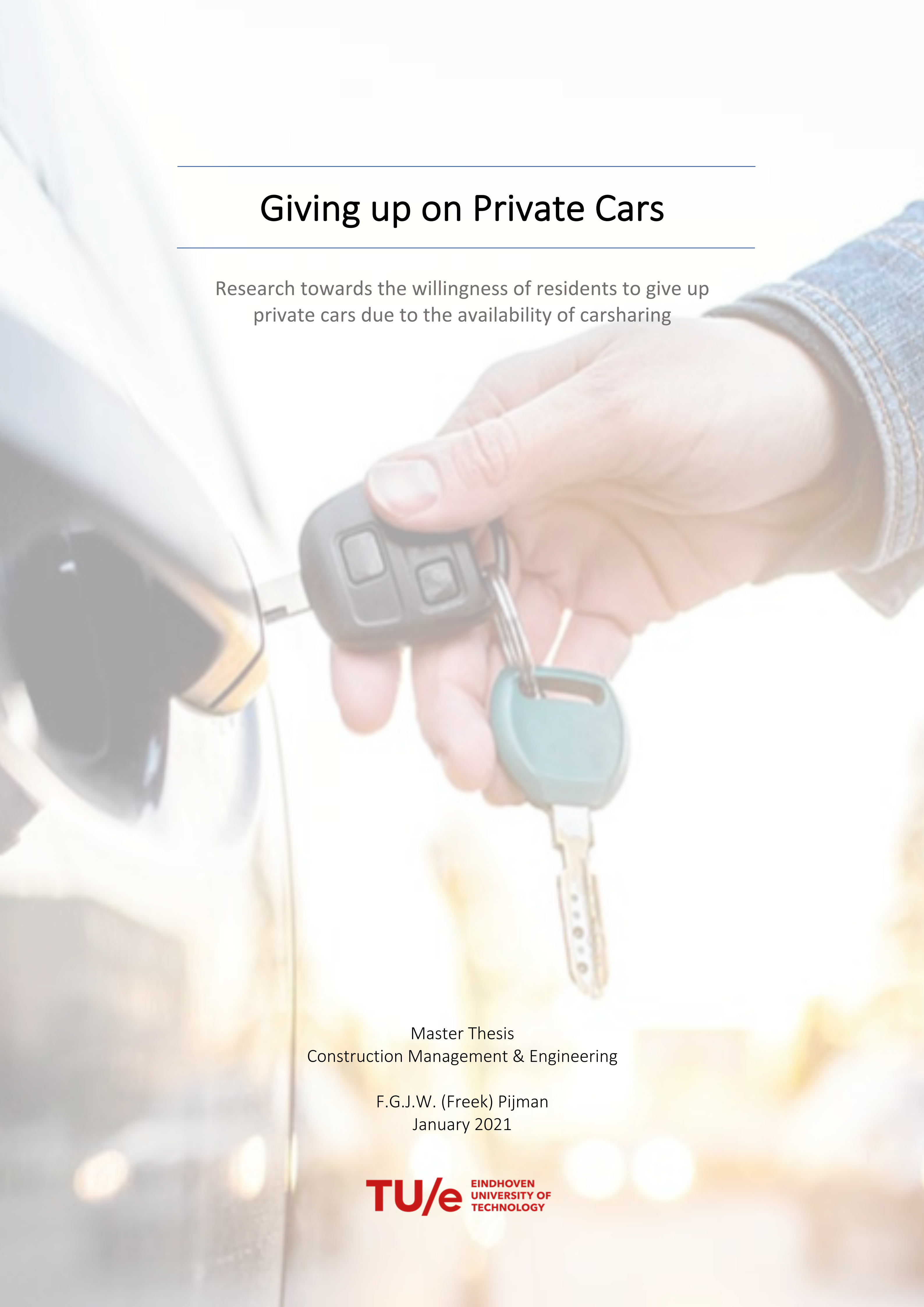

Giving up on Private Cars

Research towards the willingness of residents to give up private cars due to the availability of carsharing

Master Thesis
Construction Management & Engineering

F.G.J.W. (Freek) Pijman

January 2021

EINDHOVEN UNIVERSITY OF TECHNOLOGY

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Master Thesis
Giving up on Private Cars
Research towards the willingness of residents to give up private cars due to the availability of carsharing

Eindhoven University of Technology (TU/e)
Department of the Built Environment (BE)
Master Construction Management & Engineering (CME)

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“Rethink your ride,
Redefine your journey,
Find your own road,
And let other superheroes wrestle with traffic.”

Brandon Gaille

“Not having to own a car has made me realize
what a waste of time the automobile is.”

Diane Johnson

Preface

This thesis fulfils the final stage of my master Construction Management and Engineering at the Eindhoven University of Technology. Since I was young, I dreamed to become an architect. However, my previous higher educational study (HBO) of Construction Engineering at Avans University of Applied Sciences, changed my mind towards a more technical and smart way of thinking and innovations. After the bachelor graduation, I decided to move on with the master at the Eindhoven University of Technology. During this master, my interest in (smart) mobility and sustainability had grown. As a result, and during several conversations with one of my TU/e supervisors, Peter van der Waerden, I decided to choose a graduation topic related to shared mobility and car ownership.

I would like to thank my first supervisor, Peter van der Waerden, who guided me from the start of this project. I already knew Peter from successful collaborations within previous master courses and projects. Although graduating during the COVID-19 period was not always the most ideal, with no 'real-life' personal communication and working from home, Peter spent a lot of time in online meetings to support and guide me through this research. Since a collaboration with an external company was not possible in the end of the preparation period, I was grateful that I could use the study of Peter in my research. Besides, I would like to thank my second supervisor, Dujuan Yang, for the meetings and critical feedback during this graduation period. Although we communicated less often, I appreciated your critical feedback and more methodological oriented view on the project. Finally, a special thanks to my family, personal friends, and study related friends for the support and distraction during this graduation period.

To end these first words, I am happy with my personal developments during this graduation period. I have learned more about (big) data handling, statistical analysis, model development, and application of models. I am delighted to finish my student career with this master thesis and looking forward to the next steps in my career.

Please enjoy reading this report!

Freek Pijman

Wijchen, January 2021

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Summary

The Dutch mobility system is facing several challenges regarding congestion levels, car ownership rates, and the higher pressure on urban (parking) space and traffic networks. Municipalities are stimulating other mobility modes (including carsharing) as an alternative to private cars. To respond to these developments and the lack of knowledge regarding spatial and non-spatial factors related to car ownership, this study aims to explore and develop a model presenting the factors and relations that contribute to the willingness of residents to give up their private car(s), due to the availability of carsharing. This will be translated into an approach which provides insights into the prediction and distribution of this willingness across the Netherlands.

A carsharing system, referring to services that enable people to rent locally available cars at any desired moment and during short term periods, has the potential to positively contribute to the challenges in the Dutch mobility system. However, it is not expected that all car users will instantly switch from private cars to shared mobility systems. Besides the attributes of a carsharing system itself, are the travel demand characteristics, socio-demographic characteristics, subjective motivations, and urban & living environment characteristics of residents, able to explain mobility behaviour and private car ownership. Insights in the spatial patterns and locations where residents are more or less willing to give up their private cars, could specify the potential distribution across the Netherlands to lower the car ownership rate and stimulation of carsharing.

The main part of the research consists of two parts: model development and model application.

A model is developed which provides insights into the contribution and (spatial and non-spatial) factors that are needed to calculate and predict the willingness of residents to give up private cars. For the development, the study of van der Waerden (2019b) is introduced related to the most preferable attributes of a carsharing system and local parking situations of 631 respondents. Based on evaluations of the respondents and their personal characteristics and characteristics of the urban environment, a multinomial logistic regression model is specified and estimated. This model indicates that residents who are willing to give up their private car(s), are male, are younger than the age of 50, have a higher education level, an average or lower income, and owning more than 1 car. Besides, they live in a multi-storey housing type, in a rental house, park their car on the street, live within a very strong urbanized area, on a longer distance from a main road, and closely to a train station. Regarding travel behaviour, they travel a shorter distance for work or shopping activities, a longer distance for grocery or leisure/free time activities, and travel less frequently for all these activities. Factors directly related to a carsharing system (e.g., waiting time, costs per month, or type of parking) do not add significant value to the model.

In the model application stage, the model is applied using the Woononderzoek Nederland 2012 (WoON2012) (BZK & CBS, 2012), including 11,323 respondents out of 367 Dutch municipalities. By means of this dataset, an insight is presented into the potential Dutch municipalities with a higher and lower utility and potential share of residents with the willingness to give up their private cars. There will be concluded that the potential willingness to give up private cars is between 7% and 26% per municipality in the Netherlands. By spatially visualize the potentials on maps in a geographical information system (GIS) environment, an overview is presented with several clusters of municipalities with a higher or lower share of the willingness to give up private cars. Besides these percentages, the translation to the absolute numbers of potential reduced cars shows a different pattern, with the major Dutch municipalities consisting of the highest potential in the number of reduced private cars.

The study enhances more academic understanding of mode choice behaviour, with the focus on the spatial and non-spatial factors related to car ownership. The results and maps could bring useful insights and a valuable means of communication for municipalities and related mobility organisations in their questions and policies towards car ownership and the stimulation of alternative mobility modes. The specific presented results and insights will not directly be considered in their investment or policies. However, the use and application of the approach and strategy, starting from identifying the individual characteristics, is of added value into the research towards the potential willingness to give up private cars and the distribution across the Netherlands. Potential for a reduction in car ownership, a reduction in the use of land that (parked) cars are occupying, and a stimulation of alternative mobility solutions.

Finally, limitations and recommendations for future research are presented. In general, the data availability and representativity could be improved, since data is used in a practical situation instead of an optimal or ideal situation which fully reflects the conceptual model and distributions. An increasement of the sample size and addition of the not considered, but important factors. Besides, there was no possibility for further adjustments and to vary on the specification of factors and levels of the available datasets, causing some irregularities in the data distribution. Future research could focus on the most suitable aggregation method to process and combine the individual probabilities into the municipal shares of the willingness to give up private cars. Also, incorporate the effect of unobserved utility sources and the specific gap between the presented theoretical potential and the realistic potential, incorporating the effect that not every respondent which indicates to be willing to give up their private car(s), will actually do this. To end, the contribution and consequences of the world-wide COVID-19 pandemic in 2020 on the Dutch mobility system and presented approach and results of this study, will remain an aspect for future research. The pandemic brings a certain level of uncertainty in the prediction of the model, since not a large amount of specific COVID-19 mobility research was yet available with still unknown or uncertain reasons, factors, and consequences of the pandemic.

Samenvatting

Het Nederlandse mobiliteitssysteem ondergaat verschillende uitdagingen op het gebied van verkeerscongestie, autobezit en de toenemende druk op de stedelijke (parkeer) ruimte en verkeersnetwerken. Gemeentes stimuleren andere vormen van vervoersmogelijkheden (waaronder autodelen) als alternatief voor privéauto's. Om in te spelen op deze ontwikkelingen en het gebrek aan kennis over ruimtelijk en niet-ruimtelijke factoren die verband houden met autobezit, heeft deze studie het doel om een model te ontwikkelen dat de factoren en relaties presenteert die bijdragen aan de bereidheid van inwoners om hun privéauto op te geven, als gevolgd van de beschikbaarheid van autodeelsystemen. Dit zal vervolgens worden vertaald in een werkwijze die inzicht verschaft in de voorspelling en ruimtelijke verdeling van deze bereidheid over Nederland.

Een autodeelsysteem, de dienst waarmee personen op elk gewenst moment en gedurende korte periodes een lokaal beschikbare auto kunnen huren, heeft de potentie om een positieve bijdrage te leveren aan de uitdagingen in het Nederlandse mobiliteitssysteem. De verwachting is echter dat niet alle autogebruikers direct zullen overstappen van hun privéauto naar autodeelsystemen. Naast de kenmerken van een autodeelsysteem zijn kenmerken van het reismotief, sociaal-demografische kenmerken, subjectieve motivaties en omgevingskenmerken ook instaat om mobiliteitsgedrag en autobezit te verklaren. Inzichten in de ruimtelijke relaties en locaties waar inwoners eerder geneigd zijn om hun privéauto op te geven kunnen de mogelijke verspreiding aanduiden over Nederland om het autobezit te verlagen en het autodelen te stimuleren.

Het grootste deel van het onderzoek bestaat uit twee onderdelen: de ontwikkeling van het model en de toepassing van het model.

Een model is ontwikkeld dat inzicht geeft in de bijdrage en (ruimtelijke en niet-ruimtelijke) factoren die de bereidheid van inwoners om hun auto's op te geven kan berekenen en voorspellen. Hiervoor wordt de reeds uitgevoerde studie van Van der Waerden (2019b) geïntroduceerd gerelateerd aan de attributen van een autodeelsysteem en parkeersituaties die de meeste voorkeur hebben onder 631 respondenten. Op basis van analyses van de respondenten en hun persoonlijke kenmerken en kenmerken van de stedelijke omgeving, wordt een multinomiaal logistisch regressiemodel ontwikkeld. Dit model geeft aan dat inwoners die bereid zijn om hun privéauto('s) op te geven, man zijn, jonger zijn dan 50 jaar, een hoger opleidingsniveau bezitten, een gemiddeld of lager inkomen hebben, en meer dan 1 auto bezitten. Daarnaast wonen ze in een woningtype met meerdere verdiepingen, wonen in een huurwoning, hun auto aan de straat parkeren, wonen in een zeer sterk stedelijk gebied, op een grotere afstand wonen van een hoofdverkeersweg, en dichtbij een treinstation. Ten aanzien van reismotieven, reizen ze een kortere afstand voor werk of winkel gerelateerde activiteiten, een grotere afstand reizen voor boodschappen of vrije tijd gerelateerde activiteiten, en reizen ze minder vaak voor al deze activiteiten. Factoren die direct gerelateerd zijn aan een autodeelsysteem (bijv. wachttijd, kosten per maand, of type parkeergelegenheid) voegen geen significante waarde toe aan het model.

In de fase van de model toepassing wordt het ontwikkelde model toegepast door gebruik te maken van het Woononderzoek Nederland 2012 (WoON2012) (BZK & CBS, 2012), waarin 11.323 respondenten uit 367 Nederlandse gemeentes zijn opgenomen. Door middel van deze dataset wordt inzicht gegeven in de potentiële Nederlandse gemeenten met een grotere or kleinere utiliteit (nut) en aandeel van inwoners dat bereid is hun privéauto’s op te geven. Er wordt geconcludeerd dat de potentiële bereidheid om privéauto's op te geven ligt tussen de 7% en 26% per gemeente in Nederland. Door dit potentieel vervolgens ruimtelijk te visualiseren op kaarten in een geografische (GIS) omgeving, wordt een overzicht gegeven van clusters van gemeentes met een groter or kleiner aandeel in bereidheid om privéauto’s op te geven. Naast deze percentages laat de vertaling naar absolute waardes van het totaal aantal auto's dat binnen een gemeente kan worden gereduceerd, een andere verdeling zien, waarbij de grotere Nederlandse gemeenten het grootste potentieel bezitten in het aantal gereduceerde privéauto's.

De studie vergroot het academisch inzicht in vervoersgedragskeuze, met de nadruk op de ruimtelijke en niet-ruimtelijke factoren die verband houden met autobezit. De resultaten en kaarten kunnen bruikbare inzichten geven en een belangrijk communicatiemiddel zijn voor gemeenten en gerelateerde mobiliteitsorganisaties in hun vragen over autobezit en het stimuleren van alternatieve vervoerswijzen. De specifieke resultaten en inzichten zullen niet direct worden gebruikt bij investeringen of beleidsmaatregelen. Maar het gebruik en toepassing van de werkwijze en strategie, startend bij het identificeren van individuele karakteristieken, zal van toegevoegde waarde zijn in het onderzoek naar het aandeel in bereidheid om privéauto’s op te geven en de verdeling over Nederland. De potentie voor een vermindering van het autobezit, een vermindering van het gebruik van ruimte dat (geparkeerde) auto’s innemen, en een stimulering van alternatieve mobiliteitsoplossingen.

Tot slot worden de beperkingen in het onderzoek en aanbevelingen voor toekomstig onderzoek gepresenteerd. Over het algemeen kan de beschikbaarheid en representativiteit van de data worden verbeterd. Dit omdat data is gebruikt in een praktische situatie in plaats van een meest optimale of ideale situatie die het conceptueel model en data verdelingen volledig reflecteert. Een vergroting van de steekproefomvang en de toevoeging van de niet toegepaste, maar wel belangrijke factoren. Bovendien was er geen mogelijkheid voor verdere aanpassing en variatie op de specificatie van de factoren en niveaus van de gebruikte datasets, waardoor enkele onregelmatigheden in de datasets ontstonden. Toekomstig onderzoek zou zich kunnen focussen op de meest geschikte aggregatiemethode om de individuele bereidheid om te zetten in het gemeentelijke aantal in de bereidheid om privéauto’s op te geven. Ook zou het zich kunnen richten op het effect van de niet waar te nemen utiliteit (nut) effecten en de specifieke kloof tussen de theoretische en realistische bereidheid, gegeven het effect dat niet elke respondent die aangeeft bereid te zijn om zijn privéauto('s) op te geven, dit ook daadwerkelijk zal doen. Ter afsluiting zullen de bijdrage en gevolgen van de wereldwijde COVID-19-pandemie in 2020 op het Nederlandse mobiliteitssysteem en de gepresenteerde methode en resultaten, een aspect blijven voor toekomstig onderzoek. De pandemie brengt een bepaalde mate van onzekerheid in de voorspellingen van het model, aangezien er nog niet veel specifiek COVID-19 mobiliteitsonderzoek beschikbaar was met nog onbekende of onzekere factoren en consequenties van de pandemie.

Abstract

The Dutch mobility system is facing several challenges. Municipalities are stimulating other mobility modes (including carsharing) as an alternative to private cars. With a lack of knowledge of the factors related to car ownership, this study aims to explore and develop a model presenting the factors and relations that contribute to the willingness of residents to give up their private car(s), due to the availability of carsharing. This is translated into an approach which provides insights into the prediction and distribution of this willingness across the Netherlands.

To develop the model, the study of van der Waerden (2019b) is introduced related to the most preferable attributes of a carsharing system and local parking situations of respondents. Based on the respondents and their characteristics, a multinomial logistic regression model is specified and estimated. The model indicates the travel demand characteristics, socio-demographic characteristics, and urban & living environment characteristics that contributes to the residents' willingness to give up private cars. Factors directly related to a carsharing system do not add significant value to the model and indicates that understanding of the other factors are more crucial. Next, the model is applied using the Woononderzoek Nederland 2012. Hereby, insights are presented into the potential Dutch municipalities with a higher and lower share of residents with the willingness to give up private cars, and a higher potential in the number of reduced private cars. Insights show that the willingness is between 7% and 26% per Dutch municipality and that the major municipalities have the highest potential number in reduced private cars.

The results and maps could be useful insights and a valuable means of communication for municipalities and related mobility organisations in their questions towards car ownership and the stimulation of alternative mobility modes. The use and application of the approach and strategy, starting from identifying the individual characteristics, is of added value into the research towards the potential willingness to give up private cars and the distribution across the Netherlands. Potential for a reduction in car ownership, the use of land that (parked) cars are occupying, and a stimulation of alternative mobility solutions.

Keywords*:* willingness to give up private cars, car ownership, carsharing, multinomial logistic regression model, spatial distribution, the Netherlands.

List of Abbreviations

B2C	Business-to-customer carsharing concept
CBS	Statistics Netherlands *Dutch: Centraal Bureau voor de Statistiek - CBS*
GIS	Geographic Information System
KiM	The Netherlands Institute for Transport Policy Analysis *Dutch: Kennisinstituut voor Mobiliteitsbeleid - KiM*
Km	Kilometer
MaaS	Mobility as a Service
Mun.	Municipality
P2P	Peer-to-Peer carsharing concept
PBL	Netherlands Environmental Assessment Agency *Dutch: Planbureau voor de Leefomgeving - PBL*
TU/e	Eindhoven University of Technology
VKT	Vehicle Kilometer Travelled
WoON	Woononderzoek Nederland

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Chapter 1

Introduction

1.1. Introduction

People, goods and ideas are moving 24/7 in, out, within and between cities and regions. Mobility is not only important for contact within the society but also an important driver for sustainable and economic development. The possibility to move within and between cities is a basic need for the society (Ministry of Infrastructure and Water Management, 2019; Mobiliteitsalliantie, 2019). It is often stated that the Netherlands has some of the best-designed infrastructure and mobility systems in Europe (Ministry of Infrastructure and Water Management, 2019). However, the mobility systems are often overcrowded and congested, and the use of private cars and parking facilities will become more of a question (Bačeković, Dominković, Krajačić, & Pedersen, 2018; Ministry of Infrastructure and Water Management, 2019). Growing cities result into more mobility on less space, and growing pressure on the limited available space and liveability. Much is already happening in the field of mobility and people’s means of transport, and mobility requirements are changing. As a result, society is increasingly facing with other mobility choices (Mobiliteitsalliantie, 2019).

Standard solutions, such as investments or subsidies for new infrastructure, are no longer sufficient; it generates even more road traffic (Ministry of Infrastructure and Water Management, 2019). Therefore, it is important to keep investing in an efficient, safe, and accessible mobility system, that suits the dynamic requirements of the users. Municipalities are responding by updating their mobility plans with new parking policies, new visions regarding car ownership, and stimulation of other (active) mobility modes as an alternative for private cars (Mobiliteitsalliantie, 2019; Van der Waerden & Van der Waerden, 2020).

The implementation of shared mobility, where users have the short-term access to vehicles within an integrated and shared principle, is promised to be a challenging solution (Machado, Hue, Berssaneti, & Quintanilha, 2018). A migration towards more efficient shared mobility options, such as carsharing, has the potential to provide a reduction in the ownership and use of private cars. Carsharing, where users have the access to a car without owning one, can ensure more conscious car use, a reduction in congestion and a reduced need for parking spaces, as well as a decrease in the total number of private vehicles. It already gains interest across Europe, especially in the major urban cities. A transition in mobility, where the consumer will share the car-related options within an integrated principle. (Coevering, Zaaijer, Nabielek, & Snellen, 2008; Das & Jansen, 2016; Machado et al., 2018).

1.2. Problem Definition

The urbanisation and climate change have a huge impact on the mobility patterns, behaviour, and requirements of individuals in urban cities (Burrows, Bradburn, & Cohen, 2015). The increase in congestion levels, number of cars and car ownership rates, and the higher pressure on urban space and traffic networks result into other mobility requirements and new designs for people's trips and urban areas. As a reaction, municipalities stimulate other mobility modes to change individuals' mobility behaviour and patterns.

The increase of car ownership and the use of land that (parked) cars are occupying are issues for many urban cities in the Netherlands, and governments are trying to respond. The implementation of carsharing options can positively contribute to these urban changes. However, in general, it is not expected that individuals will easily switch between mobility modes (Anwar, 2012; Van Helvoirt, 2020). Several studies (Caiati, Rasouli, & Timmermans, 2019; Li & Voege, 2017; Liao, Molin, Timmermans, & van Wee, 2018) mentioned that the relation between the potential demand for carsharing and the willingness to give up private cars by residents is not clear. How and which factors are related to car ownership and the willingness of residents to give up their private car(s)? In addition, because the research on spatial factors and orientation affecting the supply or use of carsharing is limited (Münzel, Boon, Frenken, Blomme, & van der Linden, 2019), it could be useful to provide insight in the areas in the Netherlands where residents are more intent to give up their private cars. Differences in local policies or local urban characteristics, such as the availability of train stations, could explain differences between municipalities towards the willingness to give up private cars. These insights could contribute to the formulation of adequate policies with local and regional components (Veldhuizen & Pfeffer, 2016). Maps can give indications in clusters of municipalities with the potential to cooperate together to lower the car ownership rates and stimulating of shared mobility options (Lage, MacHado, Berssaneti, & Quintanilha, 2018; Münzel et al., 2019; Van Helvoirt, 2020; Veldhuizen & Pfeffer, 2016).

