Public transportation takes more time compared to driving cars.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

62. Public transportation is not accessible enough in rural areas.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

63. I think that public transportation is convenient.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

64. I think that public transportation is comfortable.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

65. Multiple changes in public transportation in order to reach my destination are bothering me.

Markieren Sie nur ein Oval.

Strongly Disagree

1
2
3
4
5

Strongly Agree

66. Buses are overcrowded in Luxembourg.

Markieren Sie nur ein Oval.

Strongly Disagree

1
2
3
4
5

Strongly Agree

67. Trains are overcrowded in Luxembourg.

Markieren Sie nur ein Oval.

Strongly Disagree

1
2
3
4
5

Strongly Agree

68. Trams are overcrowded in Luxembourg.

Markieren Sie nur ein Oval.

Strongly Disagree

1
2
3
4
5

Strongly Agree

69. I think that using public transport is stressful.

Markieren Sie nur ein Oval.

Strongly Disagree

1
2
3
4
5

Strongly Agree

70. Public transportation should operate more during the night (between 12PM and 6AM).

Markieren Sie nur ein Oval.

Strongly Disagree

1
2
3
4
5

Strongly Agree

Questions regarding the future

This final section will present you some statements regarding the future and your mobility behaviour. There will be statements again, where your opinion on planned changes to the public transportation infrastructure is needed. Please indicate again if you agree or disagree with these statements.

71. I would use public transportation more if I had better access to it.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

72. I would use public transportation more if car use becomes more expensive.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

73. I would use public transportation more if car use becomes slower compared to public transportation.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

74. I would use public transportation more if there were was an increased frequency of trains, buses or trams.

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

75. I would use public transportation more if transit hubs were safer. (For example equipped with security cameras or personnel)

Markieren Sie nur ein Oval.

Strongly Disagree

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Strongly Agree

76. I would use public transportation more if it were more reliable.

Markieren Sie nur ein Oval.

Strongly Disagree

1
2
3
4
5

Strongly Agree

77. I would use public transportation more if it were more punctual.

Markieren Sie nur ein Oval.

Strongly Disagree

1
2
3
4
5

Strongly Agree

78. On a scale from 1 to 10, how likely are you to use a car on your next travel in Luxembourg to an **urban** area? (Urban areas are larger cities such as, for example, Esch-sur-Alzette, Diekirch, or Luxembourg City)

Markieren Sie nur ein Oval.

Not at all likely

1
2
3
4
5
6
7
8
9
10

Certain

79. On a scale from 1 to 10, how likely are you to use a car on your next travel in Luxembourg to a **rural** area? (Rural areas are for examples the Northern, Eastern, or Western most part of Luxembourg, with smaller towns)

Markieren Sie nur ein Oval.

Not at all likely

1
2
3
4
5
6
7
8
9
10

Certain

7.2 Appendix B - Questionnaire in French

Raisons pour la possession et l'utilisation de voitures après l'introduction du transport en commun gratuit au Luxembourg

Cher·e·s participants,

Dans ce questionnaire, qui joue un rôle essentiel dans la conclusion de mes études en Master à la MODUL University Vienna, j'essaie de déterminer les raisons pour la possession et l'utilisation de voitures au Luxembourg, après l'introduction du transport en commun gratuit en mars 2020. L'objectif de cette enquête est de capturer les émotions et les pensées des conducteurs de voitures au Luxembourg par rapport à la conduite, mais aussi par rapport au transport en commun et de déterminer les facteurs qui influencent la décision du choix du mode de transport.

Ce questionnaire est adressé à des personnes qui ont roulé en voiture depuis l'introduction du transport en commun gratuit en mars 2020. Veuillez noter que votre participation dans ce sondage est anonyme, que vos réponses ne seront utilisées que dans le cadre de cette thèse et qu'il n'est pas possible de retracer vos réponses. Vous avez bien sûr le droit de sauter des questions auxquelles vous ne voulez pas répondre et des questions facultatives seront identifiées.

Le questionnaire va vous prendre à peu près 5 à 7 minutes de votre temps.

Merci pour votre participation!

Questions sur la démographie

D'abord on va vous poser des questions sur votre personne. On va vous poser des questions sur votre identité sexuelle, votre âge, votre revenu mensuel, votre education, votre lieu de résidence et d'autres questions. Vos réponses vont faciliter l'analyse de vos autres réponses au sujet du transport en commun et l'utilisation des voitures et aideront à expliquer la situation actuelle au Luxembourg. Si vous ne voulez pas divulguer certaines informations, cela ne pose pas de problèmes.

80. Identité sexuelle: Comment vous identifiez-vous?

Markieren Sie nur ein Oval.

- ◯ Femme
- ◯ Non binaire
- ◯ Homme
- ◯ Je préfère ne pas le dire
- ◯ Sonstiges: _____

81. Age: Quel âge avez-vous?

Markieren Sie nur ein Oval.

- ◯ 18 - 20
- ◯ 21 - 25
- ◯ 26 - 30
- ◯ 31 - 35
- ◯ 36 - 40
- ◯ 41 - 45
- ◯ 46 - 50
- ◯ 51 - 55
- ◯ 56 - 60
- ◯ 61 - 65
- ◯ 66 - 70
- ◯ 71+

82. Niveau d'éducation: Quel est votre plus haut niveau d'éducation?

Markieren Sie nur ein Oval.

- ◯ Sans diplôme
- ◯ Formation professionnelle initiale
- ◯ Bac (général, professionelle, technologique)
- ◯ Bac+3 (Bachelor)
- ◯ Bac+5 (Master)
- ◯ Bac+7 (Doctorat)
- ◯ Autre (Veuillez indiquer ci-dessous)
- ◯ Sonstiges: _____

83. Travail: Quel est votre statut d'emploi?

Markieren Sie nur ein Oval.

- ◯ Sans emploi
- ◯ Étudiant·e
- ◯ Employé·e
- ◯ Retraité·e
- ◯ Autre (Veuillez indiquer ci-dessous)
- ◯ Sonstiges: _____

84. Situation financière: Quel est votre revenu mensuel net?

Markieren Sie nur ein Oval.

- ◯ 0 - 1000€
- ◯ 1001€ - 2500€
- ◯ 2501€ - 4000€
- ◯ 4001€ - 5500€
- ◯ 5501€ - 7000€
- ◯ 7001€ - 8500€
- ◯ 8501€ - 10000€
- ◯ 10001€+

85. **Lieu de résidence:** Où **habitez**-vous? (Veuillez indiquer la ville dans laquelle vous habitez couramment ci-dessous, comme par ex.: Koerich, Esch-sur-Alzette, Metz, Trèves, ...)

_____

86. **Lieu de travail/études**: Où **travaillez/étudiez**-vous? (Veuillez indiquer la ville dans laquelle vous travaillez/étudiez couramment ci-dessous, comme par ex.: Koerich, Esch-sur-Alzette, Metz, Trèves, ...)

_____

87. Transport en commun gratuit: Je sais que le transport en commun au Luxembourg est complètement gratuit pour les consommateurs.

Markieren Sie nur ein Oval.

- ◯ Oui
- ◯ Non

88. Choix du mode de transport: Lequel des modes de transport suivants utilisez-vous le plus souvent pour **aller au travail** ou similaire?

Markieren Sie nur ein Oval.

- Voiture
- Vélo
- Je marche à pied
- Train
- Bus
- Tram

89. Choix du mode de transport: Lequel des modes de transport suivants utilisez-vous le plus souvent pour **faire vos courses**? Ceci inclut des trajets pour faire des courses pour acheter des aliments, des vêtements ou similaires.

Markieren Sie nur ein Oval.

- Voiture
- Vélo
- Je marche à pied
- Train
- Bus
- Tram

90. Choix du mode de transport: Lequel des modes de transport suivants utilisez-vous le plus souvent pour **pratiquer des loisirs**? Ceci inclut des trajets pour faire du sport, pratiquer des passe-temps, visiter des amis, ou aller au restaurant par exemple.

Markieren Sie nur ein Oval.

- Voiture
- Vélo
- Je marche à pied
- Train
- Bus
- Tram

91. Distance parcourue: En moyenne, combien de kilomètres parcourez-vous par jour?

Markieren Sie nur ein Oval.

- 0
- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51+

92. Combien de jours par semaine utilisez-vous une voiture au Luxembourg?

Markieren Sie nur ein Oval.

- Jamais
- 1 - 2 fois par semaine
- 3 - 4 fois par semaine
- 5 - 6 fois par semaine
- Chaque jour

93. Combien de jours par semaine utilisez-vous le transport en commun au Luxembourg?

Markieren Sie nur ein Oval.

- Jamais
- 1 - 2 fois par semaine
- 3 - 4 fois par semaine
- 5 - 6 fois par semaine
- Chaque jour

94. Le développement durable est un sujet important pour moi.

Markieren Sie nur ein Oval.

	Pas du tout d'accord					Tout à fait d'accord
	1	2	3	4	5	

95. L'environnement est important pour moi.

Markieren Sie nur ein Oval.

	Pas du tout d'accord					Tout à fait d'accord
	1	2	3	4	5	

96. Je me décrivais comme une personne qui épargne.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

97. Je me sens plus en sécurité sur la route si je conduis moi-même que si j'utilise le transport public.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

Questions par rapport à l'utilisation de voitures

Maintenant on va commencer avec les questions par rapport à l'utilisation de voitures. On va vous présenter des affirmations par rapport à l'utilisation de voitures et vous devez indiquer dans quelle mesure vous êtes d'accord avec ces affirmations sur une échelle de 1 (Pas du tout d'accord) jusqu'à 5 (Tout à fait d'accord).

98. Des voitures permettent plus de libertés que le transport public.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

99. J'apprécie l'intimité qu'une voiture m'offre.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

100. J'apprécie l'abri qu'une voiture m'offre par rapport au mauvais temps.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

101. Je pense qu'une voiture réduit la durée de trajet comparé au transport public.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

102. Je pense que je peux mieux transporter des objets lourds en voiture.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Tout à fait d'accord

103. Je pense que c'est plus facile de se déplacer avec des enfants en voiture qu'en transport public.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Tout à fait d'accord

104. Je pense qu'une voiture est pratique.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Tout à fait d'accord

105. Je pense qu'une voiture est comfortable.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Tout à fait d'accord

106. Il y a beaucoup d'embouteillages sur les routes luxembourgeoises.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Tout à fait d'accord

107. Les embouteillages au Luxembourg me dérangent.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Tout à fait d'accord

108. Il y a beaucoup de chantiers routiers au Luxembourg.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

109. Les chantiers routiers au Luxembourg me dérangent.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

110. Les voitures sont un symbole de statut pour moi.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

111. Je pense que le fait de conduire est plaisant.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

112. Le réseau routier au Luxembourg est bien.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

113. Je pense que l'achat d'une voiture coûte cher.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

114. Je pense que l'achat du carburant coûte cher.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

115. Je pense que les frais courants d'une voiture (réparations, impôts, assurance, ...) sont élevés.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ⬭

2 ⬭

3 ⬭

4 ⬭

5 ⬭

Tout à fait d'accord

116. Il y a un risque d'accident élevé lors de la conduite.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ⬭

2 ⬭

3 ⬭

4 ⬭

5 ⬭

Tout à fait d'accord

117. Je pense que le fait de conduire est stressant.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ⬭

2 ⬭

3 ⬭

4 ⬭

5 ⬭

Tout à fait d'accord

118. La circulation automobile **n'est pas** un contributeur majeur au réchauffement climatique.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ⬭

2 ⬭

3 ⬭

4 ⬭

5 ⬭

Tout à fait d'accord

119. J'ai la tendance de compenser du temps perdu en trafic par un style de conduite plus vite.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ⬭

2 ⬭

3 ⬭

4 ⬭

5 ⬭

Tout à fait d'accord

120. Je pense que les tarifs des parkings sont élevés.

Markieren Sie nur ein Oval.

	Pas du tout d'accord
1	
2	
3	
4	
5	
	Tout à fait d'accord

121. Je pense qu'il est difficile de trouver des espaces de stationnement dans des zones **urbaines**. (Des zones urbaines sont des villes plus grandes comme par ex.: Esch-sur-Alzette, Diekirch, ou Luxembourg Ville)

Markieren Sie nur ein Oval.

	Pas du tout d'accord
1	
2	
3	
4	
5	
	Tout à fait d'accord

122. Je pense qu'il est difficile de trouver des espaces de stationnement dans des zones **rurales**. (Des zones rurales sont par exemple le Nord, Est, ou Ouest du Luxembourg et des villages plus petits)

Markieren Sie nur ein Oval.

	Pas du tout d'accord
1	
2	
3	
4	
5	
	Tout à fait d'accord

123. Je pense qu'une voiture est essentielle pour mon mode de vie.

Markieren Sie nur ein Oval.

	Pas du tout d'accord
1	
2	
3	
4	
5	
	Tout à fait d'accord

Questions par rapport au transport public

La section suivante va vous présenter des affirmations par rapport au transport public. De manière similaire à la dernière section, vous devez indiquer dans quelle mesure vous êtes d'accord avec ces affirmations sur une échelle de 1 (Pas du tout d'accord) jusqu'à 5 (Tout à fait d'accord).