1.3. Research Objective

Based on the aforementioned developments and the lack of knowledge regarding spatial and non-spatial factors related to the interaction between carsharing and car ownership, this study will explore and develop a model. This model will present the factors and relations that contribute to the willingness of residents to give up their private car(s), due to the availability of carsharing. Besides, by applying the model on the Netherlands, it will visualize the distribution of the residents' willingness to give up their private cars and determines if there is potential for a reduction in private cars. Mapping and giving insights into the spatial distributions can inform urban policy and make urban management more efficient and effective. A higher effectiveness of mobility decision making by a better clarification of the potential share in the willingness to give up private cars, due to the availability of carsharing. This study aims to present a supportive approach for the decision-making process of mobility related parties by giving indications and understanding in the patterns and (clusters of) areas to work towards a reduction in the number of private cars. A potential for the stimulation of alternative carsharing systems and suitable parking policies (Harder & Brown, 2017; Kraak, 2005; Sugumaran & Degroote, 2010; Veldhuizen & Pfeffer, 2016).

1.4. Research Questions

To achieve the previously stated research objective, the following **main research question** is formulated for this study:

Which factors contribute to the willingness of residents to give up their private car(s), and how can these factors be translated into an approach which provides insights into the prediction and distribution of the willingness to give up private cars across the Netherlands?

Several **sub-questions** (SQ) are formulated to be able to give a well-considered answer to the main research question:

SQ1: What is the current state-of-the-art concerning car ownership and carsharing in the Netherlands?

SQ2: What are, based on statistical analyses, the relations between the willingness to give up private car(s) by residents on the one hand, and the spatial and non-spatial factors on the other hand?

SQ3: How can a model be developed which provides insights into the willingness of residents to give up their private car(s), given the investigated factors?

SQ4: How can the model be applied to predict and spatially visualize the distribution of residents' willingness to give up their private car(s)?

1.5. Societal and Scientific Importance

This study is able to provide insights to governments, municipalities, and related organizations in the research fields of car ownership and carsharing. A better identification of the distribution and factors related to the residents' willingness to give up their private car(s). Organizations can use the presented knowledge as an underpinning for their considerations towards car ownership reduction and stimulation of alternative mobility options. A formulation of adequate policies with local and regional components, and a supportive approach in the decision making of parties to achieve a higher effectiveness in decision making towards car ownership and carsharing. Besides, the research contributes to the academic field of mobility mode choice behaviour, with the focus on car ownership and the residents' willingness to give up private cars. Besides, it contributes with the development of a model presenting the spatial relations and orientations of the locations in the Netherlands where residents are more intent to give up their private cars.

1.6. Reading Guide

In this chapter, the research is briefly explained, including the research problem, objective, questions, and importance. In the next chapter, chapter 2, an explorative research by means of a literature study will be presented including research towards car ownership, carsharing, and the understanding of decision-making and behaviour of people to choose or give up on mobility modes. Chapter 3 will outline the research design and research approach.

A descriptive and multicollinearity analysis of the used datasets and related study is presented in chapter 4. Based on this study, the model will be developed in chapter 5, which provides insights into the willingness of residents to give up their private car(s). In chapter 6, the model will be applied to indicate and spatially visualize the distribution of residents' willingness to give up their private cars across the Netherlands. Finally, chapter 7 presents the conclusions of the research. It also includes the scientific and societal relevance, as well as the research limitations and recommendations for future research.

Chapter 2

Car Ownership & Sharing

In this chapter, the results from the literature study are presented. First, in section 2.1, the current situation of car ownership in the Netherlands will be elaborated. Section 2.2 and section 2.3 explain the concepts of shared mobility and carsharing. To complement, section 2.4 presents additional research towards the understanding of decision-making and behaviour of people to choose or give up on mobility modes.

2.1. Car Ownership

2.1.1. Increasing Number of Cars

Especially in, around, and between the five biggest cities of the Netherlands, the pressure on space is noticeable and the road congestion is still increase. The reality is that in 2018, congestion has increased by 20% in comparison to 2017 (Mobiliteitsalliantie, 2019). For the next couple of years, the KiM - Netherlands Institute for Transport Policy Analysis (2019) expects an increase of 5% in the total road traffic of the Dutch traffic network. Besides, living and working are taking place in central urban areas more often and personal mobility becomes more important. An extension of the road capacity will only partially cover the expected growth of traffic, and an increasement in the loss of travel time on the main traffic network will be expected of 23% towards 2024 (Netherlands Institute for Transport Policy Analysis, 2019).

People have more individual mobility requirements and are more dependent on the mobility options to combine and plan their activities. KiM (Netherlands Institute for Transport Policy Analysis, 2019) has mentioned a trend where Dutch people will make a higher number of trips for their activities. Besides, these movements come with even longer distances. Because of these trends, it might include other mobility and transportation requirements and people need to organize their trips in a new and different way. A logical continuation is an increasement of the pressure on urban space and mobility and transportation options (Coevering et al., 2008; Mobiliteitsalliantie, 2017).

The pressure on the urban space and mobility systems is one of the main concerns and focus points of cities as stated by the research of KiM Netherlands Institute for Transport Policy Analysis (Kansen, van der Waard, & Savelberg, 2018). Hereby, the number of cars, car ownership rates (number of cars per 100 people), and the number of car trips are important. In the period 2005-2017, the total number of personal cars has increased from 7.3 million to 8.4 million (CBS, 2018; Kansen et al., 2018). Per 100 Dutch households, around 93 personal cars are available, where around 23% has access to 2 or more cars (Coevering et al., 2008; Mobiliteitsalliantie, 2019). It is expected that the number of cars will still increase with 9-50% towards 2030, dependent on social and economic developments (Coevering et al., 2008).

This can be reflected to the results of the ODiN research (Onderzoek Onderweg in Nederland) and KiM (Netherlands Institute for Transport Policy Analysis, 2019), where it is concluded that the private car is responsible for almost 75% of the total travelled distances, and has the highest mobility share within the five major Dutch cities (Figure 1 and Figure 2).

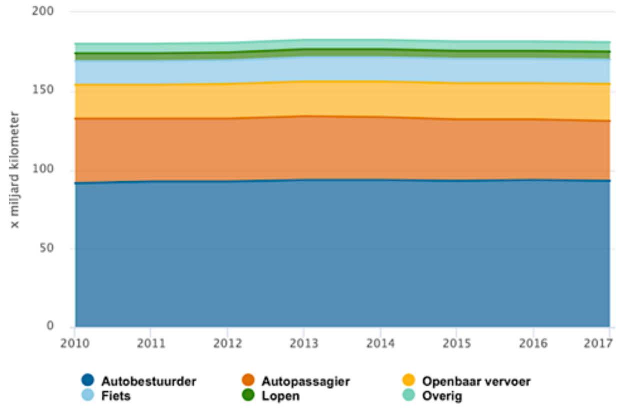


Figure 1 | Distances travelled by mobility mode, 2010-2017 (Netherlands Institute for Transport Policy Analysis, 2019, p. 9)

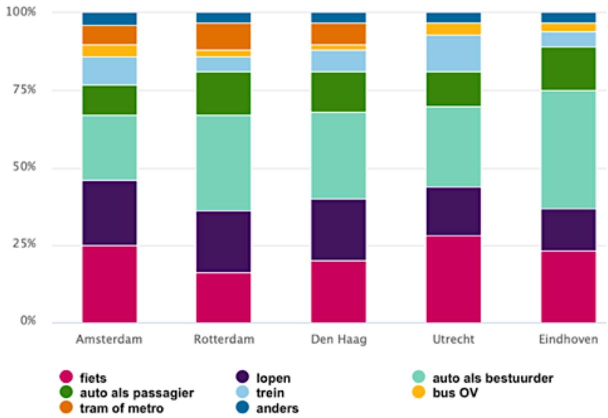


Figure 2 | Distribution mobility mode of the five major Dutch Cities, 2015-2017 (Netherlands Institute for Transport Policy Analysis, 2019, p. 10)

Municipalities and provinces are looking for opportunities to structure the increasing numbers of cars in the Netherlands. In major cities, policy planners or decision-makers apply different policies (e.g., parking policies) and aim for stimulation of other transportation and mobility modes, to lower the car ownership rates and usage (Das & Jansen, 2016).

2.1.2. Parking Policies

The pressure on the urban space and mobility systems can partly be explained by the parking policies of cities and is often one of the main concerns and focus points of cities, as stated by the research of KiM Netherlands Institute for Transport Policy Analysis (Kansen et al., 2018). Parking is part of the mobility system and influences the accessibility and pressure on the urban space. Several studies (Gruyter, Truong, & Taylor, 2020; Kansen et al., 2018; Mingardo, van Wee, & Rye, 2015; Van der Waerden & Van der Waerden, 2020) are linking (limiting) car ownership and the number of trips to the amount of car parking spots required.

An increasing number of households is owning one or more private cars (Van der Waerden & Van der Waerden, 2020, p. 50). The increase in car ownership rates resulted into an increase in parking pressure in the urban environment. Most of the urban areas are not suitable for an increase in parking demand (Coevering et al., 2008; Van der Waerden & Van der Waerden, 2020). Municipalities and provinces are looking for opportunities to structure and guide this part of the mobility system. In major urban cities, different parking requirements/standards are applied to lower car ownership and usage (Das & Jansen, 2016; Van der Waerden & Van der Waerden, 2020). "Parking requirements are used to calculate the number of parking spaces that the developer must supply for an area or development of a certain use class." (Milosavljevic & Simicevic, 2019, p. 9).

The ownership and usage of private cars and related parking capacities are important for mobility movements from origin A to destination B. When levels of car ownership increase, cities start to implement several forms of parking regulations. Implementing paid parking, time restrictions at parking spaces, or focussing on target groups, are useful applicable regulations. However, parking standards are mostly used by municipalities that are well served by public transport, and are intent to decrease the number of vehicles and car ownership rates (Mingardo et al., 2015). "Parking capacities should be limited correspondingly, to maximize utilization of transportation modes alternative to car transportation, to minimize car use and consequently traffic congestion, and hence to contribute to environmental protection." (Milosavljevic & Simicevic, 2019, p. 10). In more urban cities and new urban development regions, the parking standard will already be lowered towards 0.3 or 0.2 parking spaces per dwelling, to be able to contribute to a reduction of the car ownership and the pressure on urban space.

The standard and parking solutions should be matched by the target groups and their mobility motives and available private cars, to apply a tailor-made mobility policy and to influence the residents' car usage (Das & Jansen, 2016; Van der Waerden & Van der Waerden, 2020). "To find a good balance between supply and demand, it is important to have insight into the preferences of residents with regard to their living environment." (Van der Waerden & Van der Waerden, 2020, p. 63). Within parking policies, the factors related to car ownership and the urban environment should be considered.

2.2. Shared Economy and Mobility

As mentioned, municipalities are willing to stimulate other mobility modes and its attractiveness, as an alternative to the car ownership and to lower the pressure on urban space (Das & Jansen, 2016; Milosavljevic & Simicevic, 2019). For already a longer period, public transportation is an important alternative mobility mode in mobility policies. However, cities are continuously changing, individualization causes more mobility movements, and personal and flexible mobility becomes more important (Mobiliteitsalliantie, 2019). Cities and regions are not equal in their mobility behaviour and presence, but they all benefit from a mobility system which complies to the growing and dynamic mobility requirements of people, economy, and environment. New mobility concepts are changing the way people travel and behave within the urban context.

With new upcoming technologies, products and services, the customers' mobility expectations and requirements are shifting. With smartphones, individuals are connected to a range of services and real-time mobility information (Burrows et al., 2015). In addition, services and rental systems of vehicles (e.g., Car2Go), housing (e.g., Airbnb), workspaces (e.g., Impact Hub), etc, are upcoming. The concept of a sharing economy enables access to services beyond ownership and have the potential to promote more sustainable consumptions (Machado et al., 2018).

In 2015, an agreement has been made in the Paris Climate Agreement to face global warming and promote sustainability. Since the beginning of 2018, more than 100 Dutch parties, among which are the government, employers, and environmental organisations, have worked on a set of proposals to achieve the targets of 2030, resulting in the National Climate Agreement (Dutch Central Government, 2019). Over the last 10-15 years, the transportation and mobility sector contributed to one-third of the total energy consumption in the European Union and will be seen as one of the greater challenges towards sustainability (Bačeković et al., 2018). The mobility vision of the Climate Agreement formulates a carefree, zero-emission, and an excellent accessible mobility system for everyone in 2050. "Smart, sustainable, compact cities with an optimum flow of people and goods. Beautiful, liveable and easily accessible areas and villages, with mobility acting as the link between living, working and leisure time." (Dutch Central Government, 2019, p. 48). As part of this vision and improvements in sustainable logistics and passenger mobility, the national government and the local and regional authorities have made commitments in the Green Deal – Carsharing II (Dutch: Green Deal Autodelen II) to further stimulate the growth of concepts as Mobility as a Service (MaaS) and carsharing (Figure 3 and Figure 4) (Dutch Central Government, 2019; Green Deal, 2019).

Specifieke overwegingen Green Deal Autodelen II:

(...)

7. Zoals ook in het Voorstel Klimaatakkoord ter sprake komt, is het aannemelijk dat ons mobiliteitsgedrag gaat veranderen. Naar verwachting komt meer en meer de reis centraal te staan in plaats van het voertuig. Er ontwikkelt zich een systeem waarbij mensen per reis kiezen voor een of meer modaliteiten. Mobility as a Service (MaaS) zal zijn intrede doen waarbij de consument een reis koopt, in plaats van betaalt voor alle afzonderlijke transportmiddelen.

Figure 3 | Green Deal Autodelen II: Mobility as a Service will be introduced (Green Deal, 2019, p. 4).

3. Inzet en acties

Artikel 4 Inzet en acties Partijen gezamenlijk

Partijen zetten zich gezamenlijk in om autodelen te bevorderen. Deze samenwerking (uitvoering van de Green Deal) richt zich onder meer op de volgende speerpunten:

1. Het vergroten van de bekendheid van autodelen.
2. Het inventariseren en waar nodig verlagen van drempels voor de eindgebruiker (zakelijk of particulier).
3. Het inventariseren en agenderen van barrières en belemmeringen voortkomend uit regelgeving.
4. Het stimuleren van een consistent en uniform gemeentelijk beleid met betrekking tot autodelen (indien mogelijk met stimulerende werking).
5. Het aandacht blijven vragen bij de verzekeringssector voor de verzekeringsvraagstukken bij autodelen.

Figure 4 | Green Deal Autodelen II: Involved parties to stimulate carsharing (Green Deal, 2019, p. 7).

Shared mobility concepts are upcoming and are related to one of the segments of a shared economy. An integration of platforms that provide access to multiple and shared mobility modes could offer a solution to move forward to a smart, sustainable and more connectable mobility system, without being dependent on for example public transportation (Caiati et al., 2019). "New technological developments will bring changes in the environment. There is a larger need for demand-driven solutions, including mobility." (Palm, 2018). According to Li & Voege (2017, p. 95): "related services have been seen by transport professionals as potentially enabling a paradigm shift towards more sustainable urban mobility." They will be used as an instrument to tackle the pressure of cars on the urban space and related car ownership. If residents purchase a subscription for such a platform, they will become more flexible in their mobility and they will need a private car less often (Plantenga, 2017).

With shared mobility, visits to multiple destinations are more combined in one chain of trips through shared mobility options. It aims to "maximize the utilization of the mobility resources that society can pragmatically afford, disconnecting their usage from ownership, (…) and is the short-term access to shared vehicles according to the user's needs and convenience." (Machado et al., 2018, p. 1). Shared mobility already gains interest across Europe, especially in the major cities. A transition in mobility, where the consumer will share mobility-related options within an integrated principle (Anwar, 2012).

2.3. Carsharing

2.3.1. Introduction

As mentioned, commitments have been made in the National Climate Agreement to further advance the growth of concepts as Mobility as a Service (MaaS) and shared mobility options. For the implementation of MaaS related services, carsharing services are important for users to have access to cars of multiple suppliers on specific locations (CROW, 2020d; Green Deal, 2019). "Carsharing is a possible connection in MaaS related solutions." (CROW, 2020d). Parties involved in the 'Green Deal - Autodelen II' intended that carsharing will develop in a robust mobility option within the MaaS system (Green Deal, 2019, p. 4).

7. Zoals ook in het Voorstel Klimaatakkoord ter sprake komt, is het aannemelijk dat ons mobiliteitsgedrag gaat veranderen. Naar verwachting komt meer en meer de reis centraal te staan in plaats van het voertuig. Er ontwikkelt zich een systeem waarbij mensen per reis kiezen voor een of meer modaliteiten. Mobility as a Service (MaaS) zal zijn intrede doen waarbij de consument een reis koopt, in plaats van betaalt voor alle afzonderlijke transportmiddelen. Partijen beogen dat autodelen zich ontwikkelt tot een robuuste mobiliteitsoptie in dit mobiliteitssysteem.

Figure 5 | Green Deal Autodelen II: Carsharing will become a robust option (Green Deal, 2019, p. 4).

A unified definition of carsharing does not explicitly exist. However, according to several studies and reports, carsharing could be described as a concept which refers to services that enable people to rent locally available cars at any desired moment and during short term periods (Dieten, 2015; Frenken, 2013; ING Economics Department, 2018; Münzel et al., 2019). It is different from taxis since the car is driven by the renter, and different from car rental since the shared cars are locally available at any time and for any duration (Münzel et al., 2019).

2.3.2. History and Growth

The concept of carsharing started in Europe in the middle of the 20th century, in Zurich - Switzerland. Over the next decades, other European countries were adapting the concept as well. The first carsharing services were cooperatives with collective ownership, run by volunteers with a non-profit attitude. Later, companies were renting vehicles for a short period (Dieten, 2015; Machado et al., 2018; Rickenberg, Gebhardt, & Breitner, 2013). From the 1980s-1990s, the carsharing concept started to establish all over the world, with successful organizations in Switzerland (Mobility CarSharing Switzerland) and Germany (Stadtauto Drive). Both with the ambition to expand the carsharing concept and to demonstrate the concept as an alternative mobility option (Shaheen & Cohen, 2007). From the period of 2005-2010, the terms sharing economy and carsharing gained more popularity. More organisations started to develop the concept and experience (Dieten, 2015; Shaheen & Cohen, 2013).

Over the last decade, the number of shared cars has rapidly increased. Mid-2019, around 51,000 shared cars were available in the Netherlands, mostly available through a carsharing platform (Figure 6). The CROW (2019) and Shaheen & Cohen (2013) expect a continuous growth, partly explained by the collaboration of the Green Deal Autodelen II. In this commitment, it is formulated "to further advance the growth of carsharing up to 100,000 car shares and 700,000 users by 2021." (Dutch Central Government, 2019, p. 60).

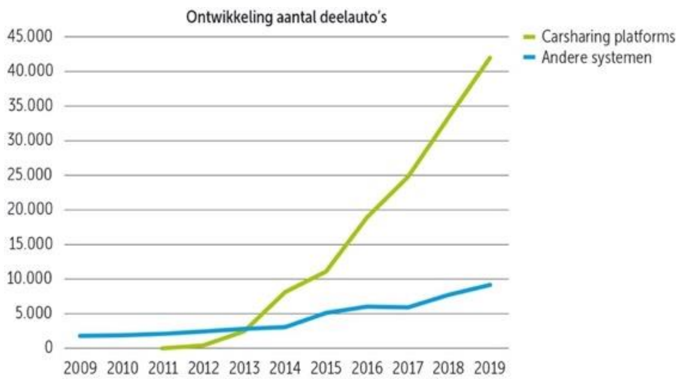


Figure 6 | Development in the number of shared cars in the Netherlands 2009-2019 (CROW, 2019)

The availability of carsharing systems is the highest in the strong urban regions (Dutch: zeer sterk stedelijk). In general, the stronger the urbanization, the more potential exists for the implementation of carsharing systems and platforms (CROW, 2019). Besides, Coevering et al. (2008, p. 10) stated that carsharing tends to be a suitable option within residential areas within or near (strong) urban areas. This can be visualized by the Figure 7, where the growth of carsharing over the last 10 years is the strongest in strong urban regions (Dutch: zeer sterk stedelijk) (CROW, 2019).

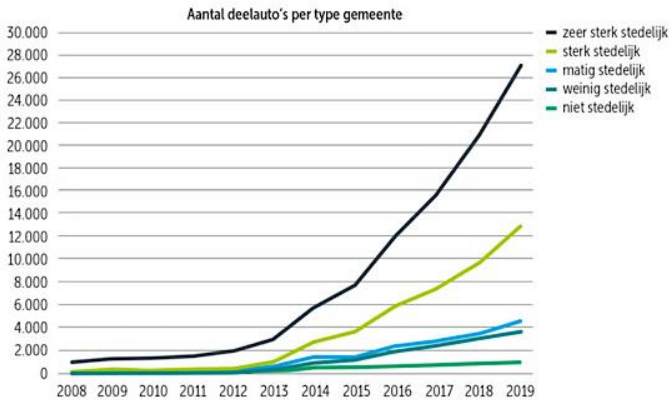


Figure 7 | Development in shared cars in the Netherlands, per urbanity type, 2008-2019 (CROW, 2019)

2.3.3. Types of Carsharing

Within the concept of carsharing, several business models and types can be distinguished, as visualized in Figure 8.

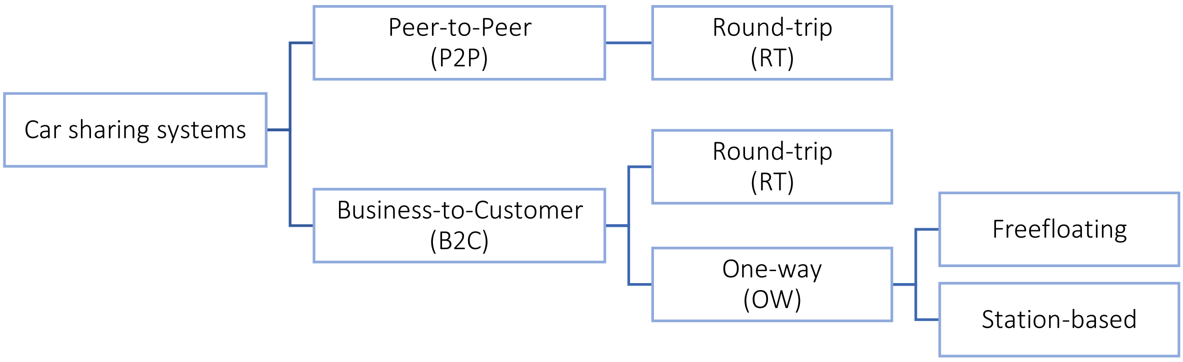


Figure 8 | Carsharing Systems (Münzel et al., 2019, p. 244)

Business-to-Consumer (B2C)

The earliest carsharing systems were established in a (traditional) business-to-customer (B2C) concept. With this concept, "the carsharing organization (be it for-profit or not-for-profit) owns a fleet of cars that it rents out to its customers." (Münzel et al., 2019, p. 244). This is usually based on a subscription which the customer has to purchase. Initially, this B2C concept was based on a Round-Trip (RT) system; a more traditional and classic system where the shared cares have to be returned to the original start location at the end of the rent period. Besides, a new type of B2C concept emerged around 2009, where the shared cars do not have to be returned to the start location, but can be dropped at special designed city areas (One-way free-floating) or provider station (One-way station-based) (CROW, 2020a; Dieten, 2015; Münzel et al., 2019).

Peer-to-Peer (P2P)

From 2011, a new type of carsharing was introduced as (online) Peer-to-Peer (P2P) platform. With P2P, car owners can rent out their car to other consumers through a website or smartphone application. It takes a specific fee for matching the supply and demand and supports other services (e.g., insurances). The P2P platforms only function as a Round-trip (RT) system since the shared car will be accessed and returned to the car owners. These P2P systems are more based on confidence since no organization is verifying or checking the car owners (Dieten, 2015; Münzel et al., 2019).