124. Le transport public est moins cher que l'utilisation d'une voiture.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

125. Le transport public est plus écologique que l'utilisation d'une voiture.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

126. Le transport public offre l'accès à des opportunités scolaires et professionnelles.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

127. Le transport public est fiable.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

128. Les bus au Luxembourg sont ponctuels.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

129. Les trains au Luxembourg sont ponctuels.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

130. Les trams au Luxembourg sont ponctuels.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

131. Le réseau de chemin de fer est susceptible aux travaux de rénovations.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

132. Le transport en commun gratuit est une bonne politique.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

133. Le réseau de chemin de fer au Luxembourg est bien.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

134. Je me sens sûr en transport public.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

135. J'utilise le transport en commun plus souvent **depuis** qu'il est devenu gratuit.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

136. J'utilise le transport en commun plus souvent **parce qu'**il est devenu gratuit.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

137. Je me sens sûr sur les arrêts du transport public.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

138. Les arrêts du transport public sont dans des endroits facilement accessibles.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Tout à fait d'accord

139. Le transport public prend plus de temps que la conduite en voiture.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Tout à fait d'accord

140. Le transport public n'est pas assez accessible dans les zones rurales.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Tout à fait d'accord

141. Je pense que le transport public est pratique.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Tout à fait d'accord

142. Je pense que le transport public est comfortable.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Tout à fait d'accord

143. Changer de transport public pour arriver à ma destination me dérange.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Tout à fait d'accord

144. Les bus au Luxembourg sont surpeuplés.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Tout à fait d'accord

145. Les trains au Luxembourg sont surpeuplés.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Tout à fait d'accord

146. Les trams au Luxembourg sont surpeuplés.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Tout à fait d'accord

147. Je pense que le transport public est stressant.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1
2
3
4
5

Tout à fait d'accord

148. Le transport public devrait opérer plus pendant la nuit (entre minuit et 6:00h).

Markieren Sie nur ein Oval.

Pas du tout d'accord

1
2
3
4
5

Tout à fait d'accord

150. J'utiliserais le transport public plus si l'utilisation de voitures devient plus cher.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1
2
3
4
5

Tout à fait d'accord

Questions par rapport au futur

Cette section finale va vous présenter encore une fois des affirmations par rapport au futur et votre mobilité. Votre opinion sur le sujet des changements envisionés pour le transport public est demandée. Vous devez (encore une fois) indiquer dans quelle mesure vous êtes d'accord avec ces affirmations sur une échelle de 1 (Pas du tout d'accord) jusqu'à 5 (Tout à fait d'accord).

149. J'utiliserais le transport public plus s'il serait plus accessible.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1
2
3
4
5

Tout à fait d'accord

151. J'utiliserais le transport public plus si l'utilisation de voitures devient plus lent que le transport en commun.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1
2
3
4
5

Tout à fait d'accord

152. J'utiliserais le transport public plus si la fréquence de trains, bus et trams serait élevée.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Tout à fait d'accord

153. J'utiliserais le transport public plus si les arrêts du transport public seraient plus sûrs. (Par exemple, équipées avec des caméras ou du personnel de sécurité)

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Tout à fait d'accord

154. J'utiliserais le transport public plus s'il serait plus fiable.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Tout à fait d'accord

155. J'utiliserais le transport public plus s'il serait plus ponctuel.

Markieren Sie nur ein Oval.

Pas du tout d'accord

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Tout à fait d'accord

156. Sur une échelle de 1 à 10, quelle est la probabilité que vous utilisez une voiture pour votre prochain trajet dans une zone **urbaine**? (Des zones urbaines sont des villes plus grandes comme par ex.: Esch-sur-Alzette, Diekirch, ou Luxembourg Ville)

Markieren Sie nur ein Oval.

Pas du tout probable

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭
6 ⬭
7 ⬭
8 ⬭
9 ⬭
10 ⬭

Certain

157. Sur une échelle de 1 à 10, quelle est la probabilité que vous utilisez une voiture pour votre prochain trajet dans une zone **rurale**? (Des zones rurales sont par exemple le Nord, Est, ou Ouest du Luxembourg et des villages plus petits)

Markieren Sie nur ein Oval.

Pas du tout probable

1 ◯

2 ◯

3 ◯

4 ◯

5 ◯

6 ◯

7 ◯

8 ◯

9 ◯

10 ◯

Certain

7.3. Appendix C - Questionnaire in German

Gründe für den Besitz und die Benutzung von Autos nach der Einführung des kostenfreiem öffentlichen Transports in Luxemburg

Sehr geehrte Umfrageteilnehmer*innen,

In dieser Umfrage, die eine essenzielle Rolle für den Abschluss meines Master Studiums an der MODUL University Vienna spielt, versuche ich die Gründe für den Besitz und die Benutzung von Autos in Luxemburg, nach der Einführung des kostenfreien öffentlichen Transports im März 2020, zu ermitteln. Der Zweck dieser Studie ist es die Gefühle und Gedankengänge der Autofahrer in Luxemburg bezüglich dem Fahren und dem öffentlichen Transport einzufangen und herauszufinden welche Faktoren ausschlaggebend für den Entscheidungshergang sind.

Bitte beachten Sie, dass diese Umfrage an Personen gerichtet ist, die seit der Einführung des kostenfreien öffentlichen Transport im März 2020 in Luxemburg Auto gefahren sind. Bitte beachten Sie ebenfalls, dass Ihre Teilnahme an dieser Umfrage anonym ist, Ihre Antworten nur für die Zwecke dieser Masterarbeit verwendet werden, und es nicht möglich ist Ihre Antworten zu Ihnen zurückzuverfolgen. Ein letzter Punkt: Ihnen ist es natürlich gestattet Fragen die Sie nicht beantworten möchten zu überspringen und optionale Fragen werden als solche auch gekennzeichnet sein.

Diese Umfrage wird ungefähr 5 bis 7 Minuten Ihrer Zeit beanspruchen.

Vielen Dank für Ihre Teilnahme!

Fragen bezüglich Demographien

Zuerst werden Ihnen einige Fragen zu Ihrer Person gestellt. Es werden Fragen bezüglich Ihrer Geschlechtsidentität, Ihres Alters, Ihres monatlichen Einkommen, Ihres Bildungsstandes, und Ihres Wohnortes und weitere Fragen gestellt. Ihre Antworten hier werden die spätere Analyse der Antworten bezüglich des öffentlichen Transports und der Benutzung von PKWs vereinfachen und helfen die momentane Situation in Luxemburg zu erklären. Wenn Sie einige Daten jedoch nicht preisgeben möchten, ist das nicht weiter schlimm.

158. Geschlechtsidentität: Wie identifizieren Sie sich?

Markieren Sie nur ein Oval.

- ◯ Frau
- ◯ Nicht-Binär
- ◯ Mann
- ◯ Ich will keine Angabe dazu machen
- ◯ Sonstiges: _____

159. Alter: Wie alt sind Sie?

Markieren Sie nur ein Oval.

- ◯ 18 - 20
- ◯ 21 - 25
- ◯ 26 - 30
- ◯ 31 - 35
- ◯ 36 - 40
- ◯ 41 - 45
- ◯ 46 - 50
- ◯ 51 - 55
- ◯ 56 - 60
- ◯ 61 - 65
- ◯ 66 - 70
- ◯ 71+

160. Bildungsstand: Bitte geben Sie Ihren höchsten Bildungsabschluss an.

Markieren Sie nur ein Oval.