The next figure shows the differences between the Business-to-customer (B2C) (or traditional carsharing) and the Peer-to-Peer (P2P) platforms, as elaborated in the studies of Dieten (2015, p. 22) and Hogerheide (2014).

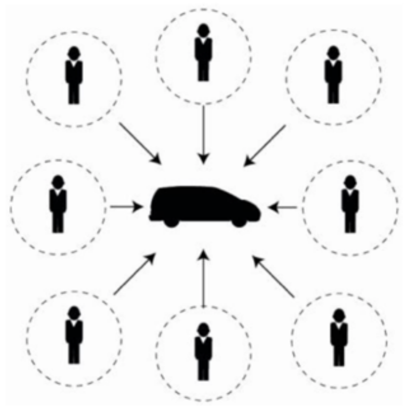
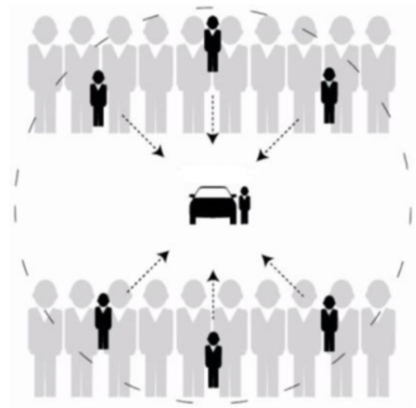
	Traditional carsharing	**Peer-to-peer**
		
- Reservations	- Up to a minute before use	- Reserving in consensus with car owner
- Contact	- Formal	- Informal
- Location of car	- Predetermined spot in neighbourhood	- Random spot in neighbourhood
- Price	- Predetermined price by organization	- Variable price (usually lower)
- Availability	- 24/7	- Dependent on car owners' availability
- Type of cars	- New, light and sustainable cars. Limited types	- Any car
- Monthly cost	- Usually a monthly fee	- No monthly fee
- Service	- Full-service	- Only assurance is arranged by organization
- Organization type	- Usually top-down	- Usually bottom-up
- Rental orientation	- Individual	- Collective
- Market orientation	- Urban areas	- Any area
- Parking	- Reserved parking on pickup location	- No
- Visibility	- Advertisements, stickers on cars etc.	- Advertisement

Figure 9 | Differences between the B2C and P2P platforms (Dieten, 2015, p. 22; Hogerheide, 2014).

Besides, the study of Schiller, Scheidl & Pottebaum (2017) of Deloitte, complement to the differences between the platforms. The B2C Round-Trip systems (B2C-RT) are usually used for the longer distances, to substitute rental cars, and lowering (private) car ownerships. The B2C One-Way systems (B2C-OW) are mostly used for shorter distances and can be compared to services like Uber. This system requires usually higher prices but offers a higher form of flexibility. The Peer-to-Peer (P2P) systems will mostly be used for the longer distances and based on a daily/weekly fee, while the B2C is mostly based on a fee per kilometer/time (Schiller et al., 2017).

2.3.4. Effects of Carsharing

The carsharing concepts are seen as intermediate modes between private mobility options and mass transit options. They can be considered as the components of an efficient mobility system in urban areas (Machado et al., 2018). Carsharing could bring several effects on the previously mentioned challenges of car ownership, congestion, parking, and sustainability.

Car ownership and Usage

In 2015, the PBL Netherlands Environmental Assessment Agency (CROW, 2020c) researched the effects of carsharing on car ownership and usage. They found a decrease in car ownership of 30% for households that started with carsharing. In the research, 37% of the respondents would have bought an additional private car, if they were not included in a carsharing concept.

Besides, the researches of Machado et al. (2018), Coevering et al. (2008), and Das & Jansen (2016) mention a decrease in the total number of vehicles needed. “It is estimated that a shared car can replace between 1 and 6.5 personal vehicles.” (Machado et al., 2018, p. 6). Since shared cars can serve more than one user, a carsharing system replaced multiple private cars, resulting in a reduction of the total number of private cars and car ownership. Car manufacturers are expecting a higher share of carsharing in their future profits since car ownership is forecast to drop (Liao et al., 2018).

More specific, many other studies, as identified and analysed by Dieten (2015), indicating a reduction of the car ownership rate, as a consequence of the implementation of carsharing. The studies of Martin (Martin & Shaheen, 2011; Wang, Martin, & Shaheen, 2011) mentioning that 50% of carsharing members are indicating a reduction of the car ownership rate and a decrease of 51% in plans of buying a private car, due to the purchase or subscription to a carsharing system. Dieten (2015) states that 44% of private cars on urban roads can be reduced with stimulation of carsharing. The analysis of the study of Kent (2014) found that, due to carsharing, the car ownership rate can be reduced from 0.47 towards 0.24 (-51%).

Differences between continents are noticeable as well. Carsharing can replace 4 to 10 cars by carsharing in Europe, 9 to 13 in North America, and 7 to 10 in Australia, dependent on the type of city and actively stimulation of the concept. Studies in Europe indicating that 15.6-34% of carsharing users sold their private vehicle, in comparison to 11-29% of studies in North-America (Table 1) (Shaheen & Cohen, 2013).

Table 1 | Impact due to carsharing (Shaheen & Cohen, 2013, p. 8)

Impact	Europe	North America	Australia
Number of private cars a carsharing vehicle replaces	4 - 10 cars	9 - 13 cars	7 -10 cars
% of users that sold their vehicle due to carsharing	15.6% - 34%	25%	21.3%

In terms of congestion and vehicle kilometers travelled (VKT), the PBL Netherlands Environmental Assessment Agency (CROW, 2020c) mentioned that carsharing users in the Netherlands are driving around 1600 kilometers less per year, instead of using a private car. This resulting in 15-20% less car driving kilometers and lower pressure on urban space and congestion. In case studies of France and Portugal (Machado et al., 2018), shared modes helped to reduce mobility congestion levels, by increasing the occupancy rate per vehicle.

Parking

As already mentioned, the usage of private cars and related parking capacities are important for mobility movements from origin A to destination B. Carsharing has the potential to reduce the need for parking spaces. Different parking standards or requirements should be matched by the target groups and their available private cars (Coevering et al., 2008; Das & Jansen, 2016; Machado et al., 2018). Mobility systems with carsharing options need less parking spaces and are able use the space more efficient. Therefore, municipalities are willing to stimulate carsharing systems even more (Frenken, 2013).

In several ways, such as specific adjustments in parking policies, cities stimulate carsharing as an opportunity to decrease car ownership and consequently lower the demand for parking spaces (Das & Jansen, 2016). A subscription for such a shared platform will create more flexibility within the travel behaviour of residents, and they might need a private car less often, resulting in lower demand for parking spaces (Plantenga, 2017). De Gruyter et al. (2020) shows that alternative mobility options “can support reduced car ownership and therefore, reduced car parking requirements.” (Gruyter et al., 2020, p. 10).

In line with the previously mentioned observations, the Massachusetts Institute of Technology (Larson, 2012) and Dieten (2015) explain that only up to 1/7th of the usual number of parking spaces is needed when a full carsharing system would be applied.

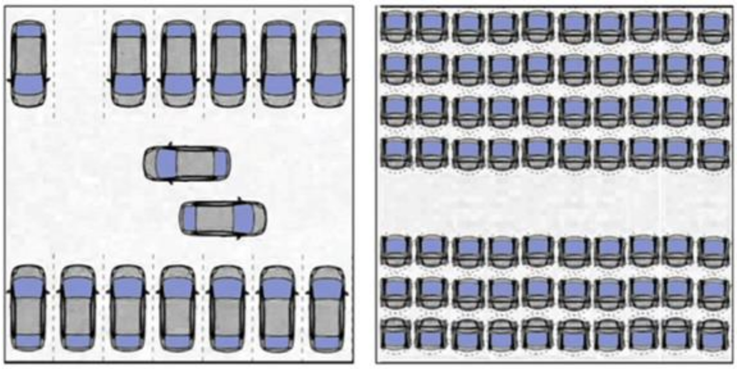


Figure 10 | Parking Requirements of carsharing versus private cars (Dieten, 2015, p. 29; Larson, 2012)

Sustainability - Social, Economic, Ecological

Future mobility users are more attached to aspects as the environment and social and financial efficiency (Machado et al., 2018). Three important components of sustainability that could be related to carsharing are *social equity, economic efficiency* and *ecologic awareness*, according to Rickenberg et al. (2013). The social equity could be achieved by giving different groups access to cars. Giving low-income groups access to cars as well could be an example of social equity. The efficiency in the economic part could be achieved by the demand-driving principle and saving costs by the share of the ownership costs. However, the largest part is the ecologic component, where users compare the systems with other mobility modes, and may realize that private car use is not as efficient. Based on the assumption that people would reduce their car usage, the car ownership rates, emissions and noise from traffic could be reduced (Rickenberg et al., 2013).

Machado et al. (2018) studied the traffic and economic efficiency of carsharing as well, mainly caused by the occupancy rates. Carsharing should be more economically efficient for car users since it is less expensive than owning and maintaining a private vehicle, especially for users that do not use the car often (Frenken, 2013). A ‘pay-as-you-go’ option within the system enables vehicle use without requiring the full costs of ownership. According to Shaheen et al. (2013, p. 9), “the maximum distance up to which carsharing is more cost-effective than leasing or owning a personal vehicle is between 10,000 and 16,093 kilometres”, depended and based on an average of several carsharing operators and locations. Carsharing is able to create more awareness of the financial side of mobility (Machado et al., 2018).

Concerning the ecological component, there will be expected that carsharing will positively contribute to the environmental and energy consumption goals as set by the national and international agreements (Frenken, 2013). Governments are focussing on the negative externalities, such as pollution or the emission of carbon dioxide (CO_2) (Frenken, 2013; Liao et al., 2018). Several studies already investigated the environmental impact of carsharing. Studies from Lisbon-Portugal, show an increased occupancy rate per vehicle and consequently a reduction in car gas emissions (Machado et al., 2018). Shaheen & Cohen (2013, p. 8) indicate a CO_2 reduction of 39%-54% when using carsharing in Europe. Within the study of North-America, a reduction was found of 27% (observed impact) and 56% (full impact). An observed value consists of the actual change in emission, and a full value includes avoided emissions as well (e.g., a forfeited car purchase).

Table 2 | CO2 reduction due to carsharing (Shaheen & Cohen, 2013, p. 8)

Impact	Europe	North America	Australia
Carbon dioxide (CO_2) emission reduction	39% - 54%	27% (observed impact) 56% (full impact)	N/A

The study of the PBL Netherlands Environmental Assessment Agency and the KiM (CROW, 2020c) stated that carsharing users emitting 175-265 kilograms less CO_2 per year than before using the carsharing concept, which is around 8-13% of the total car CO_2-emissions. Besides, the PM10 emission is decreasing with 13% due to carsharing. The institutions expect, when the Dutch carsharing share will expand to 100,000 vehicles as formulated in the Green Deal - Carsharing II (Dutch Central Government, 2019, p. 60), a CO_2 reduction of 0.2-0.3 megaton (Mt). This is a reduction which already holds 15-18% as stated in the Dutch National Climate Agreement for the transportation sector (CROW, 2020c).

Nijland, van Meerkerk, & Hoen (2015) translated the vehicle kilometers travelled (VKT) to CO_2 emissions. The VKT reduction of 1600 kilometers per year, as mentioned by the PBL Netherlands Environmental Assessment Agency (CROW, 2020c), results in a reduction of 250 kilograms CO_2. However, a change in mobility mode could result in extra emissions of around 160 kilograms CO_2 (e.g., when a user switch from no car use to carsharing). Therefore, a total reduction is calculated at 90 kilograms CO_2. Finally, the actual ownership of the car results in emissions as well, such as the energy and raw materials that are needed for the production, maintenance, and demolition. With carsharing, it could result in an additional reduction of 85-175 kilograms CO_2 per year per household, in comparison to private car ownership. These results are mentioned in Table 3, which would result in a total emission reduction of 8-13% (Nijland et al., 2015).

Table 3 | CO2-emission change as a result of car ownership and usage (Nijland et al., 2015, p. 10).

	Kilograms CO_2 per year
Change in VKT	-250
Change in mobility mode	160
Change as a result of ownership	-85 to -175
Total	**-175 to -265**

2.3.5. Motives and Attributes for Carsharing

Related to the specific effects of carsharing, several researchers (Dieten, 2015; Folmer, 2018; Liao et al., 2018; Ramos & Bergstad, 2018; Van der Waerden, 2019b) already studied the most preferable attributes and motivation of residents to choose for a carsharing system. A collection of the motivations that was identified by the extensive study of Dieten (2015) are presented in Figure 11 and in Appendix I. The study concluded that most of the people are familiar with the sharing mobility principle, but less with the carsharing concept. The early adopters of the sharing concepts are often higher educated, younger of age, and living in or near urban areas. The research towards the most preferable attributes of a carsharing systems shows that “affordability (cost), flexibility (high coverage & free-floating fleet) and an all-inclusive service (reserved parking)” (Dieten, 2015; Folmer, 2018, p. 54) are the most important attributes.

More recently, Ramos & Bergstad (2018) of the University of Götenborg, studied the motives for carsharing in Europe. Among several investigated motives, the motives of (1) convenience, (2) maintenance, (3) costs of owning, and (4) accessibility, are seen as most important. Besides, Sustainability and Parking are well-considered motives as well. These results are visualized in Figure 12 (Ramos & Bergstad, 2018, p. 11). In relation, Liao et al. (2018) mentioned price, accessibility, and availability as important attributes for a carsharing system.

Regarding the consideration to join a carsharing program, the cost savings, affordability and accessibility of owning a personal car are important aspects. As can be concluded here, the private car ownership of residents plays a prominent role in carsharing concepts and the motivation to give up on their current mobility option (Dieten, 2015).

Motivations for carsharing
- As replacement for second car
- To give up car due to low usage and expense
- For business travel
- Access to car for occasional travel
- Use car share van for work-related purposes
- Low mileage, but still occasionally need car
- As replacement for infrequently used owned car
- Low usage
- Save money
- Occasional access to a car
- To maintain driving skills
- More convenient than hire cars
- More convenient than public transport
- Alternative for taxi
- Lost job, and therefore gave up car
- Lack of initial investment
- Maintenance responsibilities
- Provision of free parking spaces
- Convenience of not owning a car
- Affordability
- Personal freedom
- Contributing to a healthy natural environment
- A friend recommended the service
- Environmental
- Expand mobility options
- Resource sharing
- Monetary
- No need to own a car

Figure 11 | Motivations for using carsharing (Dieten, 2015, p. 24)

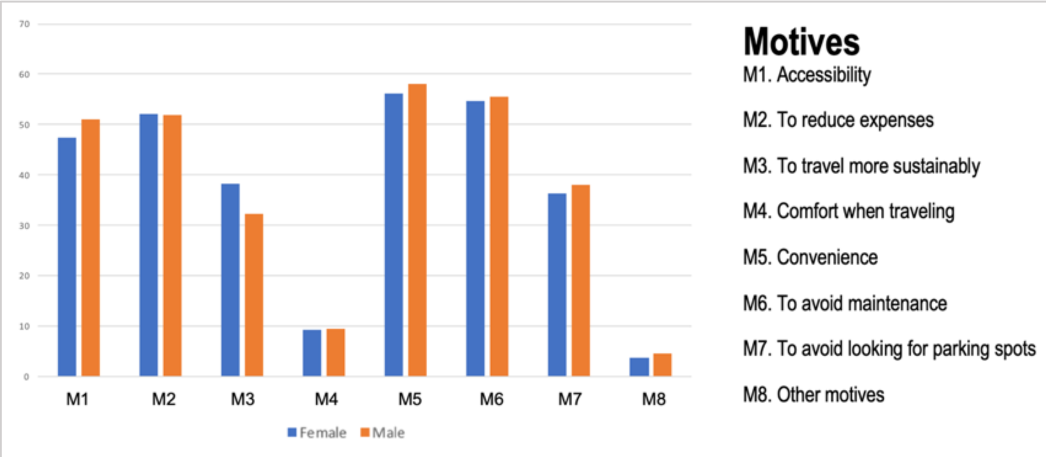


Figure 12 | Motives for using carsharing (Ramos & Bergstad, 2018, p. 11).

Finally, Machado et al. (2018, p. 14,15) show a recent selection of reasons and factors that are related to the potential adoption for carsharing mobility systems:

- *Financial:* The financial side of carsharing could influence the adoption of particular mobility options. A carsharing system could be more economically efficient since it is less expensive than owning and maintaining a private vehicle, resulting in people giving up private cars.
- *Convenience:* The ease and convenient access to the system can convince people to move away from private cars. This is partly related to the urban environment.
- *Lifestyle:* Flexibility within lifestyle, personal circumstances, and a feeling of being engaged to others, influencing the choices for a mobility mode. Users want to have contact with other users and differentiate themselves at the same time.
- *Sustainability:* Concerns regarding the environment and providing an eco-friendly system seems to be important for the improvement of the quality of life and mobility movements.

2.4. Mode Choice Decisions

Additional literature research will be conducted towards the understanding of decision making and behaviour of people to choose or give up on mobility modes. This will serve as background information towards the upcoming (model) analysis regarding the residents' willingness to give up private cars, due to the availability of carsharing.

2.4.1. Observing Decision Making

When conducting an activity, individuals have several alternatives to consider. Most of the time, people making their decisions after they have considered these several options and alternatives. While making mobility decisions, information is needed about the particular matter and situation; criteria, involved and affected stakeholders, alternatives, etc. Observing the decision-making behaviour of individuals is difficult since not all the information is available to the observer. Besides, individuals make mobility decisions and choose for a particular mobility mode according to their preferences, such as the comfort level, travel time, or security. The heterogeneity, the differences between individuals, makes it difficult to predict behaviour and understand the mobility mode choice of individuals (Hensher, Rose, & Greene, 2015).

2.4.2. Short-, mid-, and long-term decisions

To get a first understanding of decision making of individuals, a distinction can be made between short-, mid-, and long-term decisions (Beige & Axhausen, 2008). The short-term decisions are related to mobility decisions on a daily basis. These are influenced by the other decisions that are more complex and related to each other. Individuals' mid- and long-term decisions consist of personal, residential, educational, and employment factors and changes, and are strongly related to the car ownership and mobility mode choice of individuals (the mobility tools). Adjustment or alternatives in mobility choices can change the attitude towards mobility modes. "If people use one specific mobility tool for a long period of time, then the chance to use another mobility tool decreases." (Van Helvoirt, 2020, p. 37). Therefore, the living environment and personal factors are important within the mobility decisions of individuals (Beige & Axhausen, 2008; Van Helvoirt, 2020).

2.4.3. Mobility alternatives and attitudes

Adjustments and alternatives in the decision making and environment of individuals can change the attitude towards the use of mobility modes (Beige & Axhausen, 2008). Therefore, if the (new) concept of carsharing becomes available and can comply to the functional use of car ownership, the conjecture could be made that reducing the car ownership could be related to the individual attitude and willingness to replace a private car by a carsharing system (Liao et al., 2018). However, the implementation of mobility options as alternatives to private cars, such as carsharing, does not always comply with the needs of the users. Not only mobility alternatives, but the mobility requirements of residents are changing as well. As a result, society is increasingly faced with other mobility alternatives and decisions (the decision to choose for or give up on a particular mobility option), which could result in a different attitude towards mobility modes and private car ownership (Mobiliteitsalliantie, 2019).

However, in general, it is not expected that car owners will easily adapt their attitude towards other mobility modes. Reasons why individuals are owning private cars are often related to the aspects of convenience, reliability, and comfort (Anwar, 2012; Liao et al., 2018). Still, in additional experiments of Liao et al. (2018), around 40% of the car drivers are willing to switch towards carsharing in favour of the private car, and 20% indicate to consider to switch if carsharing becomes available near to them. Besides, Dieten (2015) and Nijland et al. (2015) found that 37% of the Dutch respondents in their experiment consider to give up their private car, due to the adoption of carsharing. This implies that there is potential for lowering private car ownership, due to the availability of carsharing.

2.4.4. Understanding Mode Choice

To give more insight into the willingness to give up their private car, an understanding of the potential users' preferences and related individual factors and behaviour is useful for the adoption and attitude towards carsharing and lowering of car ownership rates. Making the right decisions and focus on the underlying preferences and characteristics of individuals and urban space is fundamental for the future of the concept and for the contribution of tackling the bottlenecks of the mobility system in urban cities (ING Economics Department, 2018; Mobiliteitsalliantie, 2017). Meeting the desires of users and reflecting the urban characteristics are necessary to change the intentions of individuals to give up on private vehicles and gain more attention for shared mobility systems.

The mode choice behaviour has been studied by many researchers and is influenced by several categories of factors. Van Helvoirt (2020) and Steg (2005) stated that motivation to purchase and use a particular mobility mode depends on *practical*, *symbolic*, and *emotional* factors. The practical factors are related to the ability to conduct activities and the features of the mobility system itself, such as flexibility or safety of the mobility mode. Symbolic factors are related to the personal identity of the individual and how to express themselves by means of the car. These can be influenced by the social or urban environment. Finally, emotional factors are related to the emotions and desires of to the mobility mode, such as independency or the lack of facilities in the near environment (e.g., parking facilities). Considering car ownership, the practical factors of the mobility system are not the most important factors. The symbolic and emotional factors are underlying factors, which are important as well, but most of the time are ignored in policies and promotions towards mobility and car alternatives. According to Steg (2005), "car ownership could be associated to symbolic and emotional aspects, rather than the practical functions of the car only." (Van Helvoirt, 2020, p. 54). To comply, the study of Liao et al. (2018) suggests that changing the attributes of the system itself, the practical factors as stated by van Helvoirt (2020), does not automatically have a direct impact on people's intention to give up on their current mobility option; the decision to give up on private cars are determined by other factors as well.

The studies of Raijmakers (2019) and Yang et al. (2018), supplemented by additional studies, describing categories of factors that are important and influencing mobility choice decisions and the willingness to give up particular mobility modes:

1. *Travel demand characteristics.*
   The category of travel demand is related to the purpose of the trip, travel time, and travel distances. These influence the utility for the use of the private car. For example, "the utility of traveling by car could decrease for the purposes of shopping, social and leisure." (Raijmakers, 2019, p. 14). The studies of Raijmakers (2019), Folmer (2018) and Dieten (2015) are taking work, (grocery) shopping, recreation, and leisure trip purposes into account in research towards mobility preferences and behaviour. Hereby, the trip distances and frequencies of travel towards activities have a prominent role in their research approach and are considered to be important.

2. *Travel mode characteristics.*
   Characteristics in the category of travel modes can be compared to the practical factors, as previously explained by van Helvoirt (2020) and Steg (2005). These factors are related to the mobility mode itself, such as the travel duration, waiting time, costs, safety, comfort, flexibility, or convenience. Higher costs or higher waiting times could result in a lower connection and attitude towards the particular mobility mode (Limtanakool, Dijst, & Schwanen, 2006; Raijmakers, 2019; Yang et al., 2018).

3. *Socio-demographic characteristics.*
   The category of socio-demographic characteristics is more personally related, such as gender, age, household composition, income, education, or the number of cars owning. They seem to have a clear connection and could explain differences in perspectives towards travel behaviour and car ownership, as stated by Coevering et al. (2008) and Folmer (2018). Münzel et al. (2019), Liao et al. (2018), and Yang et al. (2018) stated that potential users for carsharing replacing car ownership, tend to be younger than average, are more often male, having a high education level, and living within a multi-person household.

4. *Subjective Motivations.*
   Subjective motivations are related to the subjective side of individuals and is a more difficult category to evaluate or analyse. It is related to subjective reasons towards the environment, mobility preferences, evaluations of comfort or convenience, etc. Users with more environmental oriented perspectives could prefer a more environmental-friendly mobility mode (Raijmakers, 2019; Yang et al., 2018).