- ◯ Kein Abschluss
- ◯ Abgeschlossene Lehre
- ◯ Hochschulabschluss (Matura, Abitur, Première, Treizième)
- ◯ Bachelor Abschluss
- ◯ Master Abschluss
- ◯ Doktorat
- ◯ Anderer (Bitte hier unten beschreiben)
- ◯ Sonstiges: _____

161. Arbeit: Was ist Ihr momentaner beruflicher Status?

Markieren Sie nur ein Oval.

- ◯ Momentan arbeitssuchend
- ◯ Studierend
- ◯ Momentan angestellt
- ◯ In Rente
- ◯ Anderer (Bitte hier unten beschreiben)
- ◯ Sonstiges: _____

162. Finanzielle Situation: Wie hoch ist Ihr momentanes monatliches Einkommen?

Markieren Sie nur ein Oval.

- ◯ 0 - 1000€
- ◯ 1001€ - 2500€
- ◯ 2501€ - 4000€
- ◯ 4001€ - 5500€
- ◯ 5501€ - 7000€
- ◯ 7001€ - 8500€
- ◯ 8501€ - 10000€
- ◯ 10001€+

163. **Wohnort**: Wo **wohnen** Sie? (Bitte schreiben Sie den Namen der Ortschaft hier drunter, z.B.: Koerich, Esch-sur-Alzette, Metz, Trier, ...)

_____

164. **Arbeitsplatz/Studienort**: Wo **arbeiten/studieren** Sie? (Bitte schreiben Sie den Namen der Ortschaft hier drunter, z.B.: Koerich, Esch-sur-Alzette, Metz, Trier, ...)

_____

165. Kostenfreier öffentlicher Transport: Ich weiß, dass der öffentliche Transport in Luxemburg kostenfrei ist.

Markieren Sie nur ein Oval.

- ◯ Ja
- ◯ Nein

166. Wahl des Verkehrsmittels: Welche der folgenden Verkehrsmittel benutzen Sie am Häufigsten um **zur Arbeit o.Ä. zu gelangen**?

Markieren Sie nur ein Oval.

- Auto
- Fahrrad
- Ich gehe zu Fuß
- Zug
- Bus
- Tram

167. Wahl des Verkehrsmittels: Welche der folgenden Verkehrsmittel benutzen Sie am Häufigsten **um Einkaufen zu gehen**? Dies beinhaltet auch Fahrten um Lebensmittel, Kleider, o.Ä. einzukaufen.

Markieren Sie nur ein Oval.

- Auto
- Fahrrad
- Ich gehe zu Fuß
- Zug
- Bus
- Tram

168. Wahl des Verkehrsmittels: Welche der folgenden Verkehrsmittel benutzen Sie am Häufigsten **in Ihrer Freizeit**? Dies beinhaltet Fahrten z.B um Sport zu betreiben, Hobbies nachzugehen, Freunde zu besuchen, oder um Essen zu gehen z.B..

Markieren Sie nur ein Oval.

- Auto
- Fahrrad
- Ich gehe zu Fuß
- Zug
- Bus
- Tram

169. Zurückgelegte Distanz: Im Durchschnitt, wie viele Kilometer reisen Sie täglich?

Markieren Sie nur ein Oval.

- 0
- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51+

170. Wie viele Tage in der Woche fahren Sie mit dem Auto in Luxemburg?

Markieren Sie nur ein Oval.

- Nie
- 1 - 2 Mal pro Woche
- 3 - 4 Mal pro Woche
- 5 - 6 Mal pro Woche
- Jeden Tag

171. Wie viele Tage in der Woche fahren Sie mit dem öffentlichen Transport in Luxemburg?

Markieren Sie nur ein Oval.

- Nie
- 1 - 2 Mal pro Woche
- 3 - 4 Mal pro Woche
- 5 - 6 Mal pro Woche
- Jeden Tag

172. Nachhaltigkeit ist ein wichtiges Thema.

Markieren Sie nur ein Oval.

	Stimme überhaupt nicht zu				Stimme vollkommen zu
	1	2	3	4	5

173. Die Umwelt ist mir wichtig.

Markieren Sie nur ein Oval.

	Stimme überhaupt nicht zu				Stimme vollkommen zu
	1	2	3	4	5

174. Ich würde mich als sparsame Person beschreiben.

Markieren Sie nur ein Oval.

	Stimme überhaupt nicht zu				Stimme vollkommen zu
	1	2	3	4	5

Fragen zur Benutzung von Autos

Nun kommen wir zu den Fragen bezüglich der Benutzung von Autos. Diese sind wie folgt aufgebaut: Ihnen werden einige Aussagen zur Benutzung von Autos vorgestellt und Sie müssen angeben, inwiefern Sie diesen zustimmen. Dazu haben Sie die Möglichkeit auf einer Skala zwischen 1 (Stimme überhaupt nicht zu) und 5 (Stimme vollkommen zu) anzugeben wie sehr diese Aussage mit Ihrer Meinung übereinstimmt.

175. Ich fühle mich sicherer auf der Straße wenn ich fahre, als wenn ich mit öffentlichen Verkehrsmitteln fahre.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

176. Autos bieten mehr Freiheit als öffentlicher Transport.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

177. Ich schätze die Privatsphäre die ein Auto mir bietet.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

178. Ich schätze den Schutz den mir ein Auto vor schlechtem Wetter bietet.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

179. Ich denke, dass, im Vergleich zu öffentlichen Verkehrsmitteln, ein Auto meine Reisezeit verkürzt.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

180. Ich denke, dass ich schwere/sperrige Objekte besser in meinem Auto transportieren kann.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

181. Ich denke, dass Reisen mit Kindern mit dem Auto einfacherer ist, als mit öffentlichen Verkehrsmitteln.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

182. Ich finde, dass ein Auto praktisch ist.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

183. Ich finde, dass ein Auto gemütlich ist.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

184. Es gibt viele Verkehrstaus in Luxemburg.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

185. Verkehrstaus ärgern mich.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

186. Auf Luxemburgs Straßen gibt es viele Baustellen.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

187. Baustellen auf Straßen ärgern mich.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

188. Ich sehe Autos also Statussymbol.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

189. Ich finde, dass Auto fahren an sich Spaß macht.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

190. Das Straßennetz in Luxemburg ist gut.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

191. Ich denke, dass ein Auto zu kaufen teuer ist.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

192. Ich denke, dass Kraftstoff (Benzin/Diesel/E10) teuer ist.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

193. Ich denke, dass die laufenden Kosten eines Autos (Reparaturen, Steuern, Versicherung, ...) hoch sind.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1
2
3
4
5

Stimme vollkommen zu

194. Das Unfallrisiko beim Autofahren ist hoch.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1
2
3
4
5

Stimme vollkommen zu

195. Ich denke, dass Auto fahren stressig ist.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1
2
3
4
5

Stimme vollkommen zu

196. Autos sind **kein** großer Mitwirkender des Klimawandels.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1
2
3
4
5