5. *Urban and Living Environment.*
   The urban and living environment is the most important category and a determinant of mode choice behaviour in the Dutch urban context (Limtanakool et al., 2006; Raijmakers, 2019; Ton, Duives, Cats, Hoogendoorn-Lanser, & Hoogendoorn, 2019). Urban and living environment characteristics are related to aspects as urbanity and density, housing type, provision of mobility services (train stations, main roads, etc.), (parking) facilities, and aspects as weather conditions or air quality (Yang et al., 2018). Münzel et al. (2019) and Liao et al. (2018) stated that potential users for carsharing tend to live within stronger urbanized areas. Tingen (2019) complement by suggesting that the parking situation, urban density, and safety could influence the adoption and attitude towards private cars and carsharing.

When considering lowering the car ownership in urban areas, the understanding of these categories seems to play an important role in the mode choice of individuals when selecting or change their most suitable and preferable mobility mode (Coevering et al., 2008). The behavioural measures are important to create a more sustainably awareness within the society towards car ownership and stimulation of carsharing concepts (Raijmakers, 2019; Yang et al., 2018). Complementary studies (Caiati et al., 2019; Li & Voege, 2017; Liao et al., 2018; Pangbourne, Mladenović, Stead, & Milakis, 2019; Van der Waerden, 2019b) stated that it is not yet clear for which type of people and underlying personal factors the carsharing concepts can be sufficient to create a mobility transition away from private car ownership.

Finally, the studies of Caiati et al. (2019), Münzel et al. (2019), and Tingen (2019) are mentioning the importance of spatial research towards the willingness of people to give up their private car(s). Since a specific spatial orientation has been found of carsharing adopters, it could be stated that spatial and urban-related factors are playing a significant role within the mobility decision making process of residents. Münzel et al. (2019) stated that the research on urban related factors affecting the supply or use of carsharing is limited. Think of the residents’ living situations, population density, parking quality, or the availability of services.

The research of Tingen (2019) concluded that the consideration of spatial factors could increase the attractiveness of a carsharing system in favour for private car ownership. It could be useful to provide insight into the spatial patterns and locations where people are more intent to give up their private cars and potential is to lower the car ownership rate and stimulation of carsharing. “Effective visualization is valuable for communicating results and messages clearly in an engaging way.” (Harder & Brown, 2017). This to ensure a positive contribution to the challenges of congestion levels, an increasing number of cars and car ownership rates, and the higher pressure on urban (parking) space and traffic networks (Lage et al., 2018; Machado et al., 2018).

2.5. Conclusion

This literature study provides insight into the current state-of-the-art and developments around the aspects of car ownership and carsharing, and the general mobility decision making of individuals. It will serve as background information towards the upcoming analysis and model development on the willingness to give up private cars by residents.

Cities in the Netherlands are facing challenges regarding the pressure on urban space, increase of car ownership rates, and the increasing use of land that (parked) cars are occupying. These challenges are mostly occurring in strongly urbanized cities and it is still expected that these numbers will increase in the near future. Governments aim for the introduction of alternative mobility modes and apply different parking policies, to lower the car ownership rates and consequently the pressure on urban space.

With more mobility movements and the importance of mobility behaviour, municipalities are stimulating shared mobility options, to be able to overcome and handle the challenges mentioned before. Especially the upcoming concept of carsharing, which refers to services that enable people to rent locally available cars at any desired moment and during short term periods, has the potential to tackle car ownership and consequently reduce the pressure of cars on the urban space. Previous studies already mentioning a positive effect on car ownership and congestion levels, since shared cars can serve more than one user. Consequently, more efficient parking policies and a sustainable contribution towards social (giving more groups mobility access), economic (saving costs of fully owning and maintaining cars), and ecological (fewer negative externalities, such as pollution or CO_2 emissions) aspects of mobility are investigated and expected.

Several studies already showed the most preferable attributes and motivation of residents to choose for a carsharing system. Affordability (financial), accessibility, convenience, flexibility, and all-inclusive services (e.g., reserved parking) seem to be the most important attributes. However, it is still not expected that all car users will instantly switch between mobility modes; changing the attributes of the carsharing system itself does not automatically have a direct impact on people’s intention to give up on their current mobility option. The understanding of several other categories and groups of factors is still crucial but are often ignored in policies and research towards mobility and private car ownership.

These categories of factors consist of travel demand characteristics (e.g., trip purpose and trip frequencies), socio-demographic characteristics (e.g., age and education level), subjective motivations (e.g., regarding environment), and urban & living environment characteristics (e.g., urban density, housing type, (parking) facilities, and mobility services). Therefore, besides the factors and attributes of the carsharing system itself, personal, trip, and spatial related factors are important as well in the research towards the willingness of people to give up their private cars when carsharing systems become available.

Especially the before mentioned factors and categories are intended to be useful within mobility decision making. To compliment, giving insight into the spatial patterns and locations where people are more intent to give up their private cars, could specify the potential distribution to lower the car ownership rate and stimulate carsharing. This to offer a positive contribution to the challenges of congestion levels, an increasing number of cars and car ownership rates, and the higher pressure on urban (parking) space.

Chapter 3

Research Approach

In this chapter, the research approach will be described. First, the conceptual model is explained in 3.1. In 3.2, the research model is presented which describes the research process. Thereafter, the upcoming research stages are described with the used theories and methodologies.

3.1. Conceptual Model

Based on the literature study, several categories of factors are identified as important in the research towards the willingness of people to give up their private car(s). These categories are processed in the conceptual model as stated below and is the first step towards the upcoming model development.

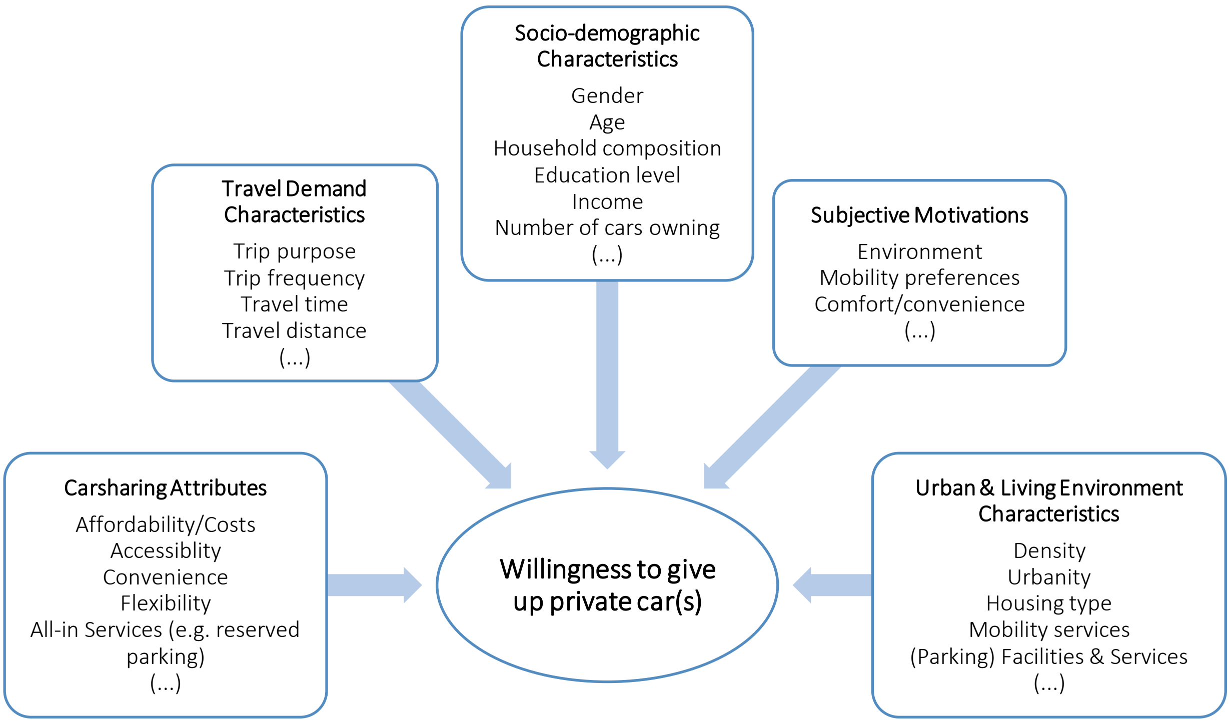


Figure 13 | Conceptual Model

3.2. Research Model

The research is divided into several research stages. The research model, as presented in Figure 14, gives a graphical presentation of the consecutive research stages.

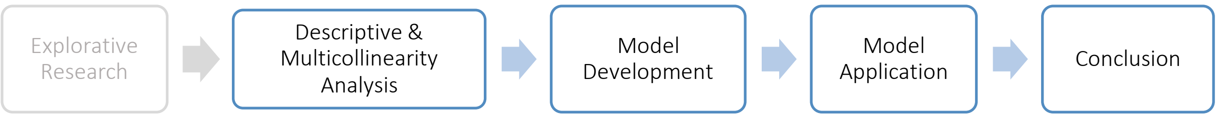


Figure 14 | Research Model

The explorative research by means of a literature study, is already presented in chapter 2. The upcoming stage starts with the descriptive analysis and multicollinearity analysis to create a better idea of the content, distributions, and correlations within the available data. The data is gathered from the stated choice experiment of van der Waerden (2019b) related to the preferred attributes of a carsharing system and the local parking situations of residents. In the current study, more factors are added for detailed modelling and the application within a visual and spatial environment. In the model development stage, the data is used to develop a model presenting the factors that are related to the willingness of residents to give up their private car(s). In the model application stage, the model will be used to predict the willingness of giving up private cars in different Dutch municipalities. Besides, several maps will be created that spatially visualize the distribution of residents' willingness to give up private cars. Finally, the research will end with the presentation of the conclusion, including the research relevance, limitations and future recommendations.

3.3. Data Collection

In this section, the available data will be introduced. To complement to the several categories of factors out of the conceptual model, datasets are considered including respondents and information concerning these categories. In a most *optimal* or *ideal situation*, the collected data should fully reflect the presented conceptual model and categories, have equal distributions, and consist of respondents being an optimal representation for each Dutch municipality. Besides, to develop the model, the data should contain an indication of the willingness of the respondents to give up their private car(s).

However, for this study, data will be used in a *practical situation*, since it has to deal with the current data availability. In this practical situation, the data will probably not fully reflect the conceptual model and equal distributions. However, the data will be supplemented by approximations and input from external datasets, so it will better reflect the presented conceptual model. For the specification of the model, the data of Van der Waerden (2019a, 2019b) is used. For the model application stage, data of the Woononderzoek Nederland, (WoON) (BZK & CBS, 2012) is used. Besides, to add additional related data, Statistics Netherlands (CBS) is consulted.

Table 4 shows an overview of the model stages with the related available data and sources.

Table 4 | Most optimal data information versus Model Stages

	Model Development	Model Application
Respondents	Van der Waerden	WoON2012
Socio-demographic characteristics	Van der Waerden | CBS	WoON2012
Urban & Living Environment characteristics	Van der Waerden | CBS	WoON2012 | CBS
Travel demand characteristics	Van der Waerden | CBS	CBS | Approximations*
Carsharing Attributes	Van der Waerden	Predefined carsharing system
Subjective motivations	--	--

* Approximations are based on comparisons with the data of Van der Waerden (2019a).

3.3.1. Stated Choice Experiment

A stated choice study is able to capture the preferences or choices of respondents. Within the stated choices experiments, respondents have to make the choice between a set of given alternatives in choice sets, which could be hypothetical (non-existing). The task of choices requires the respondents to choose the alternative that suits their individual preferences. Respondents have to make a trade-off between the presented choice alternatives and choose the most preferable alternative based on utility. The utility is the combination of the presented attribute levels of each alternative (Hensher et al., 2015; Jansen, Coolen, & Goetgeluk, 2011).

Within the transportation and mobility sector, stated choice experiments are widely used and a realistic approach since respondents are familiar with making choices between alternatives in daily life and within their mobility behaviour. Besides, it is possible to question about attributes that are hard to establish and imagine in practice. Even for individuals that are currently not using the particular mobility mode (Hensher et al., 2015).

Stated Choice Experiment - Van der Waerden (2019)

Municipalities are reducing the availability of parking spaces and carsharing systems are raising. Because of the limited knowledge regarding a preferred carsharing system and the effects of such a system, van der Waerden (2019b) started a study towards the influence of carsharing on residents' car ownership rates. By means of a stated choice experiment in an online questionnaire among 631 respondents in November 2019, the study started to investigate the most preferable attributes of a carsharing system and the local parking situation of residents. The elaboration of the data analysis and results was not yet started, but the extracted datasets are well organized and fully available for this research.

Within the stated choice part of the questionnaire, the respondents are asked multiple times (6x) to choose between two alternatives, containing two selected profiles (cards) of attributes of a carsharing system and the local parking situation. Besides, they are asked to indicate if they would consider giving up their private car(s) when this particular carsharing system becomes available. In this way, a carsharing system could be designed which was in favour of the respondents and could result in a reduction in the car ownership rate in residential areas. Considering the other parts of the questionnaire of van der Waerden (2019b), also information and data is collected of the respondents' personal factors, housing and parking situation, and travel behaviour.

Concluding from the literature study and the conceptual model presented, it is interesting and relevant to investigate these specific underlying personal and spatial factors of the individuals that are willing to give up their private car(s). Since the insights and data of the study of van der Waerden (2019a, 2019b) are in line with the literature study findings and the conceptual model, the study of van der Waerden (2019b) is introduced. The datasets will be used in this study to develop the model indicating the willingness of residents to give up their private car(s). Besides, it is a recent conducted study, fully available for this research, well organized, and there is well-maintained collaboration with the original owner.

Appendix II gives a representation and insight into the questionnaire and stated choice experiment of van der Waerden (2019b). Besides, to give a first insight, Table 5 presents some of the factors included in the datasets. For a total overview, Appendix III presents all the factors and related levels available in the extracted datasets (Van der Waerden, 2019a), according to the questions asked.

Table 5 | First insight in some factors included in the dataset of van der Waerden (2019a)

	Van der Waerden
Respondents	361 respondents
Socio-demographic characteristics	Gender, Age, Household composition, (…)
Urban & Living Environment characteristics	Housing type, Parking type, (…)
Travel demand characteristics	Trip frequencies, Travel times, Travel distances, (…)
Carsharing Attributes	Waiting time, Walking distance, Costs, (…)

3.3.2. Woononderzoek Nederland (WoON)

Data from the WoON2012 (BZK & CBS, 2012) will be used in the model application stage. The WoON, Woononderzoek Nederland, consists of information of the current and desired living and mobility situation of residents living across the Netherlands and of the age of 18 years or older (Janssen, 2013).

The WoON has also published more recently related data in 2015 and 2018 (Rijksoverheid, n.d.). However, the version of 2012 (WoON2012) consists of more usable variables towards this study and conceptual model. For example, data related to the number of cars is no longer included from the versions of 2015, and gender information is not included in the 2018 version. Besides, due to privacy reasoning, the respondents' reference towards their municipality or zip coding is removed in the latest versions of the WoON (Rijksoverheid, n.d.), which makes it more difficult to supplement the respondents with additional urban related data and to spatially map the results in the model application stage. Moreover, the WoON2012 is directly and fully available within the Eindhoven University of Technology.

Data Representativity - WoON2012

Data representativity is important for the reliability of the conducted steps and results. The WoON2012 already guaranteed the data representativity by applying different weights. This weight is applied when groups of respondents are under- or over-represented in the sample and corrects for a skewed distributed sample. Respondents that are over-represented in the sample are assigned to a lower weight than under-represented respondents. By assigning these weights to the respondents, the representativity is already optimized (Janssen, 2013).

3.3.3. Statistics Netherlands (CBS)

Statistics Netherlands (CBS, 2012a, 2015, 2016, 2019) (Centraal Bureau voor de Statistiek - CBS) has published several datasets with information per zip code (numeric part of the zip code - PC4) or municipality code. Since the respondents from the stated choice experiment and the WoON2012 are coupled to a zip code or municipality code, it is possible to retrieve and relate their data with additional data of Statistics Netherlands. Data regarding the *urbanity level, income level,* and *proximity to facilities and services* is added to the datasets, as presented in Table 6.

Table 6 | Added data from Statistic Netherlands (CBS)

Factor	Levels
Urbanity level	- Non-urbanity: ≤ 499 addresses per km^2 - Small urbanity: 500 - 999 addresses per km^2 - Moderate urbanity: 1000 - 1499 addresses per km^2 - Strong urbanity: 1500 - 2499 addresses per km^2 - Very strong urbanity: ≥ 2500 address per km^2
Income level	- Below Average: ≤ €22,199 - Average: €22,200 - €28,399 - Above Average: €28,400 - €36,599 - High: ≥ €36,600
Distance to: - closest large supermarket - closest (smaller) grocery - closest (café) restaurant or take-away service	- < 0.4 km; - 0.4 km - 0.59 km - 0.6 km - 0.79 km - 0.8 km - 0.99 km - ≥ 1.0 km
Distance to: - closest main road entrance way	- < 1.0 km - 1.0 km – 1.9 km - 2.0 km – 2.9 km - ≥ 3.0km
Distance to: - closest train station	- < 2.0 km - 2.0 km - 3.9 km - 4.0 km - 5.9 km - ≥ 6.0 km

The *urbanity* is the “measure of the concentration of human activities in a given area, based on the mean address density.” (CBS, 2016, p. 3). It is related to the number of addresses per km^2. The *income level* is the median of the standardized income of households per zip code (CBS, 2019). The levels of both the urbanity and income are formulated according to the classification of the CBS (Leeuwen, 2019).

The distances towards the closest facility or service option are determined by the average distance of all inhabitants within a particular zip code or municipality to the facility or service, calculated by road (Leeuwen, 2019) (CBS, 2012a, 2015). Since the proximity distances to the facilities and services are not evenly distributed, several level classifications are applied (Leeuwen, 2019).

3.4. Data Preparation and Cleaning

Before the analysis can start, some of the data should be prepared and cleaned to be able to statistically handle the data. The following data preparation and cleaning activities are conducted: matching to the conceptual model, removing and merging, and effects coding.

3.4.1. Matching factors to Conceptual model

Since the categories of the conceptual model are considered to be important in the research towards the willingness of people to give up their private car(s), all the factors of the dataset of van der Waerden (2019a) are matched and organized according to the categories of the conceptual model. In this way, the categorical classification of the conceptual model will remain the guideline for this research. Appendix IV presents the classification with related factors.

3.4.2. Removing and Merging

If the descriptive analysis shows that the distribution of a factor is skewed, and is therefore not interesting for analysis, the factor is removed from further analyses. Also, when a level within a factor is not assigned to one of the respondents in the dataset, the level is removed. Finally, if some of the distributions in levels are determined to be small, they are merged into one level (e.g., into the level 'Others'). Appendix IV explains these processes.

3.4.3. Effects Coding

Since the level of measurement of the gathered data is nominal or ordinal, coding is used to be able use the categorical factors in the model. For coding, dummy or effects coding can be used. The advantage of effects coding, in comparison to dummy coding, is that the base level of a factor can easier be distinguished with the grand mean of the utility function (Hensher et al., 2015). Considering effects coding, a specific coding format is used, as stated in Figure 15 (Hensher et al., 2015, p. 215). This is the coding principle up to four levels within a factor.

	Variable 1	Variable 2	Variable 3
Level 1	1		
Level 2	–1		
Level 1	1	0	
Level 2	0	1	
Level 3	–1	–1	
Level 1	1	0	0
Level 2	0	1	0
Level 3	0	0	1
Level 4	–1	–1	–1

Figure 15 | Effects coding format (Hensher et al., 2015, p. 215)

"The number of new variables created is equivalent to the number of levels of the factor being coded, minus one." (Hensher et al., 2015, p. 213). For example, if a factor consists of four levels, three variables need to be created. With effects coding, the base level will be coded as -1 across all the included variables.

This coding principle allows to test the individual utility of each level of the factors. Here, a standard utility function will be considered as stated by function 3.1 (Hensher et al., 2015, p. 210).

$$V_i = \beta_{0i} + \beta_{1i} f(X_{1i}) + \beta_{2i} f(X_{2i}) + \beta_{3i} f(X_{3i}) + ... + \beta_{Ki} f(X_{Ki}) \quad (3.1)$$

Where,

- V_i = the utility value of alternative i;
- β_{0i} = the parameter representing the role of all the unobserved sources of utility;
- β_{1i} = the weight (or parameter) associated with variable 1 and alternative i;
- $f(X_{1i})$ = the effects coding structure corresponding with variable 1 and alternative i.

For example, when considering a factor with three levels, the utility of level 1 will be determined by the function as stated by function 3.2, with a X_{Ki}-value of 1 for variable 1 (X_{1i}) and a X_{Ki}-value of 0 for variable 2 (X_{2i}).

$$V_i = \beta_{0i} + \beta_{1i} \text{ x } 1 + \beta_{2i} \text{ x } 0 = \beta_{0i} + \beta_{1i} \quad (3.2)$$

The utility of level 2 can be determined by function 3.3, with X_{Ki}-values of 0 and 1.

$$V_i = \beta_{0i} + \beta_{1i} \text{ x } 0 + \beta_{2i} \text{ x } 1 = \beta_{0i} + \beta_{2i} \quad (3.3)$$

The utility of the final level can be determined by function 3.4, with X_{Ki}-values of -1.

$$V_i = \beta_{0i} + \beta_{1i} \text{ x } (-1) + \beta_{2i} \text{ x } (-1) = \beta_{0i} - (\beta_{1i} + \beta_{2i}) \quad (3.4)$$

In this way, a different value of utility is associated with each level within the factor and a better understanding of the true utility function can be obtained (Hensher et al., 2015, pp. 214–215).

3.5. Multicollinearity

Before the model will be developed and specified, the multicollinearity between the factors will be checked in chapter 4, after the descriptive analysis. Multicollinearity appears when two factors are "so closely correlated that the effect of one cannot be isolated from the effect of the other" (Hensher et al., 2015, p. 1122). In this case, it would be difficult to specify the influence of each independent factor. An often-used method to test and prevent the multicollinearity is checking the bivariate correlations (Hensher et al., 2015). First, a simple bivariate analysis will be performed to check for multicollinearity within each category of factors. When factors are highly correlated, there could be decided to remove the factors from further analysis. Besides, a larger correlation analysis will be performed among and between all the socio-demographic, urban & living environment, and travel demand characteristics. When a correlation appears between a set of factors, these could give problems in the model analysis and development (Heijnen, 2017; Hensher et al., 2015). The characteristics of the carsharing profiles are disregard in this larger correlation analysis, since they are independently predefined and not directly associated with the objective characteristics of the respondents. These analyses will be performed using the statistical software package IBM SPSS® Statistics 24.

3.6. Model Development

The model development stage will develop a model presenting the factors, utility, and the probability related to the respondents' willingness to give up their private car(s). For the model development, the data of van der Waerden (2019a) is used. The statistical software package IBM SPSS® Statistics 24 will be used to estimate and develop the models.

3.6.1. Ordinal and Multinomial Logistic Regression

Logistic Regression

A regression analysis is able to predict the values of the dependent factor from one or more independent factors or predictors (Field, 2009). In this case, the regression analysis will predict the β-values of the utility models. The notation of a regression model (function 3.5) can be compared to the standard utility function as described before (function 3.1) (Sarstedt & Mooi, 2011, p. 196).

$$y = \alpha + \beta_1(X_1) + \beta_2(X_2) + \beta_3(X_3) + ... + \beta_K(X_K) \quad (3.5)$$

A logistic regression model is an extension of regression that is able to predict categorical outcomes based on a set of predictors (independent factors). With logistic regression, a prediction can be made of which of the alternatives within a dependent factor an individual is likely to belong to, giving certain additional information (Field, 2009; Hensher et al., 2015). By comparing each alternative, the alternative that yields the highest level of utility, will be considered as the alternative that will be chosen by the individual, the utility maximization. As stated by function 3.6, the choice probability that an individual *n* will choose for alternative *i* is given as the probability that outcome *i* has the highest utility *U* (Greene, 2007, p. 14; Hensher et al., 2015, p. 85).

$$\text{Prob}(ni) = \text{Prob}(U_{ni} > U_{nj}, \forall j \neq i) \quad (3.6)$$

Where,

- Prob(*ni*) = the probability of individual *n* choosing for alternative *i* out of a set of *j* alternatives;
- $U_{ni} = V_{ni} + \varepsilon_{ni}$, and ε_{ni} "captures the factors that affect utility but are not measured within utility V_i and not directly observable by the analyst." (Hensher et al., 2015, p. 83).