Stimme vollkommen zu

197. Ich tendiere dazu verlorene Zeit in Staus mit einem schnelleren Fahrstil zu kompensieren.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1
2
3
4
5

Stimme vollkommen zu

198. Ich finde, dass Parktarife hoch sind.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1
2
3
4
5

Stimme vollkommen zu

199. Ich finde es schwierig in **städtischen** Gegenden einen Parkplatz zu finden. (Städtische Gegenden sind größere Städte wie Esch-sur-Alzette, Diekirch, oder Luxemburg Stadt)

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1
2
3
4
5

Stimme vollkommen zu

200. Ich finde es schwierig in **ländlichen** Gegenden einen Parkplatz zu finden. (Ländliche Gegenden sind z.b. der Norden, Osten, oder Westen von Luxemburg und kleinere Dörfer)

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1
2
3
4
5

Stimme vollkommen zu

201. Ich finde, dass ein Auto essenziell für meinen Lebensstil ist.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1
2
3
4
5

Stimme vollkommen zu

Fragen zum öffentlichen Transport

Dieser Abschnitt wird Ihnen wieder Aussagen bezüglich des öffentlichen Transports in Luxemburg präsentieren die Sie wie im letzten Abschnitt anhand der Übereinstimmung mit Ihrer persönlichen Meinung zwischen 1 (Stimme überhaupt nicht zu) und 5 (Stimme vollkommen zu) bewerten sollen.

202. Öffentlicher Transport ist billiger als Auto fahren.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

203. Öffentlicher Transport ist umweltfreundlicher als Auto fahren.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

206. Ich kann darauf vertrauen, dass Busse in Luxemburg pünktlich sind.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

207. Ich kann darauf vertrauen, dass Züge in Luxemburg pünktlich sind.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

204. Öffentlicher Transport bietet Zugang zu Bildung und Arbeitsplätzen.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

205. Öffentlicher Transport ist zuverlässig.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

208. Ich kann darauf vertrauen, dass Trams in Luxemburg pünktlich sind.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

209. Der Schienenverkehr ist besonders anfällig für Reparaturarbeiten.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

210. Kostenfreier öffentlicher Transport ist eine gute Politik.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1
2
3
4
5

Stimme vollkommen zu

211. Das Schienennetzwerk in Luxemburg ist gut.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1
2
3
4
5

Stimme vollkommen zu

212. Ich benütze öffentliche Verkehrsmittel öfter, **seit** sie kostenfrei wurden.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1
2
3
4
5

Stimme vollkommen zu

213. Ich benütze öffentliche Verkehrsmittel öfter, **weil** sie kostenfrei wurden.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1
2
3
4
5

Stimme vollkommen zu

214. Ich fühle mich in öffentlichen Verkehrsmitteln sicher.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1
2
3
4
5

Stimme vollkommen zu

215. Ich fühle mich an Haltestellen des öffentlichen Transports sicher.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1
2
3
4
5

Stimme vollkommen zu

216. Haltestellen sind an einfach erreichbaren Orten.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1
2
3
4
5

Stimme vollkommen zu

217. Öffentliche Verkehrsmittel brauchen mehr Zeit als Auto fahren.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1
2
3
4
5

Stimme vollkommen zu

218. Öffentliche Verkehrsmittel sind in ländlichen Gegenden nicht erreichbar genug.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Stimme vollkommen zu

219. Ich finde, dass öffentliche Verkehrsmittel praktisch sind.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Stimme vollkommen zu

220. Ich finde, dass öffentliche Verkehrsmittel gemütlich sind.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Stimme vollkommen zu

221. Mehrfaches Umsteigen in öffentlichen Verkehrsmitteln um mein Ziel zu erreichen ärgert mich.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Stimme vollkommen zu

222. Busse sind in Luxemburg überfüllt.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Stimme vollkommen zu

223. Züge sind in Luxemburg überfüllt.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Stimme vollkommen zu

224. Trams sind in Luxemburg überfüllt.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1
2
3
4
5

Stimme vollkommen zu

225. Ich denke, dass öffentliche Verkehrsmittel benutzen stressig ist.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1
2
3
4
5

Stimme vollkommen zu

226. Öffentliche Verkehrsmittel sollten vermehrt nachts (zwischen 24 Uhr und 6 Uhr) fahren.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1
2
3
4
5

Stimme vollkommen zu

Fragen zur Zukunft der Mobilität in Luxemburg

Dieser letzte Abschnitt wird Ihnen Aussagen präsentieren bezüglich Ihres Reiseverhaltens und Ihre Meinung zu geplanten Änderungen des öffentlichen Verkehrsmittelnetzwerks ist gefragt. Wie in den Abschnitten zuvor, geben Sie bitte an inwiefern sie mit den folgenden Aussagen auf einer Skala von 1 (Stimme überhaupt nicht zu) und 5 (Stimme vollkommen zu) einverstanden sind.

227. Ich würde öfter öffentliche Verkehrsmittel benutzen, wenn sie besser erreichbar wären.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1
2
3
4
5

Stimme vollkommen zu

228. Ich würde öfter öffentliche Verkehrsmittel benutzen, wenn Auto fahren teurer wird.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1
2
3
4
5

Stimme vollkommen zu

229. Ich würde öfter öffentliche Verkehrsmittel benutzen, wenn Auto fahren vergleichsweise langsamer wird.

Markieren Sie nur ein Oval.

	Stimme überhaupt nicht zu
1	
2	
3	
4	
5	
	Stimme vollkommen zu

230. Ich würde öfter öffentliche Verkehrsmittel benutzen, wenn Busse, Züge, und Trams öfter fahren würden.

Markieren Sie nur ein Oval.

	Stimme überhaupt nicht zu
1	
2	
3	
4	
5	
	Stimme vollkommen zu

231. Ich würde öfter öffentliche Verkehrsmittel benutzen, wenn Haltestellen sicherer wären. (Zum Beispiel durch Überwachungskameras oder Sicherheitspersonal)

Markieren Sie nur ein Oval.

	Stimme überhaupt nicht zu
1	
2	
3	
4	
5	
	Stimme vollkommen zu

232. Ich würde öfter öffentliche Verkehrsmittel benutzen, wenn sie zuverlässiger wären.

Markieren Sie nur ein Oval.

	Stimme überhaupt nicht zu
1	
2	
3	
4	
5	
	Stimme vollkommen zu

233. Ich würde öfter öffentliche Verkehrsmittel benutzen, wenn sie pünktlicher wären.

Markieren Sie nur ein Oval.

Stimme überhaupt nicht zu

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stimme vollkommen zu

234. Auf einer Skala von 1 bis 10, wie wahrscheinlich ist es, dass Sie für Ihre nächste Fahrt in Luxemburg in eine **städtische** Gegend das Auto nehmen? (Städtische Gegenden sind größere Städte wie Esch-sur-Alzette, Diekirch, oder Luxemburg Stadt)

Markieren Sie nur ein Oval.

Ganz unwahrscheinlich

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯
6 ◯
7 ◯
8 ◯
9 ◯
10 ◯

Sicher

235. Auf einer Skala von 1 bis 10, wie wahrscheinlich ist es, dass Sie für Ihre nächste Fahrt in Luxemburg in eine **ländliche** Gegend das Auto nehmen? (Ländliche Gegenden sind z.b. der Norden, Osten, oder Westen von Luxemburg und kleinere Dörfer)

Markieren Sie nur ein Oval.

Ganz unwahrscheinlich

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯
6 ◯
7 ◯
8 ◯
9 ◯
10 ◯

Sicher

7.4. Appendix D - Questionnaire in Luxembourgish

Grënn vir den Besëtz an d'Benotzung vun Autoen no der Aféierung vum gratis ëffentlechem Transport zu Lëtzebuerg

Leif Participanten vun dëser Ëmfro,

Mat dëser Ëmfro, déi eng essentiel Roll fir den Ofschloss vun mengem Master un der MODUL University Vienna spillt, probéieren ech d'Grënn vir den Besetz an d'Benotzung vun Autoen an Lëtzebuerg, no der Aféierung vum gratis ëffentlechen Transport am Mäerz 2020 erauszefannen. Den Zweck vun dëser Étude ass et d'Gefiller an Gedankegäng vun den Autoschauffer hei am Land par Rapport zum Autofueren mee och zum ëffentlechen Transport anzefänken an erauszefannen wéi eng Faktoren ausschlaggebend vir den Choix vum Transportmëttel sinn.

W.e.g. denkt drun, dass des Ëmfro un Persounen geriicht ass dei säit der Aféierung vum gratis ëffentlechen Transport am Mäerz 2020 mam Auto zu Lëtzebuerg gefuer sinn. Är Participatioun un dëser Ëmfro ass komplett anonym an Är Äntwerten ginn nëmmen vir den Zweck vun dëser Masteraarbecht verwennt an et ass och net méiglech Är Äntwerten zu lech zeréck ze verfollegen. Een leschten Punkt: Dir dierft natierlech Froen déi dir net beäntweren wëllt iwwersprangen an optional Froen wäerten och sou gekennzeechent sinn.

Des Ëmfro wäert ongeféier 5 bis 7 Minutten vun Ärer Zäit beusprochen.

Merci vir Är Participatioun!

Froen zur Demographie

Ufanks wäerten Iech Froen zu Ärer Persoun gestallt ginn. Et wäerten Froen zu Ärer Geschlechtidentitéit, Ärem Alter, Ärem Akommes, Ärem Bildungsstand, Ärem Wunnuert, an weider Froen gestallt. Är Äntwerten hei wäerten d'Analyse vun Ären aneren Äntwerten zum ëffentlechen Transport an zum Autofueren vereinfachen an wäerten hëllefen déi momentan Situatioun zu Lëtzebuerg ze erklären. Wann Dir awer verschidden Donnéeë iwwert Iech net wëllt präisginn, ass dat weider keen Problem.

236. Geschlechtsidentitéit: Wéi identifizéiert dir Iech?

Markieren Sie nur ein Oval.

- ◯ Fra
- ◯ Net Binär
- ◯ Mann
- ◯ Ech wëll dozou keng Ausso maan
- ◯ Sonstiges: _____

237. Alter: Wei al sidd Dir?

Markieren Sie nur ein Oval.

- ◯ 18 - 20
- ◯ 21 - 25
- ◯ 26 - 30
- ◯ 31 - 35
- ◯ 36 - 40
- ◯ 41 - 45
- ◯ 46 - 50
- ◯ 51 - 55
- ◯ 56 - 60
- ◯ 61 - 65
- ◯ 66 - 70
- ◯ 71+

238. Bildungsstand: Gidd w.e.g. Ären héchsten Bildungsofschloss un.

Markieren Sie nur ein Oval.

- ◯ Keen Ofschloss
- ◯ Ofgeschlossen Léier
- ◯ Lycées Ofschloss (Première, Treizième)
- ◯ Bachelor Ofschloss
- ◯ Master Ofschloss
- ◯ Doktorat
- ◯ Anescht (W.e.g. hei drënner beschreiwen)
- ◯ Sonstiges: _____

239. Aarbecht: Wat ass Ären momentanen berufflechen Status?

Markieren Sie nur ein Oval.

- ◯ Momentan aarbechtsichend
- ◯ Studeierent
- ◯ Momentan schaffend
- ◯ An der Pensioun
- ◯ Anescht (W.e.g. hei drënner beschreiwen)
- ◯ Sonstiges: _____

240. Finanziell Situatioun: Wei héich ass Äert momentaant Akommes pro Mount?

Markieren Sie nur ein Oval.

- ◯ 0 - 1000€
- ◯ 1001€ - 2500€
- ◯ 2501€ - 4000€
- ◯ 4001€ - 5500€
- ◯ 5501€ - 7000€
- ◯ 7001€ - 8500€
- ◯ 8501€ - 10000€
- ◯ 10001€+

241. **Wunnuert**: Wou **wunnt** Dir? (W.e.g. schreiwt den Numm vun der Uertschaft hei drënner, z.B.: Koerich, Esch-sur-Alzette, Metz, Tréier, ...)

_____

242. **Aarbechtsplaatz/Studienplaatz**: Wou **schafft/studéiert** Dir? (W.e.g. schreiwt den Numm vun der Uertschaft hei drënner, z.B.: Koerich, Esch-sur-Alzette, Metz, Tréier, ...)

_____

243. Gratis ëffentlechen Transport: Ech weess, dass den den ëffentlechen Transport an Lëtzebuerg gratis ass.

Markieren Sie nur ein Oval.

- ◯ Jo
- ◯ Nee

244. Choix vum Verkéiersmëttel: Wéi een vun den folgenden Verkéiersmëttel huelt dir am Meeschten **vir op d'Aarbecht oder an d'Schoul ze fueren**?

Markieren Sie nur ein Oval.

- Auto
- Vëlo
- Ech ginn ze Fouss
- Zuch
- Bus
- Tram

245. Choix vum Verkéiersmëttel: Wéi een vun den folgenden Verkéiersmëttel huelt dir am Meeschten **vir akaafen ze goen**? Domat sinn och Trajeten vir Liewensmëttel, Kleeder, asw. gemengt

Markieren Sie nur ein Oval.

- Auto
- Vëlo
- Ech ginn ze Fouss
- Zuch
- Bus
- Tram

246. Choix vum Verkéiersmëttel: Wéi een vun den folgenden Verkéiersmëttel huelt dir am Meeschten **an Ärer Fräizäit**? Domat sinn Trajeten vir z.B.: Sport ze maachen, Hobbies nozegoen, Frënn ze gesinn, oder Iessen ze goen gemengt.