Since the analyst may not be able to define all the factors an individual will actually consider in its choice, it results in unobserved utility sources. Besides the observed component of utility (V_{ni}) is the unobserved component of utility (ε_{ni}) assumed as an independently and identically distribution (IID). Often, the models assume no common unobserved factors which could influence the utilities of the alternatives. Besides, an identical distribution refers to an equal variance in the unobserved factors among the alternatives (Hensher et al., 2015, pp. 81–82).

To calculate the individual probability, the exponential of the utility of alternative *j* is divided by the sum of the exponential of the utilities of all the alternatives, as stated by function 3.7 (Greene, 2007, p. 14; Hensher et al., 2015).

$$\text{Prob}(ni) = \frac{e^{V_{ni}}}{\sum_{j=0}^{I} e^{V_{nj}}} \quad , i = 0, \ldots, I \;\; j \neq i \tag{3.7}$$

Where,

- Prob(ni) = the probability that individual n chooses for alternative i over alternative j;
- $e^{V_{ni}}$ = the exponential of the utility of individual n for alternative i;
- $\sum_{j=0}^{I} e^{V_{nj}}$ = the sum of the exponential of the utilities of all J alternatives

This principle is suitable for this study where the prediction needs to be made on the probability that the respondents will choose for one of the alternatives of the dependent factor (the likeliness to give up private cars). This also allows to predict whether a new and random respondent, of another sample, will choose for one of the alternatives in giving up their private cars (Field, 2009). Therefore, logistic regression is also useful for the model application stage, where the model will predict the share in the willingness to give up private cars in different Dutch municipalities, using the sample of the WoON2012.

Ordinal logistic regression

Since the dependent factor, 'the likeliness to give up private cars', is questioned and processed on an ordinal measurement level, an ordinal logistic regression (often just called 'ordinal regression') analysis will be conducted first, where the relationship between the dependent ordinal factor and the independent factors are investigated. Ordinal logistic regression is used when the alternatives of the dependent factor are ordered or ranked, as is the case in this study (Field, 2009).

The main assumption in the ordinal regression is that the effects of the independent factors are consistent or proportional across the thresholds. It assumes that the independent factors or predictors have an identical effect on the odds. Therefore, the ordinal logistic regression is also called as the proportional odds model (Sarstedt & Mooi, 2011). To give an example, assuming to have an ordinal dependent factor with alternatives 1 (lowest) to 4 (highest). Under proportional odds, the odds ratio for alternative 1 versus alternative 2-4 should be the same as for alternatives 1-2 versus 3-4, and the same for alternatives 1-3 versus alternative 4. All the logistic regressions outputs should then estimate the same odds ratio.

IBM SPSS® Statistics 24 calls this the main assumption of parallel lines. Based on the test of parallel lines, as will be explained in 3.6.2, there can be determined if ordinal regression is sufficient or that an additional multinomial logistic regression analysis is needed. (Field, 2009; Sarstedt & Mooi, 2011).

Multinomial logistic regression

The multinomial logistic regression analysis assumes the same principles as the ordinal logistic regression, but it considers a dependent factor with a nominal measurement level and is less restrictive. This brings the disadvantage that information about ordering will be lost. It can be applied when there are more than two alternatives within the dependent factor (Field, 2009; Sarstedt & Mooi, 2011).

A multinomial logistic regression assumes that the included data is specific for each alternative. The outcomes are modelled as a linear combination of the factors and estimate the contribution of each individual independent level to each alternative of the dependent factor (Field, 2009; Sarstedt & Mooi, 2011); each independent factor and level has a single value for each alternative. Therefore, the power of the multinomial logistic regression is that it is easily interpretable by providing multiple interpretations for the independent factors.

One alternative of the dependent factor is determined as the reference alternative and regression coefficients are estimated for each independent factor (Monyai, Lesaoana, Darikwa, & Nyamugure, 2016). Therefore, this study can estimate the contribution and utility of each independent factor against the alternatives of the dependent factor.

Model Optimization

From a base model including all the considered factors and levels, the model will be improved and optimized based on the model performance, individual parameter estimates (the β-values of the individual levels), and significance of the individual levels. Considering the parameter estimates and part-worth utilities, there will be considered if the outcomes are plausible and explainable. The optimization and improvement of the model is performed by means of merging of levels within the factors. This should result in an optimization of the plausibility and explainability of the individual levels. The model development stage will therefore search for the best possible combination and composition of independent factors and levels, given the model interpretations and performances.

3.6.2. Model Comparison and Performance

Based on several indicators in the output of the regression models, models can be compared and an indication can be given of the model performances (Field, 2009; Marquier, 2019; Norusis, 2011; UCLA Statistical Consulting Group, 2020).

Model Fitting Information

Indicates if the model is a good finding on how well the model fits the data and is useful to compare models. It shows if the created model is significantly different and better in performance in comparison to a model with an intercept only (Field, 2009; Marquier, 2019).

Goodness of Fit

Only for ordinal regression - Assesses the discrepancy between the current model and the full model. It indicates whether the predicted probabilities deviate from the observed probabilities, and gives an indication of the model performance (Field, 2009; Marquier, 2019).

Pseudo R-square (R^2)

The Nagelkerke value explains how many % of the variance in the dependent factor will be explained. Nagelkerke is one of the most common indicators for the model performance in regression analysis. There is no ‘acceptable range’ for this performance indicator; it is not specifically for model evaluating, but to compare different created models (Field, 2009).

Test of Parallel Lines
Only for ordinal regression - The test of parallel lines tests the main assumption and the proportional odds underlying the ordinal regression model. The null hypothesis of this test indicates "that the slope coefficients in the model are the same across response categories (and lines of the same slope are parallel)." (UCLA Statistical Consulting Group, 2020). The test for parallel lines tests if the one-equation model is valid. Therefore, the significance indicates if ordinal regression can be applied; if the null hypothesis should be rejected ($p < 0.05$), the ordinal logit coefficients are not equal across the levels of the outcome. Then it is possible that the link function is incorrect for the available data or that the relations between the independent factors and logits are not the same for all logits (Norusis, 2011). In that case, a less restrictive model (multinomial logistic model) should be applied. If it fails to reject the null hypothesis ($p > 0.05$), the assumption holds and the lines are parallel (Marquier, 2019; Norusis, 2011; UCLA Statistical Consulting Group, 2020).

Predicted Response Category
As an additional model performance indicator, the statistical software package IBM SPSS® Statistics 24 is able to show the *predicted response category*, indicating which alternative of the dependent factor has the largest expected probability and is predicted for each respondent by the developed model. Comparing this with the actual and true outcome given by the respondents, there can be indicated how much the model is predicting correctly.

3.7. Model Application

After the development of the model, the model will be applied using the WoON2012. The model is able to calculate the utility and the probability of the willingness of people to give up their private car(s). Besides several maps will be created that spatially visualize the distribution of residents' willingness to give up private cars across the Netherlands.

3.7.1. Utility and Probability

The utility function for each individual alternative of the dependent factor will be drafted on the basis of function 3.1. The β-values correspond to the parameters estimates as stated by the developed model. The reference or base alternative is devoid of any factors level, but it does not mean that the respondent is indifferent to this level. The difference in the utility matters, not the absolute values (Hensher et al., 2015). Therefore, the utility of the base (or reference) alternative is considered to be 0, as stated by function 3.8.

$$V_{\text{base-alternative}} = 0 \qquad (3.8)$$

Based on the predicted utility, the probability can be calculated that a respondent would choose for one of the alternatives, based on function 3.7. Since the alternatives are mutually exclusive and exhaustive (the probabilities of the alternatives are between 0 and 1.00 and the sum of the probabilities must be equal to 1.00), implies that the utilities are related via their related probabilities. If the utility for one alternative increases, the probability of this alternative increases, and the probabilities of the other alternatives will decrease (Hensher et al., 2015, p. 85). If the dependent factor consists of 3 alternatives (alternatives X, Y, Z), the calculation will be performed by the functions 3.9-3.12, that are based on function 3.7 (Field, 2009, p. 266).

$$\text{Probability(X)} = \frac{e^{V\text{-alt.X}}}{e^{V\text{-total}}} = \frac{e^{V\text{-alt.X}}}{e^{V\text{-alt.X}} + e^{V\text{-alt.Y}} + e^{V\text{-alt.Z}}} \quad (3.9)$$

$$\text{Probability(Y)} = \frac{e^{V\text{-alt.Y}}}{e^{V\text{-total}}} = \frac{e^{V\text{-alt.Y}}}{e^{V\text{-alt.X}} + e^{V\text{-alt.Y}} + e^{V\text{-alt.Z}}} \quad (3.10)$$

$$\text{Probability(Z)} = \frac{e^{V\text{-alt.Z}}}{e^{V\text{-total}}} = \frac{e^{V\text{-alt.Z}}}{e^{V\text{-alt.X}} + e^{V\text{-alt.Y}} + e^{V\text{-alt.Z}}} \quad (3.11)$$

$$\text{Total Probability} = \text{Probability(X)} + \text{Probability(Y)} + \text{Probability(Z)} = 1.00 \quad (3.12)$$

3.7.2. Application using WoON

The model will be applied using the dataset of the WoON2012. Since this dataset (with additional data from CBS) consists of the same factors as the developed model, the model can be applied using the respondents present in the WoON2012 dataset. Only for the characteristics of a carsharing system, a single predefined carsharing system is applied with average levels, since the carsharing system is not directly associated with the respondents.

Probabilities and Municipal Share in the willingness to give up private cars

For each respondent in the WoON2012, the utility and probability can be calculated towards the willingness to give up their private car(s), based on the previous stated functions and the part-worth utilities of the developed model. The '(very) likely' alternative of the dependent factor indicates that the respondent is willing to give up their private car(s). The probability that the respondent will choose for '(very) likely' to give up their private car(s), corresponds to the probability of the final choice to give up private cars.

Besides, the utility and potential share can be determined for each present Dutch municipality in the WoON towards the willingness to give up private cars. Therefore, a first insight can be presented into the locations where there is a high and low share of residents that are willing to give up their private cars and potential is to lower the car ownership rate.

1. Individual probability to give up private cars

To calculate and predict the probability of an individual respondent, the functions as explained in 3.7.1 will be considered. For each respondent, present in the WoON, the probability will be calculated to give up their private car(s) (related to the alternative and willingness of '(very) likely').

2. From individual probabilities to municipal share

There will be assumed that the respondents will represent their municipality. To make the translation from the respondents' individual probabilities within each municipality to an overall municipal share in the willingness to give up private cars, several data aggregation methods can be useful. Such as aggregation on the average, standard deviation, or using an weighted average (Rouse & Mullins, 2020). Giving the fact that the WoON already included measures to guarantee the representativity of the sample, a simplified method will be applied in this study. For each municipality, the average will be calculated of all the individual respondents' probabilities present within one municipality. This average corresponds to the share of the municipality in the willingness to give up private cars.

As an example, assuming a municipality with three respondents with the probability to give up private cars ((very) likely) of respectively 0.24, 0.16, and 0.32, as visualized in Figure 16. The municipal share will be calculated by function 3.13.

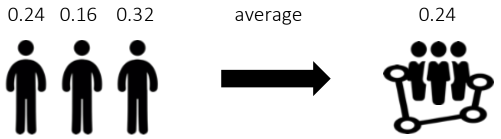


Figure 16 | Example a municipality with three respondents

$$\text{Municipal share in the willingness to give up private cars: } \frac{0.24 + 0.16 + 0.32}{3 \text{ (respondents)}} = 0.24\ (24\%) \tag{3.13}$$

When municipalities are missing, then will be considered to search for respondents of the missing municipality and related utilities in the dataset of the model development stage.

Number of Households and Private Cars

The potential share in the willingness to give up private cars of a municipality will be translated to absolute number of households that are willing to give up private cars and to the absolute number of private cars that could be given up (the reduction in the number of cars).

3. Number of households that are willing to give up private cars

To calculate the number of households that are willing to give up private cars, the total number of households within a municipality (retrieved from CBS (2012a)) will be multiplied by the municipal share of the willingness to give up private cars ((very) likely) as calculated by function 3.13. This results in function 3.14.

$$\text{Number of Households giving up cars}_{mun.Y} = \text{Total N. Households}_{mun.Y} \times \text{Share of willingness}_{mun.Y} \tag{3.14}$$

4. Potential reduction in the number of private cars

The potential reduction in the number of private cars within a municipality will be calculated by multiplying the number of households that are willing to give up private cars (as calculated by function 3.14) by the average number of cars per household presented within the particular municipality (retrieved from CBS (2012a)). This results in function 3.15.

$$\text{Reduction in Cars}_{mun.Y} = \text{N. Households giving up cars}_{mun.Y} \times \text{Average N. Cars per Household}_{mun.Y} \tag{3.15}$$

3.7.3. Spatial Visualization - Mapping

To present and indicate the potential share to give up private cars for each municipality, spatial visualization by means of mapping will be used. Spatial environment information is useful to formulate adequate policies with local and regional components (Veldhuizen & Pfeffer, 2016). Spatial insights and visualizations give better understanding in where and what is happening and are able to discover trends and patterns in the results. “It is valuable for communicating results and messages clearly in an engaging way.” (Harder & Brown, 2017).

In this study, heat maps will spatially visualize the distribution of the potential share to give up private car(s) across the municipalities in the Netherlands. Heat maps are able to visualize the distributions by means of different colours and gives indications in clusters of municipalities with similar potentials. It offers the possibility to effectively study the characteristics and relations between areas and determines if there is potential for a reduction in private cars (Harder & Brown, 2017; Veldhuizen & Pfeffer, 2016). Clusters of municipalities with a high potential can cooperate together towards a reduction in the number of private cars, a stimulation of carsharing systems, and to lower the pressure on urban space. A supportive approach for parties to achieve a higher effectiveness of decision making and a better clarification of the potential share in the willingness to give up private cars, due to the availability of carsharing (Kraak, 2005; Sugumaran & Degroote, 2010).

The open source geographic information system (GIS) of QGIS 3.14 (QGIS Development Team, 2020) will be used to develop the maps. Besides, geographical data regarding the municipal boundaries is retrieved from the CBS (2012b).

After application and spatially visualization of the willingness to give up private cars, specific insights behind the distributions within the maps can be analysed and described.

3.8. Conclusion

This chapter presented the research approach. Based on a recent conducted study of van der Waerden (2019a, 2019b), it is attempted to develop an ordinal or multinomial logistic regression model presenting the factors, utility, and the probability related to respondents' willingness to give up their private car(s).

Based on the output of the developed model, utility functions are drafted that can be applied on the respondents. Besides, the probability can be calculated that the respondent is willing to give up their private car(s). Based on these functions, the developed model will be applied using the data of the WoON2012, including respondents living within almost all the municipalities in the Netherlands. Therefore, the utility and potential share can be calculated for each presented municipality towards the willingness to give up private cars and the potential reduction in the number of private cars.

Finally, the research will provide insight into the spatial patterns and locations with a higher share of residents with the willingness to give up their private car(s). This by means of mapping the results within a geographical information system (GIS) environment. Therefore, the maps are able to indicate and visualize the locations and areas within the Netherlands with the most potential to lower the car ownership and stimulation of carsharing.

Chapter **4**

Descriptive & Multicollinearity Analysis

In this chapter, the descriptive analysis is described. The first part of this chapter describes the exploratory analysis of the answers of the questionnaire and stated choice data from the study of van der Waerden (2019a, 2019b). Besides, a multicollinearity analysis will be conducted to prevent multicollinearity between the factors in the upcoming model development. The analyses are performed using the statistical software package IBM SPSS® Statistics 24.

4.1. Sample Description

With the questionnaire, the respondents' personal characteristics are collected. In addition, the input from Statistic Netherlands (CBS, 2016, 2019) are considered. In total, 631 respondents filled in the questionnaire. Table 7 shows the sample characteristics.

This sample distribution is compared to the expected percentages retrieved from Statistics Netherlands (CBS, 2016, 2019, 2020). The comparison will check if the observed sample of van der Waerden (2019b) has similar distributions as the expected distribution of characteristics of Statistics Netherlands, and can be considered as a good representation for the Dutch population.

Table 7 | Sample Distribution. Also compared to the expected statistics of Statistics Netherlands (CBS, 2020)

	Characteristic	(Observed) Frequency	(Observed) Percentage (%)	(Expected) Percentage* (%) CBS	(Expected) Frequencies** CBS
Gender	Male	283	44.8	49.6	313
	Female	348	55.2	50.4	348
Age	18-29 years old	123	19.5	16.4	103
	30-49 years old	260	41.2	33.0	208
	50-65 years old	166	26.3	26.9	170
	> 65 years old	82	13.0	23.7	150
Highest Education Level	Primary or Secondary education	81	12.8	33.9	214
	Secondary vocational education (MBO)	285	45.2	29.4	186
	Higher professional education (HBO) or University education (WO)	265	42.0	36.7	231
Household composition	Single without children	135	21.4	17.2	108
	Single with children	34	5.4	5.2	33
	Multi-person household without children	211	33.4	31.8	201
	Multi-person household with children	201	31.9	42.9	271
	Other	50	7.9	2.9	18

Urbanity	Non-urbanity Small urbanity Moderate urbanity Strong urbanity Very strong urbanity	56 103 114 193 165	8.9 16.3 18.1 30.6 26.1	8.0 10.7 15.0 26.2 40.1	50 68 95 165 253
Income	Below Average (≤ €22,199) Average (€22,200 - €28,399) Above Average (€28,400 - €36,599) High (≥ €36,600)	26 146 212 247	4.2 23.1 33.6 39.1	19.4 21.7 16.4 42.5	122 137 104 268
Number of cars	1 car 2 or more cars	477 154	75.6 24.4	-	-
	Total	631	100%	100%	631

** Retrieved from Statistics Netherlands (CBS, 2016, 2019, 2020)*
*** Calculated: Expected percentage x 631 (total N of respondents)*

A statistical Chi-square test could indicate if the sample is a good representation and if the distribution of van der Waerden (2019a) (the observed frequencies) follows the distribution of Statistics Netherlands (CBS, 2020) (the expected frequencies) (Hensher et al., 2015). To perform this test, the following hypotheses are formulated:

Hypothesis H_0: The observed data follow the expected distribution (there are no significant differences between the observed and expected values);
Hypothesis H_1: The observed data does not follow the expected distribution (there are significant differences between the observed and expected values).

As can be seen in Table 8, the test statistics indicate that the observed values are statistically different and do not follow the expected distribution (Asymp. Sig. < 0.05; rejecting H_0/accepting H_1). Therefore, the sample cannot be considered as a good representation for the Dutch population. However, the groups are well filled with enough respondents. The differences could be explained by the fact that the questionnaire topic of carsharing and car ownership plays a more determined role in the lives of certain groups of people.

Table 8 | Test Statistics output Chi-Square Test

	Gender	Age	Education level	Household composition	Urbanity	Income
Chi-square*	5.706	47.804	140.357	82.248	57.895	189.932
Df	1	3	2	4	4	3
Asymp. Sig. (p-value)	0.017	0.000	0.000	0.000	0.000	0.000

** 0 cells (0.0%) have expected frequencies less than 5.*

Concluding from the sample distribution (Table 7):

- A slightly higher percentage of the respondents is female;
- Most of the respondents are between 30 and 49 years old;
- Most of the respondents have a higher level of education;
- Most of the respondents are living within a multi-person household (with or without children);
- Most of the respondents are living in a strong or very strong urbanized area. This could be explained by the fact that car ownership is more of an issue in urbanized areas, as concluded by the literature study;

- Most of the respondents have an income above average or higher;
- All of the residents have access to at least 1 car. Most of the respondents own only 1 car (± 75%). The other part owns 2 or more cars (± 25%).

All the respondents are living in the Netherlands. Based on their indicated zip codes (PC4), the distribution of the respondents is plotted in Figure 17. As can be seen, the respondents are spread across the Netherlands. However, most of the respondents are living on the West-side of the Netherlands, in the direction of the Randstad (region Amsterdam-The Hague-Rotterdam-Utrecht).

Figure 17 | Distribution respondents across the Netherlands (N=631)

4.2. Housing and Car Parking

Since housing and parking within the living and urban environment are important towards the willingness of people to give up their private car(s), the housing and parking situation of the respondents is showed in this section. First, the distribution in housing type is visualized in Figure 18 and Figure 19. Here can be concluded that most of the respondents are living in a row house or a flat/apartment. Besides, most are owning their house, instead of renting.

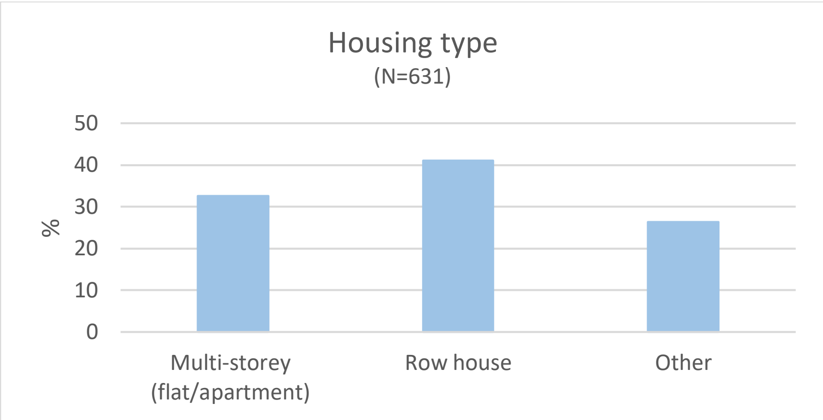


Figure 18 | Type of Housing

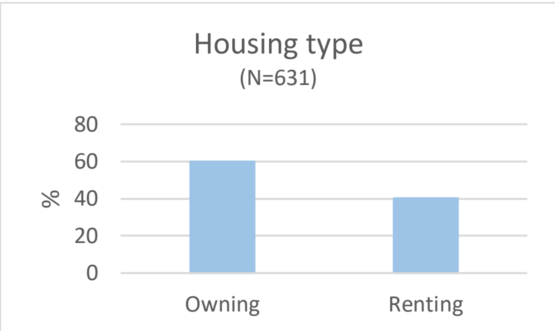


Figure 19 | Owner-occupied or Rental housing

Since parking is important within the policies of municipalities and towards the attitude of car ownership, the respondents are asked to give an indication of their parking characteristics. Some confident conclusions can be made here:

- The cars of the respondents are mostly parked on the street (approximately 70%) (Figure 20). This is related to the issue of pressure on urban space by the increasing use of land that parked cars are occupying;
- The results of (1) walking distance to the parking spot, (2) clear view to parking spot, (3) payed parking, (4) security at parking, and (5) if the parking spot will be used by others, show a skewed distribution. Therefore, these factors are removed from further analysis. For the integrality, the results are still elaborated in Appendix V.

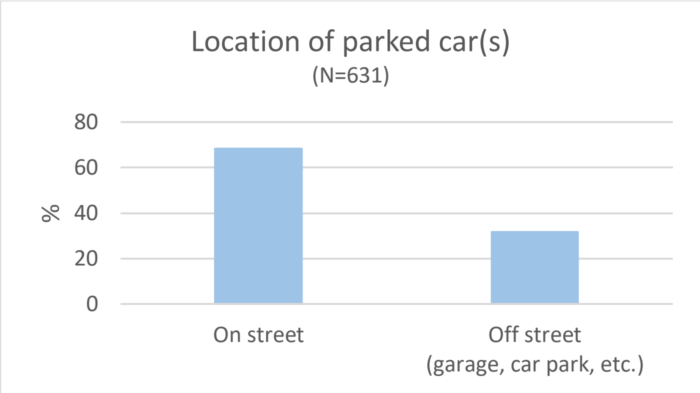


Figure 20 | Location of parked car(s)

4.3. Travel Demand and Behaviour

Since the travel demand characteristics as trip purposes (of work, (grocery) shopping, leisure, etc.), trip frequencies, travel times, and travel distances are considered to be important towards mobility behaviour and the willingness of people to give up their private car(s), the current mobility and travel behaviour of the respondents can be analysed by means of the results of the questionnaire.

4.3.1. Driving License

First, the distribution in the possession of a driving license is analysed. Only 6 out of the 631 respondents (<1%) indicating not having a driving licence.

These respondents (N=6) are not excluded from the results and upcoming analyses; it could still be interesting to include their preferences and opinions towards (future) car ownership and carsharing, since it is not expected that respondents without a driving license are not making use of a car. They can make use of a car as a car-passenger. This is confirmed by analysing the relation between respondents 'not having a driving license' (N=6) and their most preferred travel mode for a particular activity (Table 9). Here, multiple times, respondents without a driving license, indicating the Car as most frequently used mode for their activities.

Table 9 | Most used mobility mode of respondents not having a driving license (N=6) in relation to the activity types

	Activity type			
Most frequently used mode	Work	Grocery	Shopping	Leisure/Free time
Car	2	1	2	5
Bike	3	3	2	0
Other/Not applicable	1	2	2	1
Total	*6*	*6*	*6*	*6*

However, since this factor shows a skewed distribution (<1% versus >99%), the factor itself is removed from further analysis.

4.3.2. Mobility Mode

Regarding travel behaviour, analysis towards the most frequently used mobility mode per activity can be conducted (Figure 21). There can be concluded that, out of the 631 conducted responses per activity type, most of the trips are performed by car (52%-80%), with an exception in leisure and free time activities.

That most of the trips are performed by car is in line with the mobility research and prognosis of the Netherlands Institute for Transport Policy Analysis (2019), stating that around 75% of the trips are performed by car. Besides, this emphasized the usability of these datasets towards the willingness of people to give up their private car(s).

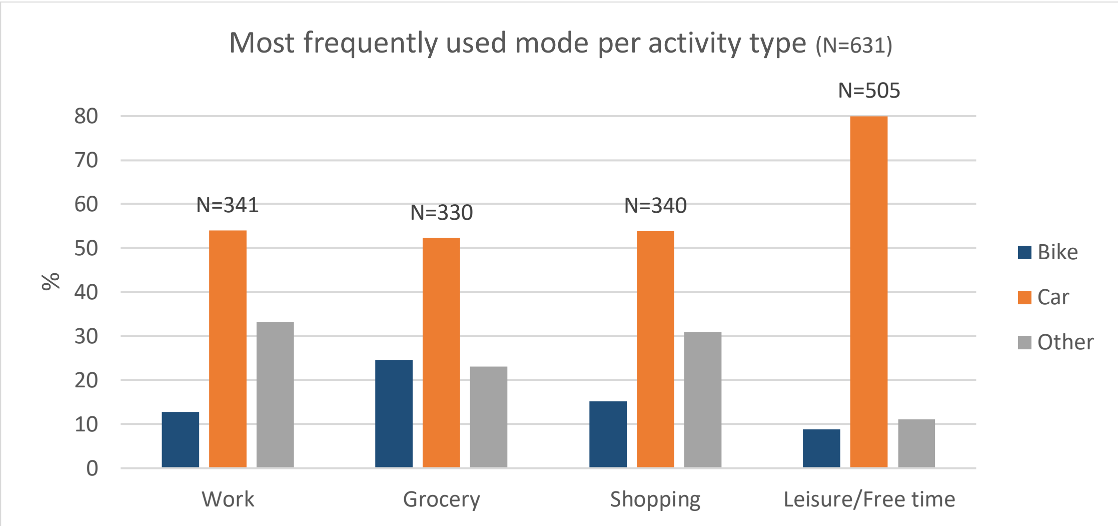


Figure 21 | Most frequently used mode per activity type

4.3.3. Frequency

Regarding the *Car* frequency, how often respondents use the car for a particular trip purpose (Table 10 and Table 11), the following conclusions can be made:

- For work related activities, the car will mostly be used for 5 or more days per week, which seems logical since most of the time people have a work week of 5 days;
- For grocery activities, the car will mostly be used for 1-2 times a week, which could be related to most of the household's grocery's schedules;
- For shopping and leisure/free time related activities, the car will mostly be used less than 1 time per week.

Table 10 | Frequencies Work - Car mobility mode (N=341)

	Work	
Frequency	Frequency	Percentage (%)
≤ 3 days per week	77	22.6
4 days per week	88	25.8
≥ 5 days per week	**168**	**49.3**
N/A	8	2.3
Total	*341*	*100%*

Table 11 | Frequencies Grocery, Shopping, Leisure/Free - Car mobility mode (N=330; 340; 505)

	Grocery		Shopping		Leisure/Free time	
Frequency	Freq.	%	Freq.	%	Freq.	%
< 1x per week	49	14.9	**298**	**87.7**	**311**	**61.6**
1-2x per week	**209**	**63.3**	33	9.7	160	31.7
≥ 3x per week	60	21.2	5	1.5	32	6.3
N/A	2	0.6	4	1.2	2	0.4
Total	*330*	*100%*	*340*	*100%*	*505*	*100%*

Appendix V present the frequencies per activity over all the presented mobility modes (including car, bike, and others).

4.3.4. Travel distance and time

In this section, analysis will be conducted towards the respondents' distances and time travelled by *Car* for a particular activity (Table 12 and Table 13). Travel time and travel distance seems to be closely related, and similar conclusions can be formulated from the analysis:

- For work related activities, the car will mostly be used for the distances of 10-30 km and for the average travel times within 16-60 minutes;
- For grocery activities, the car will mostly be used for shorter distance ranges (<10 km) and travel times (0-15 minutes);
- For shopping related activities, the car will mostly be used within the distances of 30km and travel times of 16-30 minutes;
- Finally, for leisure or free time activities, the car will mostly be used within the distances of 10-30km and travel times of 16-60 minutes.

Table 12 | Average travel distances per Activity - Car mobility mode (N=341; 330; 340; 505)

	Work		Grocery		Shopping		Leisure/Free time	
Travel Distances	Freq.	%	Freq.	%	Freq.	%	Freq.	%
< 10km	97	28.5	**308**	**93.3**	**145**	**42.6**	125	24.8
10-30 km	**139**	**40.8**	19	5.8	**158**	**46.4**	**174**	**34.4**
30-50 km	61	17.9	0	0	27	7.9	75	14.9
> 50km	42	12.3	0	0	7	2.1	120	23.8
N/A	2	0.6	3	0.9	3	0.9	11	2.2
Total	*341*	*100%*	*330*	*100%*	*340*	*100%*	*505*	*100%*

Table 13 | Average travel time per Activity - Car mobility modes (N=341; 330; 340; 505)

	Work		Grocery		Shopping		Leisure/Free time	
Travel times	Freq.	%	Freq.	%	Freq.	%	Freq.	%
≤ 5min	6	1.8	**132**	**40.0**	7	2.1	16	3.2
6-15 min	86	25.2	**165**	**50.0**	118	34.7	97	19.2
16-30 min	**125**	**36.7**	23	7.0	**154**	**45.3**	148	29.3
31-60 min	**107**	**31.4**	6	1.8	49	14.4	139	27.3
≥ 61 min	14	4.1	0	0	9	2.6	93	18.4
N/A	3	0.9	4	1.2	3	0.9	13	2.6
Total	*341*	*100%*	*330*	*100%*	*340*	*100%*	*505*	*100%*

Appendix V present the travel distances and travel times over all the presented mobility modes (including car, bike, and others).

4.3.5. Travel distances - PC4 zip codes

In addition, analysis will be conducted towards the average proximity distances that respondents have to travel from their home location to particular facilities and services (Figure 22, Figure 23, and Figure 24), based on the gathered data of Statistic Netherlands (CBS, 2015). The following conclusions can be formulated:

- Most of the respondents are living close and within 800m from a large supermarket, grocery store, and restaurant/take-away. This can be related to the fact that most of the respondents are living within a strong or very strong urbanized area;
- The majority of the respondents is living within 2.0 km from a road entrance way and within 4.0 km from a train station.

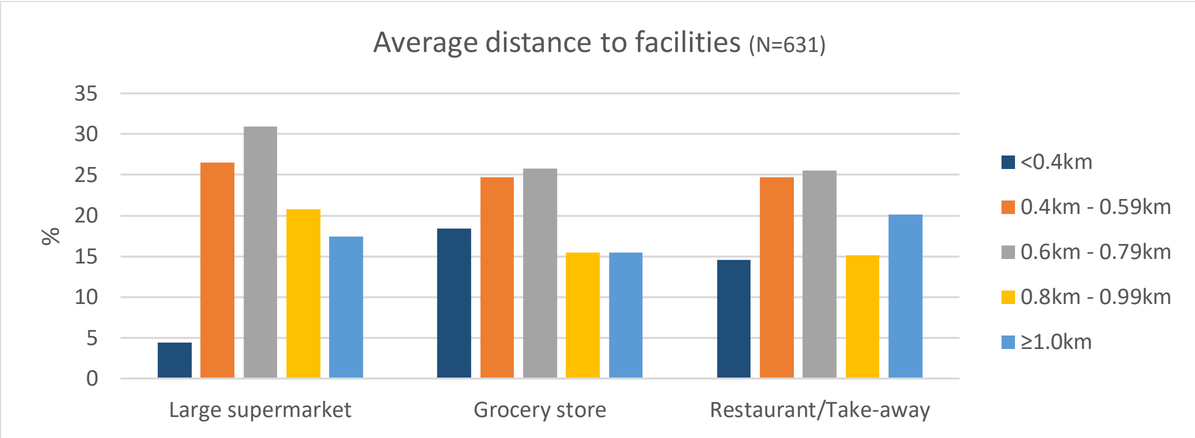


Figure 22 | Average distance to closest facility

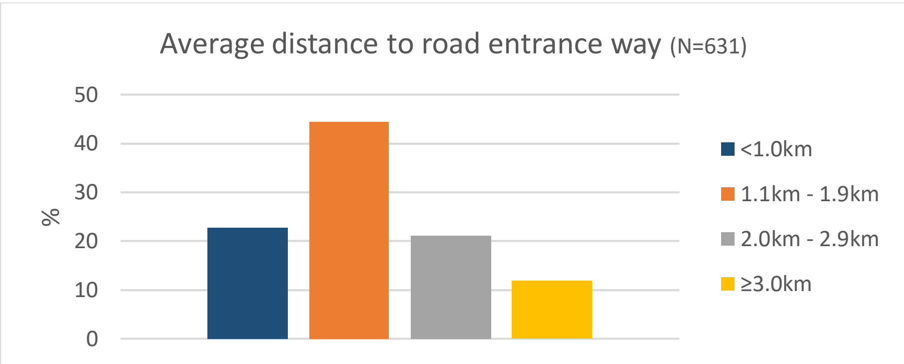


Figure 23 | Average distance to closest road entrance way

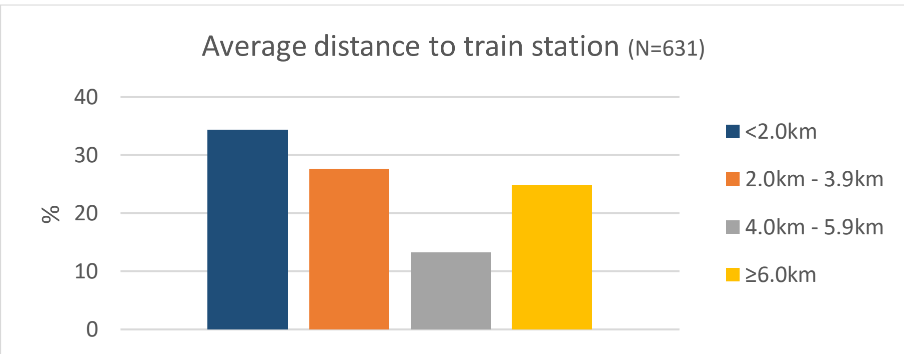


Figure 24 | Average distance to closest train station

4.4. Carsharing and Ownership

4.4.1. Carsharing Profiles

Within the stated choice part of the questionnaire, the respondents are asked multiple times (6 sets per respondent; total of 3786 sets) to choose between several choice alternatives, containing two selected profiles (cards) of attributes of a carsharing and parking system. In total, every profile is assigned on average 281 times, divided among the respondents. From the results of the respondents' choices, a top 3 of most preferable profiles can be determined, based on the response frequency of the profiles (Table 14 and Table 15).

For example: in total, profile 9 is offered in 280 sets. From these 280 sets, the profile is 202 times (72.1%) chosen as most preferred profile.

Table 14 | Top 3 - Most preferable carsharing profiles

Ranking	Profile ID	Frequency Offered	Frequency - chosen as most preferred ∨	Percentage (%) - chosen as most preferred ∨
1	9	280	202	72.1
2	15	281	200	71.2
3	1	280	194	69.3

Table 15 | Attributes Top 3 - Most preferable carsharing profiles

Profile Attribute	Profile 9	Profile 15	Profile 1
Waiting time for shared car	0 minutes	5 minutes	0 minutes
Walking distance to shared car	100 meters	50 meters	0 meters
Costs per month	€15	€15	€5
Usage costs per hour	€2	€2	€6
Usage costs per km	€0.20	€0.20	€0.30
Reserved parking spot	Yes	Yes	Yes
Fuel type	Electric	Electric	Benzine
Cost parking	€0	€0	€0
Walking distance to parking	0 meters	200 meters	0 meters
Type of parking	Parking Garage	Parking area/park	On street

Concluding from Table 15, the respondents prefer the carsharing systems with shorter distances, shorter waiting times, and with the lower costs, which seems logical since this is more profitable for the respondents.

The complete analysis of the most preferable carsharing profiles is elaborated in Appendix V.

4.4.2. Giving up private car(s)

After the presented carsharing and parking profiles, the respondents are asked to indicate if they would consider giving up their private car(s) in favour of the most preferred particular carsharing system out of the two profiles. As can be seen in Figure 25, almost 80% of the respondents' responses are indicating that it is *very unlikely* or *unlikely* to give up private car(s) for a carsharing system. On the other hand, around 20% of the results of the respondents indicates that it is *likely* or *very likely* to give up a private car for a carsharing system.

This emphasised the need for the upcoming research towards the factors that contribute to the willingness of residents to give up their private car(s) for carsharing mobility options, to be able to offer a positive contribution to the mentioned issues and stimulation of shared mobility options.

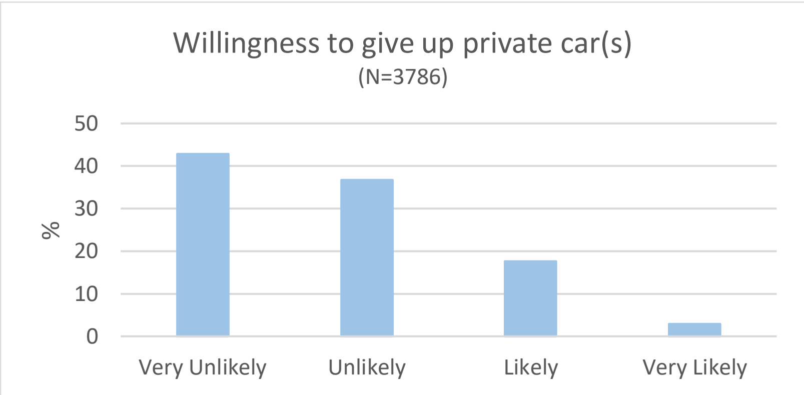


Figure 25 | Willingness to give up private car(s) for carsharing and parking system

4.5. Multicollinearity Analysis

4.5.1. Bivariate Analysis

A bivariate analysis will be performed to check for multicollinearity between the independent factors within each category. Eventually, when factors are too high correlated, they are excluded in the upcoming extended correlation analysis. First, the correlations are checked within each category (Socio-demographic characteristics; Urban & Living Environment characteristics; Travel demand characteristics; Carsharing characteristics).

Table 16 - Table 19 specify if factors are correlated. When a (too high) correlation appears between a set of factors, these could give problems in the upcoming model development. If the correlation value is stronger than (-)0.500, then the factors would be considered as correlated (orange cell) (Heijnen, 2017). In this case, it is useful to not use the factors together in upcoming analyses. When there is no significant correlation between two factors (correlation weaker than (-)0.500), the cell has no colour.

The full SPSS bivariate correlation outputs are presented in Appendix VI.

Table 16 | Correlations Socio-demographic characteristics

	Gender	Age	Household	Education	Income	N. of cars
Gender						
Age						
Household						
Education						
Income						
N. of cars						

Table 17 | Correlations Urban & Living environment characteristics

	1	2	3	4	5	6	7	8	9
1. Housing type									
2. Owning or renting									
3. Location parking									
4. Urbanity level									
5. Distance to closest large supermarket									
6. Distance to closest grocery store									
7. Distance to closest restaurant or take-away									
8. Distance to closest road entrance way									
9. Distance to closest train station									

Table 18 | Correlations Travel Demand characteristics

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Most used mode for work																
2. Number of days to work																
3. Average travel distance to work																
4. Average travel time to work																
5. Most used mode for grocery																
6. Number of days to grocery																
7. Average travel distance to grocery																
8. Average travel time to grocery																
9. Most used mode for shopping																
10. Number of days to shopping																
11. Average travel distance to shopping																
12. Average travel time to shopping																
13. Most used mode for leisure/free time																
14. Number of days to leisure/free time																
15. Average travel distance to leisure/free time																
16. Average travel time to leisure/free time																

Table 19 | Correlations Carsharing characteristics

	1	2	3	4	5	6	7	8	9	10	11	12
1. Waiting time for shared car												
2. Walking distance to location shared car												
3. Costs for carsharing subscription per month												
4. Additional usage costs per hour												
5. Additional usage costs per km												
6. Reserved parking spot at destination?												
7. Fuel type of shared car												
8. Costs of parking in living surrounding												
9. Walking distance to closest located parking spot												
10. Type of parking area/spot												
11. Preferable combination (card/profile)												
12. Likeliness to give up their private car												

Concluding from the bivariate analysis:

- All the socio-demographic factors could be used together in the upcoming analyses, since there is no significant correlation;
- From the urban & living environment factors, the *urbanity, distance to a large supermarket*, *distance to grocery store*, and *distance to restaurant/take-away*, could not be used together in analyses, since they are highly correlated to each other. This could be explained by the fact that the urbanity level already indicates how close facilities and services are located to each other. Therefore, the *distance to a large supermarket*, *distance to grocery store*, and *distance to restaurant/take-away* are excluded in upcoming analyses;
- From the travel demand factors, the *travel times* could not be used together with the *travel distances* of the same activity. However, this was already the expectation, since travel times and travel distances were closely related in the descriptive analysis. Therefore, the *travel times* is excluded in upcoming analyses;
- From the travel demand factors of work-related activities, the *number of days to work* could not be used together with the *travel times* and *distances* to work activities. Since the travel times are already excluded, and the distances of the other activities are remaining, the *number of days to work* is excluded. In this way, *'the distance to activity'* factor of all the activity types remains in the upcoming analyses;
- Finally, from the carsharing factors, the subscription and usage costs are considered as three separated factors in the original questionnaire and dataset (costs per month - per hour - per km). However, according to the correlations, these three factors could certainly not be used together in upcoming analyses (correlation of (-)1.000). This can be explained by the fact that a particular subscription cost per month is always coupled to the same usage costs per hour and km. Therefore, only the *subscription costs per month* will be considered in upcoming analyses.

4.5.2. Overall Correlation Analysis

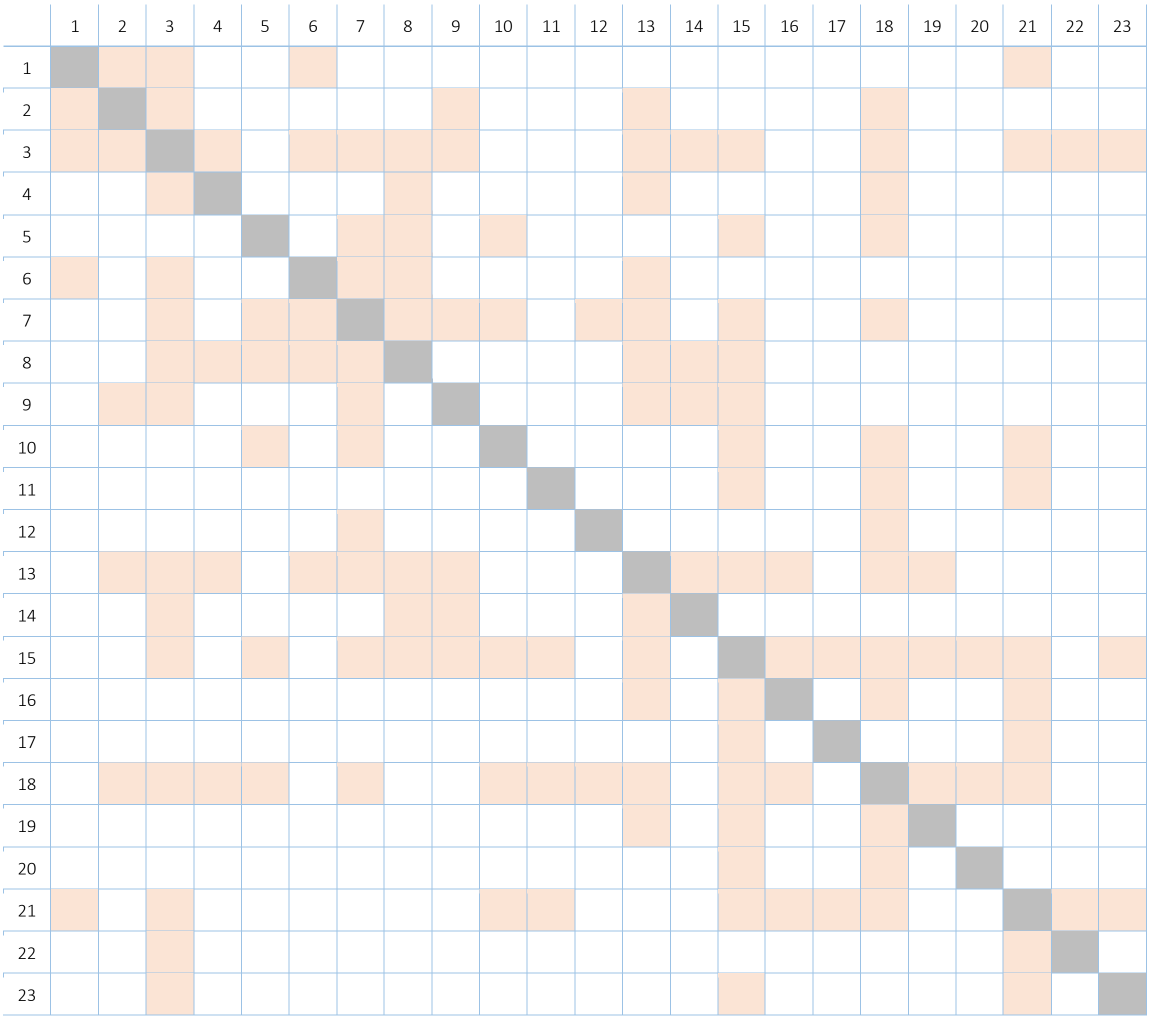
After checking for correlations within each category, an additional correlation analysis will be performed among and between all the independent factors. When a correlation appears between a set of factors, these could give problems in the model development. The characteristics of the carsharing profiles are disregarded in this correlation analysis.