Markieren Sie nur ein Oval.

- Auto
- Vëlo
- Ech ginn ze Fouss
- Zuch
- Bus
- Tram

247. Zeréckgeluechten Distanz: An der Moyenne, wéi vill Kilometer reest Dir deeglech?

Markieren Sie nur ein Oval.

- 0
- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51+

248. Wéi vill Deeg an der Woch fuert Dir mam Auto zu Lëtzebuerg?

Markieren Sie nur ein Oval.

- Nie
- 1 - 2 Mol pro Woch
- 3 - 4 Mol pro Woch
- 5 - 6 Mol pro Woch
- All Daag

249. Wéi vill Deeg an der Woch fuert Dir mam ëffentlechen Transport zu Lëtzebuerg?

Markieren Sie nur ein Oval.

- Nie
- 1 - 2 Mol pro Woch
- 3 - 4 Mol pro Woch
- 5 - 6 Mol pro Woch
- All Daag

250. Nohaltegkeet ass en wichtegt Thema.

Markieren Sie nur ein Oval.

	Stemmen guer net zou				Stemmen ganz zou
1	2	3	4	5	

251. D'Ëmwelt ass mir wichteg.

Markieren Sie nur ein Oval.

	Stemmen guer net zou				Stemmen ganz zou
1	2	3	4	5	

252. Ech géif mech als spuersam Persoun beschreiwen.

Markieren Sie nur ein Oval.

	Stemmen guer net zou				Stemmen ganz zou
1	2	3	4	5	

Froen zur Benotzung vun Autoen

Elo kommen mir zu Froen zum Thema Autofueren. Des sinn wei follegt opgebaut: Dir kritt e puer Aussoen zum Thema Auto benotzen presentéiert an Dir musst uginn aweifern dir mat dësen Aussoen d'Accord sidd. Dozou hutt dir d'Méiglechkeet op enger Skala vun 1 (Stemmen guer net zou) bis 5 (Stemmen ganz zou) unzeginn wei staark des Ausso mat Ärer Meenung iwwerteneestëmmt.

253. Ech fillen mech méi sécher op der Strooss wann ech fueren, wei wann ech mam ëffentlechen Transport fueren.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stemmen ganz zou

254. Autoen bidden méi Fräiheet wéi den ëffentlechen Transport.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stemmen ganz zou

255. Ech schätzen d'Privatsphär déi en Auto mir bitt.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stemmen ganz zou

256. Ech schätzen den Schutz deen en Auto mir virun schlechtem Wieder bitt.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stemmen ganz zou

257. Ech denken, dass, am Verglach zum ëffentlechen Transport, en Auto meng Reeszäit verkierzt.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Stemmen ganz zou

258. Ech denken, dass ech schwéier/sperreg Objeten besser an engem Auto transportéieren kann.

Markieren Sie nur ein Oval.

	Stemmen guer net zou
1	
2	
3	
4	
5	
	Stemmen ganz zou

259. Ech denken, dass reesen mat Kanner mam Auto méi einfach ass wéi mam ëffentlechen Transport.

Markieren Sie nur ein Oval.

	Stemmen guer net zou
1	
2	
3	
4	
5	
	Stemmen ganz zou

260. Ech fannen, dass en Auto praktesch ass.

Markieren Sie nur ein Oval.

	Stemmen guer net zou
1	
2	
3	
4	
5	
	Stemmen ganz zou

261. Ech fannen, dass en Auto gemittlech ass.

Markieren Sie nur ein Oval.

	Stemmen guer net zou
1	
2	
3	
4	
5	
	Stemmen ganz zou

262. Et ginn vill Stauen zu Lëtzebuerg.

Markieren Sie nur ein Oval.

	Stemmen guer net zou
1	
2	
3	
4	
5	
	Stemmen voll zou

263. Stauen iergeren mech.

Markieren Sie nur ein Oval.

	Stemmen guer net zou
1	
2	
3	
4	
5	
	Stemmen ganz zou

264. Op den Lëtzebuerger Stroossen ginn et vill Baustellen.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

265. Baustellen op den Stroossen iergeren mech.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

266. Ech gesinn Autoen als Statussymbol.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

267. Ech fannen, dass Auto fueren un sech Spaass mëscht.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

268. D'Stroossennetz zu Lëtzebuerg ass gudd.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

269. Ech denken, dass en Auto kafen deier ass.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

270. Ech denken, dass Benzin/Diesel/E10 deier ass.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

271. Ech denken, dass d'lafend Käschten vun engem Auto (Reparaturen, Steieren, Assurance, ...) héich sinn.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

272. Den Risiko z'accidentéieren ass beim Autofueren héich.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

273. Ech fannen, dass Autofueren stresseg ass.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

274. Autoen sinn **keen** groussen Dreiwer vum Klimawandel.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

275. Ech tendéieren dozou verlueren Zäit an Stauen mat engem méi séieren Fuerstil ze kompenséieren.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

276. Ech fannen, dass Parktariffer ze héich sinn.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

277. Ech fannen et schwiereg an **urbanen** Géigenden eng Parkplaatz ze fannen. (Urban Géigenden sinn méi grouss Stied wéi Esch-sur-Alzette, Dikrech, oder d'Stad)

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

278. Ech fannen et schwiereg an **ländlechen** Géigenden eng Parkplaatz ze fannen. (Ländlech Géigenden sinn z.B.: den Norden, den Osten oder den Westen vum Land an méi kleng Dierfer)

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

279. Ech fannen, dass en Auto essentiel vir mäin Liewensstil ass.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

Froen zum ëffentlechen Transport

Dës Sektioun wäert Iech Aussoen zum ëffentlechen Transport presentéieren an wei am leschten Abschnitt ass et un Iech unzeginn aweifern des Aussoen mat Ärer Meenung iwwerteneestëmmen. Dofir hutt dir rëm déi selwecht Skala vun 1 (Stemmen guer net zou) bis 5 (Stemmen ganz zou).

280. Ëffentlechen Transport ass méi bëlleg wéi Autofueren.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

281. Ëffentlechen Transport ass méi ëmweltfrëndlech wéi Autofueren.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

282. Ëffentlechen Transport bitt Zougang zu Educatioun an Aarbechtsplaatzen.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

283. Ëffentlechen Transport ass zouverlässeg.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

284. Ech kann dorop vertrauen, dass Busser zu Lëtzebuerg pünktlech sinn.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

285. Ech kann dorop vertrauen, dass Zich zu Lëtzebuerg pünktlech sinn.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

286. Ech kann dorop vertrauen, dass den Tram zu Lëtzebuerg pünktlech ass.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

287. Den Schinneverkéier ass besonnesch ufälleg vir Reparaturaarbechten.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

288. Gratis ëffentlechen Transport ass eng gudd Politik.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

289. D'Schinnenetz zu Lëtzebuerg ass gudd.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

290. Ech benotzen den ëffentlechen Transport méi oft **seit** en gratis ginn ass.

Markieren Sie nur ein Oval.