The following factors are considered in the analysis:

1. Gender
2. Age
3. Household composition
4. Education level
5. Income level
6. Number of cars
7. Housing type
8. Owning or renting
9. Location parking
10. Urbanity level
11. Distance to closest road entrance way
12. Distance to closest train station
13. Most used mode for work
14. Average travel distance to work
15. Most used mode for grocery
16. Number of days to grocery
17. Average travel distance to grocery
18. Most used mode for shopping
19. Number of days to shopping
20. Average travel distance to shopping
21. Most used mode for leisure/free time
22. Number of days to leisure/free time
23. Average travel distance to leisure/free time

Table 20 specifies if factors are correlated. When a (too high) correlation appears between a set of factors, this could give problems in the upcoming model development. If the correlation value is stronger than (-)0.500 or when the p-value is lower than 0.05, then the factors would be considered as correlated (orange cell) (Heijnen, 2017). When there is no or weak correlation between two factors (correlation weaker than (-)0.500 or p-value higher than 0.05), the cell has no colour. A full overview with specific correlation values is presented in Appendix VI.

Table 20 | Correlation analysis



Concluding from this correlation analysis:

- The composition of the households is often correlated at an unacceptable level (number 3) (correlated in 14 of the 22 cases);
- The modes for the specific activities often correlated at an unacceptable level (numbers 13-15-18-21) (correlated in 10-15 of the 22 cases).

Since high and often-correlated factors could give problems in the upcoming model development, these factors are excluded in upcoming analyses and model development.

Table 21 presents the overview without the 'often-correlated' factors. Then, still some correlations exist, but not so often that the particular factor has to be excluded (now only correlated in maximum 6 of the 17 cases). Besides, factors regarding the Housing and Parking situation (numbers 7, 8 and 9) are still considered to be crucial in the research towards the willingness to give up private cars. Therefore, they will still be included in upcoming analyses. However, these insights have to be considered when problems occur.

Appendix VII gives an overview of the excluded and included factors towards the upcoming model analysis and development.

Table 21 | Correlation Analysis without the correlated factors

	1	2	4	5	6	7	8	9	10	11	12	14	16	17	19	20	22	23
1																		
2																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		
11																		
12																		
14																		
16																		
17																		
19																		
20																		
22																		
23																		

4.6. Conclusion

This chapter presented the descriptive analysis and multicollinearity analysis towards the used data of van der Waerden (2019a, 2019b) in combination with the self-added data. The categories of factors, as elaborated in the conceptual model, are considered in the descriptive analysis. Since these are very dependent and different per individual, it is difficult to determine these afterwards.

The sample description indicates that most of the respondents within the study of van der Waerden (2019a, 2019b) are between 30 and 49 years old, have a high level of education background, living within a multi-person household, are living in a strong or very strong urbanized area, and have an above average or higher income. Important for this study is that all the respondents have access to at least one car.

Research towards the travel behaviour and most frequently used mobility mode, shows that the car will most frequently be used across all considered activity types. These cars are mostly parked on street. This is related to the issue of pressure on urban space by the increasing use of land that parked cars are occupying. Since travel distance and travel time are closely related, the car is mostly used for the distances within 20km and related travel times up to 30 minutes. Besides, the respondents are living close to facilities and services as supermarkets, groceries, main road entrances, or train stations.

Regarding the willingness of residents to give up their private car(s), the research sample showed that most of the respondents are indicating that it is *very unlikely* or *unlikely* to give up private car(s) for a carsharing system. This emphasised the need for additional research towards the factors and relations that contribute to the willingness of residents to give up their private car(s) for carsharing mobility options, to be able to offer a positive contribution to the mentioned issues and stimulation of shared mobility options.

Finally, a multicollinearity analysis is performed among the independent factors. The analysis showed that some factors are correlated at an unacceptable level, and therefore have to be excluded in further analysis and model development. These conclusions will be used as input for the upcoming model development towards the residents' willingness to give up private cars.

Chapter 5

Model Development

In this chapter, regression models are specified and estimated. As discussed in the research approach, an ordinal (logistic) regression model will be developed first. Dependent on the outcome of the model, there will be decided if a multinomial logistic regression model is needed. Based on the performance and interpretation of the model, a final model is specified which is able to predict the willingness of residents to give up their private car(s). The statistical software package IBM SPSS® Statistics 24 will be used to develop the model.

5.1. Base Model

On the first hand, the statistical regression analysis showed several warnings, outliers in parameter estimates, and irregularities that might disturb the regression analyses. Originally, the dependent variable included 4 alternatives. Due to the weak distribution towards 'Very Likely' and 'Likely', there has been decided to merge the dependent factors to 3 alternatives: (1) Very Unlikely, (2) Unlikely, and (3) (Very) Likely. In this case, the warnings, outliers and (most of) the irregularities disappeared. Now, a base model is created. This base model includes all the factors and levels as identified in the previous chapter.

5.1.1. Base Model - Ordinal Logistic Regression

The model performances of the ordinal logistic regression base model indicate that it fails to confirm the main test of proportional odds; the null hypothesis should be rejected (p-value <0.05 - Table 22), which indicates that the ordinal and slope coefficients are not equal across the levels of the outcome (UCLA Statistical Consulting Group, 2020). Therefore, the ordinal logistic regression output is not reliable and sufficient, and a less restrictive model (multinomial logistic model) should be applied instead of an ordinal logistic regression model.

Table 22 | Test of Parallel Lines - Ordinal logistic regression Base Model

Test of Parallel Lines

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	7396.292			
General	6790.975	605.317	63	0.000

Appendix VIII present the full model performance SPSS-outputs of this model.

5.1.2. Base Model - Multinomial Logistic Regression

Since the ordinal regression output is not applicable, a multinomial logistic regression model is applied. Table 23 and Table 24 are showing the model comparison and performances of the estimated multinomial logistic regression base model. The model fitting information indicates that the created model (in table: Final) is significantly different (p-value <0.05) and better (based on the -2 log likelihood) in performance than a model with an intercept only. The Nagelkerke result indicates that 21.4% of the variance in the dependent factor is explained.

Table 23 | Model Fitting Information - Multinomial Logistic Regression Base Model

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	7923.210			
Final	7132.368	790.842	126	0.000

Table 24 | Pseudo R-Square Performance - Multinomial Logistic Regression Base Model

Pseudo R-Square	
Nagelkerke	0.214

Appendix VIII present the full SPSS-outputs and results of this model.

The base model is specified. In the upcoming sub-chapter, the model will be improved and optimized. The optimization of the model is performed by means of merging of levels or factors, as indicated by Appendix IX.

5.2. Multinomial Logistic Regression Model

5.2.1. Model Performance

The base model is improved to optimize the plausibility and explainability of the individual levels. To evaluate the model performance of this final model, the model performance indicators of this model and the base model are compared. Appendix X present the full SPSS-outputs and results of the model.

Table 25 | Model Performance - Base model versus Multinomial Logistic model

Model	Model Fitting - Log Likelihood	Model Fitting - Significance	Pseudo R^2 (Nagelkerke)
Base Model - Multinomial L. Reg.	7132.210	0.000	0.214
Multinomial Logistic Regression Model	7294.965	0.000	0.171

Table 25 indicates that the final model (Multinomial Logistic Regression Model) is significantly different and better in performance than a model with an intercept only (model fitting p-value <0.05). The Log Likelihood and Pseudo R^2 results indicate that the final model will lose a small part of its predictive power (21.4% to 17.1%) in comparison to the base model.

However, this could be expected since levels are merged and the number of levels is decreased, resulting in less predictors and lowering of the model performance and predictive power. Still, 17.1% of the variance in the dependent factor is explained, which seems a good result overall, giving the fact that there was not much influence on the specification of most of the factors and levels.

Besides, the *predicted response category*, indicating which alternative of the dependent factor is predicted for each respondent by the developed model and SPSS® Statistics, is able to provide an additional indication of the model performance. When comparing these values with the actual outcome given by the respondents, an indicating could be given on how well the model is predicting correctly. As stated by Table 26, the model predicted 1905 cases (1059 + 711 + 135) correctly, which result in a model performance of 50.3% (1905 / 3786). This is an improvement towards (1) a basic prediction without any applied model (proportional distribution - Table 27) where only 33.3% is predicted correctly (1262 / 3786), and towards (2) an intercept only model (model without any independent factor - Table 28) where only 42.8% is predicted correctly (1620 / 3786).

Table 26 | Model Performance - Actual Likelihood versus Predicted Likelihood

		Predicted Response Category (Likelihood) by the model			
		Very Unlikely	Unlikely	(Very) Likely	Total
Actual Likelihood as indicated by the respondents	Very Unlikely	**1059**	494	67	1620
	Unlikely	577	**711**	100	1388
	(Very) Likely	329	314	**135**	778
	Total	1965	1519	302	3786

Table 27 | Model Performance - Basic Prediction

		Predicted Response Category (Likelihood) by the model			
		Very Unlikely	Unlikely	(Very) Likely	Total
Actual Likelihood as indicated by the respondents	Very Unlikely	**540**	540	540	1620
	Unlikely	462	**463**	463	1388
	(Very) Likely	260	259	**259**	778
	Total	1262	1262	1262	3786

Table 28 | Model Performance - Intercept Only Model

		Predicted Response Category (Likelihood) by the model	
		Very Unlikely	Total
Actual Likelihood as indicated by the respondents	Very Unlikely	**1620**	1620
	Unlikely	1388	1388
	(Very) Likely	778	778
	Total	3786	3786

5.2.2. Part-worth Utilities

Given that the model performance is acceptable, Table 29 presents the part-worth utilities and corresponding significance levels of the final multinomial logistic regression model. Appendix X present the full SPSS-outputs and results of this model.

Table 29 | Part-worth Utilities - Multinomial Logistic Regression Model

		Very Unlikely [a]			Unlikely [a]		
Category	Factor and Level	β-value		p-value	β-value		p-value
	Constant	1.848	**	0.000	1.123	**	0.000
Socio-demographic characteristics	Gender: Male	-0.373	**	0.000	-0.158	**	0.001
	Gender: Female	0.373			0.158		
	Age: <50 years old	-0.294	**	0.000	-0.120	**	0.039
	Age: ≥ 50 years old	0.294			0.120		
	Education: Primary, Secondary education, or Secondary vocational education (MBO)	0.084	*	0.089	-0.118	**	0.017
	Education: Higher professional education (HBO) or University education (WO)	-0.084			0.118		
	Income: Average or below: ≤ €28,399	-0.043	*	0.092	-0.220	**	0.001
	Income: Above average: ≥ €28,400	0.043			0.220		
	Number of cars: 1 car	0.098	*	0.084	0.043		0.454
	Number of cars: 2 or more cars	-0.098			-0.043		
Urban & Living Environment characteristics	Housing Type: Multi-storey	-0.135	*	0.075	-0.078		0.305
	Housing Type: Row House	0.239	**	0.000	0.265	**	0.000
	Housing Type: Other	-0.104			-0.187		
	Housing Type: Owning	0.061		0.231	0.099	*	0.052
	Housing Type: Renting	-0.061			-0.099		
	Parking Location: On street	-0.083		0.124	-0.103	*	0.055
	Parking Location: Off street	0.083			0.103		
	Urbanity: Moderate or lower	0.155	*	0.059	-0.098		0.231
	Urbanity: Strong	0.240	**	0.001	-0.029		0.688
	Urbanity: Very strong	-0.395			0.127		
	Proximity Road: ≤ 1.0 km	0.223	**	0.005	-0.047		0.565
	Proximity Road: 1.1 - 1.9 km	-0.244	**	0.000	0.047		0.464
	Proximity Road: ≥ 2.0 km	0.021			0.000		
	Proximity Train: < 4.0 km	0.090		0.111	-0.200	**	0.000
	Proximity Train: ≥ 4.0 km	-0.090			0.200		
Travel demand characteristics	Work - Average distance: < 10 km	-0.187	**	0.010	-0.103		0.152
	Work - Average distance: ≥ 10km	0.207	**	0.003	-0.049		0.485
	Work - Average distance: N/A	-0.020			0.152		
	Grocery - Freq: < 1x per week	0.072		0.670	-0.146		0.346
	Grocery - Freq: 1 - 2x per week	0.767	**	0.000	0.322	**	0.020
	Grocery - Freq: ≥ 3x per week	0.352	**	0.024	0.118		0.403
	Grocery - Freq: N/A	-1.191			-0.294		
	Grocery - Average distance: < 10 km	-0.713	**	0.004	0.015		0.954
	Grocery - Average distance: ≥ 10 km	-1.118	**	0.000	-0.877	**	0.001
	Grocery - Average distance: N/A	1.831			0.862		
	Shopping - Freq: ≤ 2x per week	-0.061		0.767	-0.628	**	0.002

	Shopping - Freq: ≥ 3x per week	0.516		0.105	0.512	*	0.098
	Shopping - Freq: N/A	-0.455			0.116		
	Shopping - Average distance: < 10 km	-0.725	**	0.000	-0.283	*	0.075
	Shopping - Average distance: ≥ 10km	-0.717	**	0.000	-0.202		0.208
	Shopping - Average distance: N/A	1.442			0.485		
	Leisure/Free time - Freq: < 1x per week	-0.230		0.129	-0.018		0.915
	Leisure/Free time - Freq: 1 - 2x per week	0.148		0.351	-0.039		0.823
	Leisure/Free time - Freq: ≥ 3x per week	0.738	**	0.000	0.151		0.485
	Leisure/Free time - Freq: N/A	-0.656			-0.094		
	Leisure/Free time - Av. distance: < 30 km	-0.244	*	0.097	0.316	*	0.059
	Leisure/Free time - Av. distance: ≥ 30 km	-0.400	**	0.007	-0.116		0.494
	Leisure/Free time - Av. distance: N/A	0.644			-0.200		
Carsharing characteristics	Waiting time: 0 min (directly)	0.026		0.695	-0.035		0.589
	Waiting time: 5 min	-0.067		0.327	0.018		0.795
	Waiting time: 10 min	0.041			0.017		
	Walking distance to shared car: 0 m	-0.059		0.383	-0.045		0.503
	Walking distance to shared car: 50 m	0.054		0.417	0.062		0.355
	Walking distance to shared car: 100 m	0.005			-0.017		
	Costs per month: 5 euro	0.055		0.409	-0.039		0.566
	Costs per month: 10 euro	0.012		0.865	0.125	*	0.064
	Costs per month: 15 euro	-0.067			-0.086		
	Reserved parking spot: Yes	-0.042		0.401	-0.012		0.810
	Reserved parking spot: No	0.042			0.012		
	Fuel type: Benzine	0.078		0.224	0.006		0.924
	Fuel type: Electric	-0.001		0.991	0.018		0.787
	Fuel type: Hybrid	-0.077			-0.024		
	Cost parking per month: 0 euro	-0.065		0.300	-0.166	**	0.009
	Cost parking per month: 10 euro	-0.037		0.581	0.026		0.700
	Cost parking per month: 20 euro	0.102			0.140		
	Walking distance to parking: 0 m	-0.054		0.413	-0.106		0.110
	Walking distance to parking: 100 m	-0.025		0.707	0.039		0.555
	Walking distance to parking: 200 m	0.079			0.067		
	Type of parking: On street	-0.137	**	0.038	-0.114	*	0.085
	Type of parking: Car park	0.124	*	0.060	0.078		0.233
	Type of parking: Parking garage	0.013			0.036		

a. Reference category: (Very) Likely
*** Significant at 5% level*
** Significant at 10% level*

5.2.3. Model Interpretation

The model is improved and optimized based on the model performance, part-worth utilities (the β-values of the coded individual levels), and significance of the individual levels. There is considered if the interpretations and assumptions of the outcome, as formulated by the model, are plausible and explainable.

Willingness to give up private car(s)
The constant in this model is positive and significant at the 95% confidence level for both alternatives of the dependent variable. The constant "represents on average the role of all the unobserved sources of utility" (Hensher et al., 2015, p. 210). The positive utilities indicate that it is more likely that the respondents would choose for 'Very Unlikely' or 'Unlikely' instead of '(Very) Likely' for giving up their private car(s). This is plausible, since the descriptive analysis already concluded that most of the respondents indicated that it is very unlikely or unlikely to give up their private car(s).

Socio-Demographic characteristics
The socio-demographic factors indicate that people who (1) are male, (2) are younger than average, (3) having an average or lower income, and (4) owning more than 1 car, are less intent to choose for 'very unlikely' or 'unlikely', but therefore are more willing to give up their private cars (choose for '(very) likely'). These results are almost all significant at the presented confidence levels and are in line with the findings of the literature study.

However, the assumptions regarding education level are showing a different interpretation. Concluding from the 'very unlikely' model, people with a lower education level are less willing to give up their private car, which is in line with the findings in the literature study. However, the results from the 'unlikely' part are indicating that people with a lower education level are more willing to give up their private car, which is not in line with the literature study. This could be explained by the fact that the 'very unlikely' response group are strongly outspoken, and the 'unlikely' group are more doubtful and less outspoken. Both sides are significant on at least the 90% confidence level.

Urban & Living Environment characteristics
The first part of the urban and living environment characteristics indicates that people who (1) are living in a multi-storey house, (2) are renting their house, and (3) parking their car on the street, are more willing to give up their private car(s). These results are not all significant on the confidence levels. This could be explained by the fact that these factors showed some correlations in the multi-collinearity analysis.

The model shows a different outcome between 'very unlikely' and 'unlikely' for the urbanity factor. It is plausible and in line with the literature that people in a very strong urbanized area are more willing to give up their private car(s) compared to lower urbanity levels, which is shown by the 'very unlikely' model. However, the 'unlikely' model shows an opposite behaviour, but is also not significant at the confidence levels.

The proximity to a main road or train station factors are showing a divided prediction, considering the 'very unlikely' and 'unlikely' part. However, the significant results show that people who are closely living to a main road, are less willing to give up their private car(s); for these people is could be more preferable to keep their cars since the access to a main road is close by. Besides, considering the significant results, people who are living closely to a train station are more willing to give up their private car(s) in comparison to people who are living on a longer distance from this facility; people are more inclined to use the train instead of a car when the train is available within a closer distance range, which seems plausible.

Travel Demand characteristics
In terms of travel distances, the model indicates that people who are travel (1) a short distance for work, (2) a long distance for grocery, (3) a short distance for shopping, and (4) a long distance for leisure/free time, are more willing to give up their private car(s). In the first place, this seems plausible, since a car could be more intended for longer distances instead of distances very close by that could also be performed by walking or cycling. The different behaviour for grocery activities could be explained by the fact that the group for the longer grocery distances is smaller and more strongly outspoken. Besides, since leisure/free time activities are less frequently undertaken and more on the longer distances, a carsharing concept (and giving up a car) could be more profitable for the longer distances. There has to be mentioned that not all the travel demand levels are significant at the confident levels. However, the interpretations of the utilities are plausible and explainable.

The frequencies of travelling show a consistent interpretation among all the travel purposes; people who are travel on a lower frequency are more willing to give up their private car(s). Although not all the levels are significant at the confident levels, this seems plausible since they need the car less often.

Carsharing characteristics
The factors regarding the carsharing characteristics do not show significant results; almost all the levels are not significant at the stated confidence levels. This indicates that the characteristics of the carsharing system do not add significant value to the willingness of people to give up their private car(s) for a carsharing system. However, this is in line with the findings of the literature study where it is concluded that changing the attributes of a carsharing system itself does not automatically have a direct impact on people's intention to give up on their current mobility option. This also confirms that understanding of the other categories and groups of factors, the personal and living environment, seems to be more crucial in the willingness of people to give up their private car(s).

5.3. Conclusion

This chapter specified and estimated a regression model which is able to calculate and predict the willingness of residents to give up their private car(s).

Based on the model performance, an ordinal logistic regression model is not reliable and sufficient, and a less restrictive model is applied. A multinomial logistic regression model is successfully specified with a well-considered plausibility and explainability of the factors and levels.

The socio-demographic factors, urban & living environment factors, and travel demand factors are considered to be good predictors towards the willingness of residents to give up their private car(s). The model indicates that people who are willing to give up their private car(s) (a higher utility towards '(very) likely' to give up private cars), are male, are younger than the age of 50, have a higher education level, an average or lower income, and owning more than 1 car. Besides, they live in a multi-storey housing type, in a rental house, park their car on the street, live within a very strong urbanized area, on a longer distance from a main road, and closely to a train station. Regarding travel behaviour, they travel a shorter distance for work or shopping activities, a longer distance for grocery or leisure/free time activities, and travel less frequently for all these activities. The factors directly related to the carsharing system do not add significant value to this willingness and indicates that understanding of the other factors are more crucial in the willingness of people to give up their private car(s).

Chapter 6

Model Application

After developing the model, which is able to calculate and predict the utility and probability of the willingness of residents to give up their private car(s), the model will be applied. First, the utility and probability functions are tested and verified using the data of van der Waerden (2019a). Next, the model will be applied using the WoON2012. Based on these results, maps are created within a geographical information system (GIS) environment to spatially visualize the distribution of the willingness to give up the private cars across the municipalities in the Netherlands. Insights will be given in the outliers or municipalities with higher potential.

6.1. Calculated Utility & Probability

The utility function is drafted based on the model output of chapter 5. A utility function can be specified for each individual alternative of the dependent factor. The utility functions consist of the constant and the additional part-worth utilities of each category and factors. Therefore, the utility (V) function for each level of the dependent factor is drafted in the form of function 6.1.

$$V_{likeliness} = \beta_{0\text{-}constant} + \beta_{socio\text{-}demographic} + \beta_{urban\ \&\ living\ environment} + \beta_{travel\ demand} + \beta_{carsharing} \qquad (6.1)$$

As an example, a respondent (out of the study of van der Waerden (2019a)) is considered with its own characteristics and one of the assigned carsharing systems, as stated by Table 30. This table also indicates the part-worth utilities of the characteristics, originating from the multinomial logistic regression model.

According to Table 30, the particular respondent corresponds with the following utilities:

$V_{very\ unlikely}$ = 0.379
$V_{unlikely}$ = 0.176
$V_{(very)\ likely}$ = 0 (utility of base/reference alternative)

Based on these utilities, the probability or likeliness can be calculated that the respondent would choose for ‘very unlikely’, ‘unlikely’, or ‘(very) likely’ to give up their private car(s), as stated by the functions 6.2-6.4. The ‘(very) likely’ alternative indicates the willingness of the resident to give up their private car(s). Function 6.5 controls for the mutual exclusiveness and exhaustiveness; the probabilities are between 0.00 and 1.00 and the sum of the probabilities is equal to 1.00.

$$\text{Probability (very unlikely)} = \frac{e^{0.379}}{e^{0.379} + e^{0.176} + e^{0}} = 0.40\ (40\%) \tag{6.2}$$

$$\text{Probability (unlikely)} = \frac{e^{0.176}}{e^{0.379} + e^{0.176} + e^{0}} = 0.33\ (33\%) \tag{6.3}$$

$$\text{Probability ((very) likely)} = \frac{e^{0}}{e^{0.379} + e^{0.176} + e^{0}} = 0.27\ (27\%) \tag{6.4}$$

$$\text{Total Probability} = 0.40 + 0.33 + 0.27 = 1.00 \tag{6.5}$$

These values are verified by the calculation of the SPSS® Statistics software, which predicted that the particular respondent will most likely choose for ‘very unlikely’ (prob. 0.40), followed by ‘unlikely’ (prob. 0.33) and ‘(very) likely’ (prob. 0.27).