1
2
3
4
5

291. Ech benotzen den ëffentlechen Transport méi oft **well** en gratis ginn ass.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

292. Ech fillen mech am ëffentlechen Transport sécher.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

293. Ech fillen mech un Haltestellen vum ëffentlechen Transport sécher.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

294. Haltestellen sinn un einfach ereechbaren Plaatzen.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

295. Ëffentlechen Transport brauch méi Zäit wéi Autofueren.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

296. Ëffentlechen Transport ass an ländlechen Géigenden net erreechbar genuch.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Stemmen ganz zou

297. Ech fannen, dass den ëffentlechen Transport praktesch ass.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Stemmen ganz zou

298. Ech fannen, dass den ëffentlechen Transport gemittlech ass.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Stemmen ganz zou

299. Am ëffentlechen Transport öfters emzeklammen vir meng Destinatioun z'erreechen iergert mech.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Stemmen ganz zou

300. Busser an Lëtzebuerg sinn iwwerfëllt.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Stemmen ganz zou

301. Zich an Lëtzebuerg sinn iwwerfëllt.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

Stemmen ganz zou

302. Den Tram zu Lëtzebuerg ass iwwerfëllt.

Markieren Sie nur ein Oval.

	Stemmen guer net zou
1	
2	
3	
4	
5	Stemmen ganz zou

303. Ech fannen den ëffentlechen Transport ze huelen stresseg.

Markieren Sie nur ein Oval.

	Stemmen guer net zou
1	
2	
3	
4	
5	Stemmen ganz zou

304. Ëffentlech Verkéiersmëttel sollten méi nuets (zweschen Mëtternuecht an 6:00) fueren.

Markieren Sie nur ein Oval.

	Stemmen guer net zou
1	
2	
3	
4	
5	Stemmen ganz zou

Froen zur Zukunft vun der Mobilitéit zu Lëtzebuerg

Dës lescht Sektioun wäert lech Aussoen zu Ärem Reesverhaalen an Ärer Meenung zu gewëssen Ännerungen vum ëffentlechen Transport presentéieren, déi Dir, wei och virdrun, rëm op enger Skala vun 1 (Stemmen guer net zou) bis 5 (Stemmen ganz zou) bewäerten sollt.

305. Ech géif méi oft mam ëffentlechen Transport fueren wann en méi accessibel wier.

Markieren Sie nur ein Oval.

	Stemmen guer net zou
1	
2	
3	
4	
5	Stemmen ganz zou

306. Ech géif méi oft mam ëffentlechen Transport fueren wann Autofueren méi deier gett.

Markieren Sie nur ein Oval.

	Stemmen guer net zou
1	
2	
3	
4	
5	Stemmen ganz zou

307. Ech géif méi oft mam ëffentlechen Transport fueren wann Autofueren vergläichsweis méi lues géif ginn.

Markieren Sie nur ein Oval.

	Stemmen guer net zou				Stemmen ganz zou
	1	2	3	4	5

308. Ech géif méi oft mam ëffentlechen Transport fueren wann Bussen, Zich, an den Tram méi oft géifen fueren.

Markieren Sie nur ein Oval.

	Stemmen guer net zou				Stemmen ganz zou
	1	2	3	4	5

309. Ech géif méi oft mam ëffentlechen Transport fueren wann Haltestellen méi sécher wieren. (z.B.: duerch Kameras oder Sécherheetspersonal)

Markieren Sie nur ein Oval.

	Stemmen guer net zou				Stemmen ganz zou
	1	2	3	4	5

310. Ech géif méi oft mam ëffentlechen Transport fueren wann en méi zouverlässeg wier.

Markieren Sie nur ein Oval.

	Stemmen guer net zou				Stemmen ganz zou
	1	2	3	4	5

311. Ech géif méi oft mam ëffentlechen Transport fueren wann en méi pünktlech wier.

Markieren Sie nur ein Oval.

Stemmen guer net zou

1
2
3
4
5

Stemmen ganz zou

312. Op enger Skala vun 1 bis 10, wéi wahrscheinlech ass et, dass Dir vir Ären nächsten Trajet an Lëtzebuerg an eng **urban** Géigend den Auto huelt? (Urban Géigenden sinn méi grouss Stied wéi Esch-sur-Alzette, Dikrech, oder d'Stad)

Markieren Sie nur ein Oval.

Ganz onwahrscheinlech

1
2
3
4
5
6
7
8
9
10

Sécher

313. Op enger Skala vun 1 bis 10, wéi wahrscheinlech ass et, dass Dir vir Ären nächsten Trajet an Lëtzebuerg an eng **ländlech** Géigend den Auto huelt? (Ländlech Géigenden sinn z.B.: den Norden, den Osten oder den Westen vum Land an méi kleng Dierfer)

Markieren Sie nur ein Oval.

Ganz onwahrscheinlech

1
2
3
4
5
6
7
8
9
10

Sécher

7.5. Appendix E - Mean Scores of Age and Intent to use PT more

		Age									
		21-25	31-35	56-60	51-55	36-40	41-45	26-30	46-50	61-65	18-20	71
	Frequency	29	29	27	26	25	24	22	20	18	5	1
Better access	Mean	3.86	3.66	3.27	3.08	3.68	3.63	3.86	3.4	3.28	3.8	2
Cars more exp.	Mean	2.86	2.45	2.62	2.12	2.08	2.21	2.73	1.9	2.06	2.5	2
Cars slower	Mean	3.24	2.9	2.85	2.92	2.76	2.83	3.45	2.45	2.44	2.5	2
More	Mean	3.86	3.34	3.08	3	3.25	3.04	3.68	3.37	2.94	4	2
Safer	Mean	3.17	2.72	2.85	2.73	2.79	2.71	3.41	3	2.94	2.8	2
Reliable	Mean	4	3.55	3	3.38	3.46	3.54	4.05	3.58	3.39	4.6	2
Punctual	Mean	3.97	3.48	3.15	3.31	3.42	3.63	4.05	3.58	3.56	4.6	2

7.6. Appendix F - Mean Scores of Levels of Education and Intent to use PT more

		Education					
		High School Degree	Bachelor's Degree	Vocational Training	Master's Degree	No Degree	Doctorate Degree
	Frequency	95	41	40	24	19	3
Better access	Mean	3.38	3.85	3.38	3.63	3.58	4
Cars more exp.	Mean	2.16	2.63	2.25	2.79	2.21	3.67
Cars slower	Mean	2.61	3.46	2.35	3.71	2.78	5
More	Mean	3.19	3.68	2.77	3.88	3.37	3.33
Safer	Mean	2.96	3	2.87	2.58	2.84	3
Reliable	Mean	3.58	3.68	3.23	3.88	3.58	3.33
Punctual	Mean	3.59	3.71	3.33	3.79	3.37	4.33