Table 30 | Example Utility Calculation for a respondent (ID: 285928)

		Very Unlikely [a]	Unlikely [a]
Category	**Factor and Level**	**β-value**	**β-value**
	Constant	1.848	1.123
Socio-demographic characteristics	Gender: Female	0.373	0.158
	Age: <50 years old	-0.294	-0.120
	Education: Primary, Secondary education, or Secondary vocational education (MBO)	0.084	-0.118
	Income: Above average: ≥ €28,400	0.043	0.220
	Number of cars: 2 or more cars	-0.098	-0.043
Urban & Living Environment characteristics	Housing Type: Other	-0.104	-0.187
	Housing Type: Renting	-0.061	-0.099
	Parking Location: On street	-0.083	-0.103
	Urbanity: Moderate or lower	0.155	-0.098
	Proximity Road: ≥ 2.0 km	0.021	0.000
	Proximity Train: ≥ 4.0 km	-0.090	0.200
Travel demand characteristics	Work - Average distance: ≥ 10km	0.207	-0.049
	Grocery - Freq: ≥ 3x per week	0.352	0.118
	Grocery - Average distance: < 10 km	-0.713	0.015
	Shopping - Freq: ≤ 2x per week	-0.061	-0.628
	Shopping - Average distance: ≥ 10km	-0.717	-0.202
	Leisure/Free time - Freq: < 1x per week	-0.230	-0.018
	Leisure/Free time - Av. distance: ≥ 30 km	-0.400	-0.116
Carsharing characteristics	Waiting time: 0 min (directly)	0.026	-0.035
	Walking distance to shared car: 50 m	0.054	0.062
	Costs per month: 5 euro	0.055	-0.039
	Reserved parking spot: Yes	-0.042	-0.012
	Fuel type: Electric	-0.001	0.018
	Cost parking per month: 10 euro	-0.037	0.026
	Walking distance to parking: 200 m	0.079	0.067
	Type of parking: Parking garage	0.013	0.036
	Total Utility	**0.379**	**0.176**

a. Reference category: (Very) Likely

6.2. Application WoON

6.2.1. Introduction

The developed model will be applied using the dataset of the WoON2012 to calculate the utility and potential share for almost all the municipalities in the Netherlands towards the residents' willingness to give up private car(s).

Within the dataset, approximations are made towards the *average distance* factors of *grocery* and *shopping* activities. The approximations are based on comparisons of the municipalities' area surfaces. Municipalities out of the WoON2012 with similar area surfaces as municipalities out of the data of Van der Waerden (2019a) are coupled to the same distances to grocery and shopping activities.

Within the dataset, some respondents did not answer all the questions within their questionnaire. Therefore, these respondents are excluded. In total, 11,323 respondents are remaining in the WoON2012 dataset, who are residing in 367 Dutch municipalities (out of a total of 415, according to the Dutch municipal distribution of 2012 (BZK & CBS, 2012)). Besides, a single predefined carsharing system is composed and applied to all the respondents, based on average levels, as stated in Table 31.

Table 31 | Predefined carsharing system for model application

Factor	Predefined level	Factor	Predefined level
Waiting time	5 minutes	*Fuel type*	Benzine
Walking distance to shared car	50 meters	*Cost parking per month*	10 euro/month
Costs per month	10 euro/month	*Walking distance to parking*	100 meters
Reserved parking spot	Yes	*Type of parking*	On street

6.2.2. Potential Share and Number of Households & Cars

As stated in the research approach of chapter 3.7, the probabilities to give up private cars of each respondent are translated to the Dutch municipalities. Therefore, a first insight can be presented into the municipalities with a higher or lower share of residents with the willingness to give up private cars and the corresponding number of households and cars.

Example - Municipality of Appingedam (mun. code: 3)
Assuming an example of the municipality of Appingedam (municipality code: 3), where an average municipal share in the willingness to give up private cars of 0.0948 (9.5%) is calculated among the represented respondents:

Respondent 1: Probability to give up private cars - (very)likely: 0.1290
Respondent 2: Probability to give up private cars - (very)likely: 0.1347
Respondent 3: Probability to give up private cars - (very)likely: 0.0641
Respondent 4: Probability to give up private cars - (very)likely: 0.0512 +
0.3790

$$\text{Municipal share in the willingness to give up private cars: } \frac{0.3790}{4 \text{ (respondents)}} = 0.0948 \text{ (9.5\%)} \quad (6.6)$$

To calculate the number of households that are willing to give up private cars, the total number of households within the municipality (5517 households in Appingedam, according to CBS (2012a)) will be multiplied by the municipal share of the willingness to give up private cars (0.0948). This results in function 6.7 and 523 households within the municipality with the willingness to give up their private cars.

$$\begin{aligned}\text{Number of Households giving up cars} &= \text{Total N. Households} \times \text{Share of willingness}\\ &= 5517 \times 0.0948\\ &= 523 \text{ households}\end{aligned} \tag{6.7}$$

The potential reduction in the number of private cars for the municipality of Appingedam is calculated by multiplying the number of households that are willing to give up private cars (523) by the average number of cars per household presented within the municipality (for Appingedam: average of 1.0 cars per household, according to CBS (2012a)). This results in function 6.8 and a potential reduction of 523 cars.

$$\begin{aligned}\text{Reduction in Cars} &= \text{N. Households giving up cars} \times \text{Average N. Cars per Household}\\ &= 523 \times 1.0\\ &= 523 \text{ private cars}\end{aligned} \tag{6.8}$$

Appendix XI gives an overview of the potential share, the number of households, and the related reduction in the number of cars per Dutch municipality towards the willingness to give up private cars. Besides, it indicates the missing municipalities, with no corresponding data in the dataset.

6.3. Mapping

By the application using the WoON2012, maps are created within a geographical information system (GIS) environment to spatially visualize the distribution of the willingness to give up the private car(s) across the municipalities in the Netherlands.

6.3.1. Potential share to give up private cars

Figure 26 on the next page visualizes the spatial distribution of the potential share in the willingness to give up private cars per municipality (related to the willingness of '(very) likely'). Appendix XII presents the same map, including the specific values per municipality. Besides, it presents the maps including the specific values for the willingness of *Unlikely* and *Very Unlikely.*

The map and related results showing that the potential willingness to give up private cars, related to the willingness of '(very) likely', is between 7% and 26% per municipality. Several clusters of high potentials (15-20%) can be determined that are distributed across the Netherlands. Especially in the east of the Netherlands, a cluster becomes visible with potentials above 15%. The few municipalities with the lowest potentials (5%-10%) are not clustered but located next to a municipality with a higher potential. For example, the municipality of Bunnik with a low potential (7%) is located near the municipality of Utrecht with a higher potential (16%).

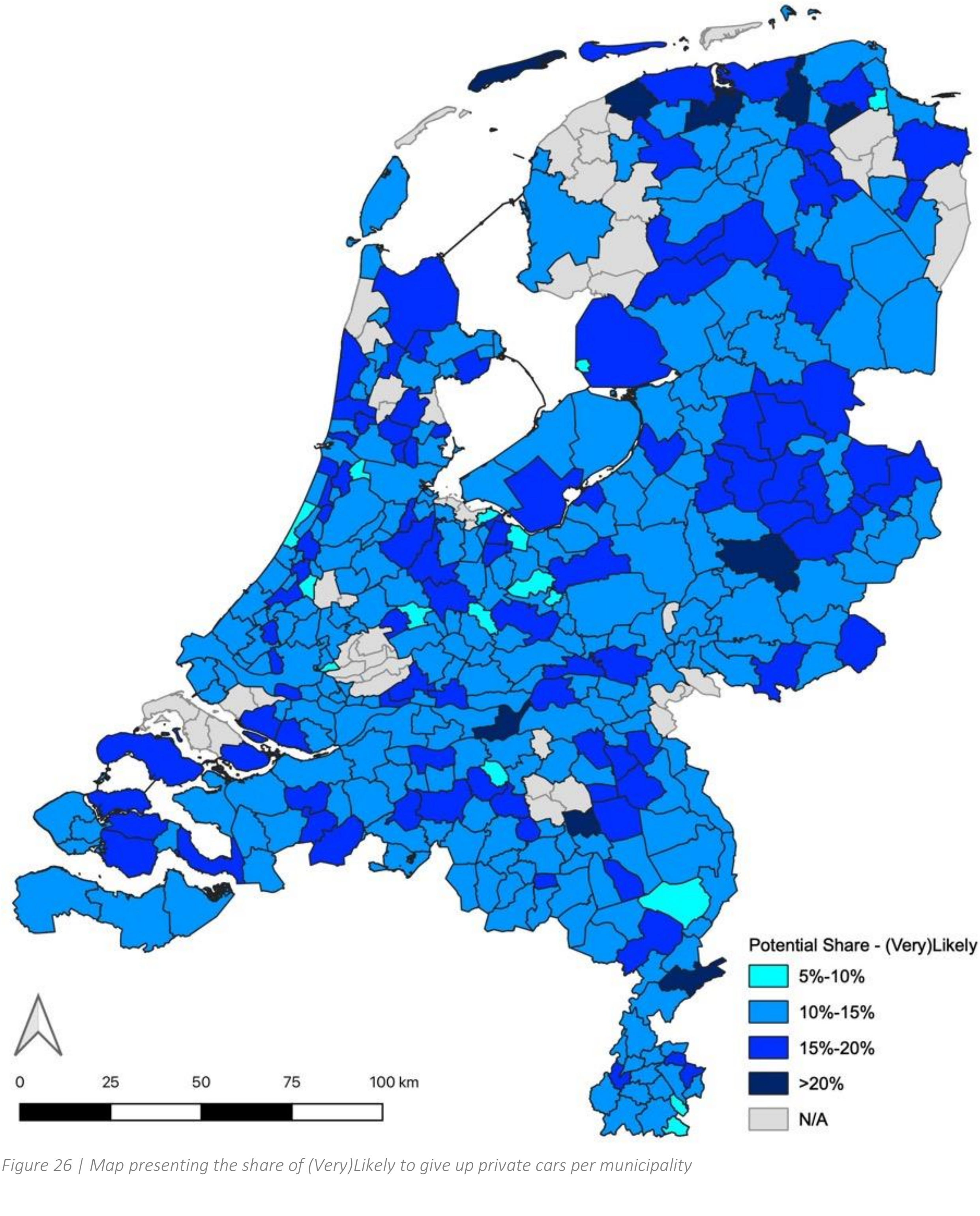


Figure 26 | Map presenting the share of (Very)Likely to give up private cars per municipality

6.3.2. Number of Households - Giving up their private car(s)

Figure 27 visualizes the spatial distribution of the number of households that are willing to give up their private cars per municipality (related to the willingness of '(very) likely'). Appendix XII presents the same map, including the specific values per municipality.

This gives a slightly different outcome as presented in Figure 26. The map shows several clusters of stronger urban cities, such as Amsterdam or Rotterdam, with a high number of households (>6000) with the willingness to give up their private cars. The calculated number of households with the willingness to give up private cars is lower in the more rural areas.

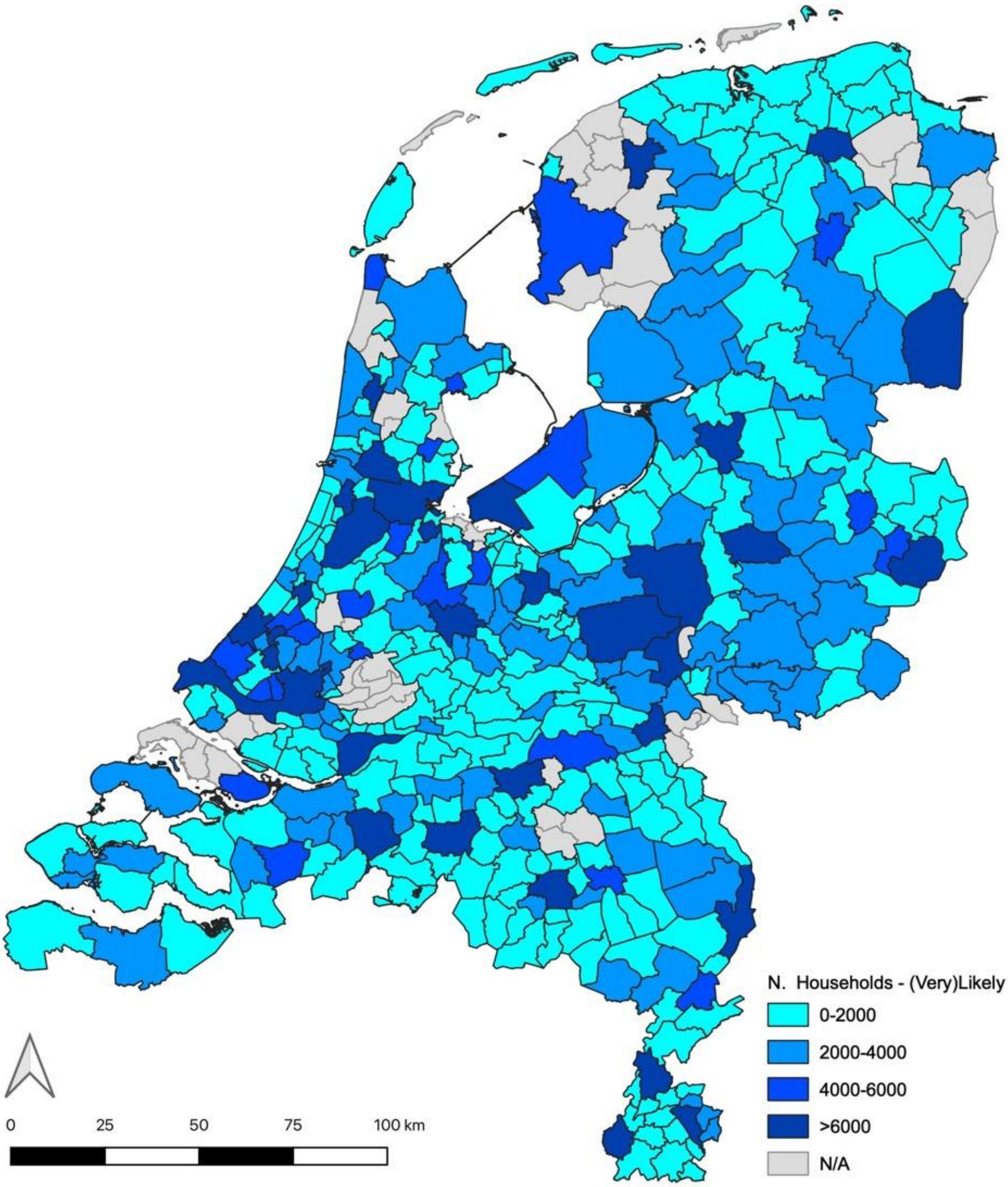


Figure 27 | Map presenting the number of households that are willing to give up private car(s) per municipality

6.3.3. Reduction in number of Cars

Figure 28 visualizes the spatial distribution of the number of cars that potentially could be given up by each municipality; the reduction in number of cars (related to the willingness of '(very) likely'). Appendix XII presents the same map, including the specific values per municipality.

This map shows slightly different patterns in comparison to the map of Figure 27, resulting from the function where the number of households is multiplied by the average number of cars per household presented within the municipality. In the figure below, clusters are noticeable around the major Dutch municipalities as Amsterdam, Rotterdam or The Hague. Less clusters with a high number of cars that potentially could be given up could be find in the north of the Netherlands.

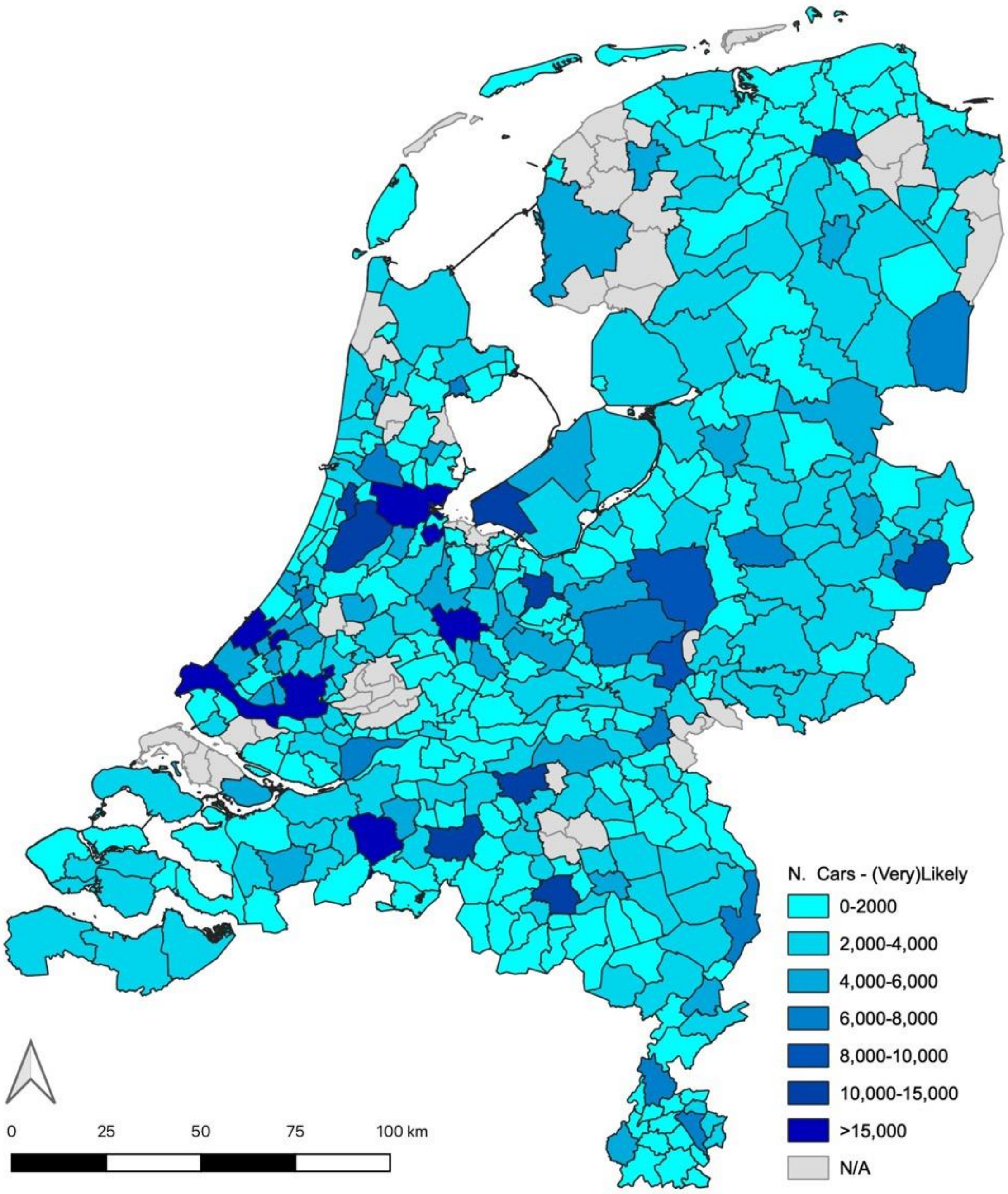


Figure 28 | Map presenting the potential reduction in the number of cars by each municipality

6.4. Insights in Municipalities

After mapping, specific insights and the reasoning behind the distributions within the maps can be analysed and described.

6.4.1. Top-5

Based on the presented maps and related data, a top-5 can be determined of the municipalities with the highest potential share in the willingness to give up private cars (related to the willingness of (very) likely) (Table 32) and the municipalities with the highest potential reduction in the actual number of cars (Table 33).

As can be noticed, the potential number of cars that could be given up (or the reduction in the number of cars) is not only dependent on the municipal's share in giving up private cars. Actually, the number of households within the municipalities highly determines this potential reduction in the number of cars. Therefore, Table 33 could be nuanced by the fact that the high potential reduction in the number of cars is more resulting from the municipality size in terms of the number of households, than from the potential share in giving up private cars.

Table 32 | Top-5 of municipalities with the highest potential share in the willingness to give up private cars

Ranking	Municipality (mun. code-2012)	Share in giving up private cars - (very)likely ∨	Reduction in N. of Cars - (very)likely
1	• Terschelling (93)	26%	577
2	• Ferwerderadiel (1722)*	24%	879
3	• Kollimerland en Nieuwkruisland (79)* • Winsum (53)	22%	1382 1547
4	• Laarbeek (1659) • Lochem (262) • Maasdriel (263) • Roerdalen (1669) • Ten Boer (9)	21%	2379 3814 2561 2485 746
5	• Beemster (370) • Landerd (1685) • Oostflakkee (580) • Ouder-Amstel (437) • Uitgeest (450) • Waalre (866)	20%	854 1615 4228 1180 1128 1827

* The municipality of *Ferwerderadiel* and *Kolimmerland en Nieuwkruisland* have merged into the municipality of Noardeast-Fryslân on January 01, 2019.

Table 33 | Top-5 of municipalities with the highest potential reduction in the number of cars

Ranking	Municipality (mun. code-2012)	Reduction in N. of Cars - (very)likely ∨	Share in giving up private cars - (very)likely
1	Rotterdam (599)	33,231	15%
2	Amsterdam (363)	32,305	15%
3	's-Gravenhage/The Hague (518)	26,358	15%
4	Utrecht (344)	21,395	16%
5	Breda (758)	17,482	12%

6.4.2. Insights in the Top-5

Based on the previous maps and top-5, two examples of insights are presented. By giving insights, the underlying reasoning becomes clear why several municipalities have a higher or lower willingness to give up private cars and potential reduction in the number of private cars.

Potential Share in Willingness

Figure 29 marks the municipalities of Terschelling (municipality code: 93) and Ferwerderadiel (municipality code: 1722), the municipalities with the highest potential share in the willingness to give up private cars (related to the willingness of '(very) likely') with respectively 26% and 24%.

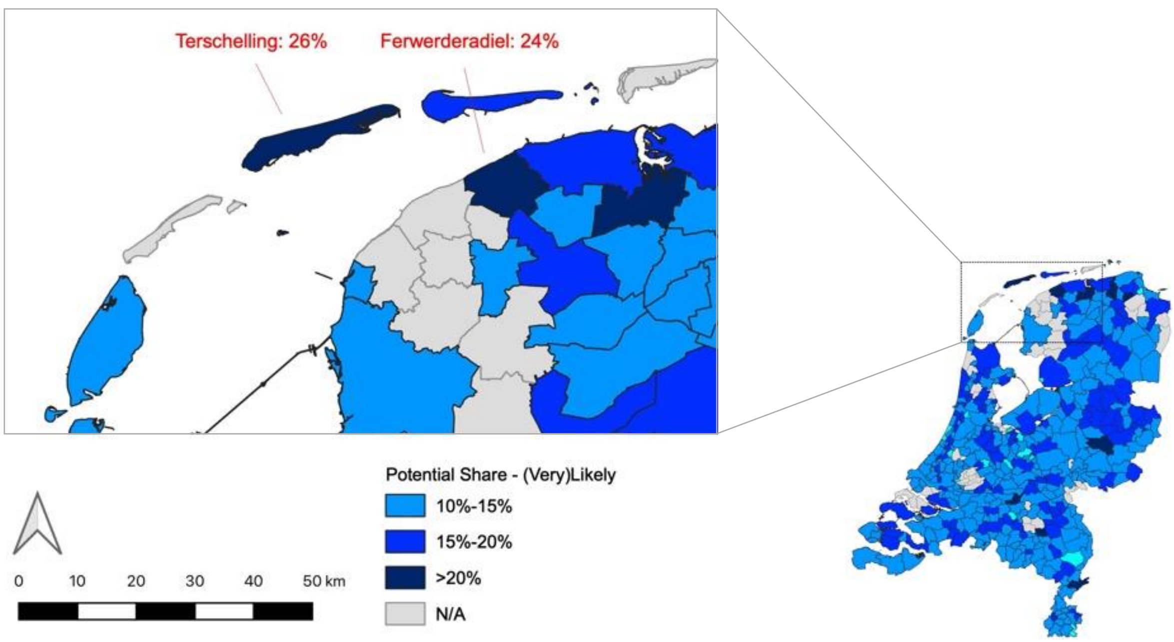


Figure 29 | Map of the potential share (Very) Likely to give up private cars, municipalities of Terschelling and Ferwerderadiel

These results can be explained by the fact that most of the respondents of these municipalities: are male, are below the age of 50, having an average or lower income, having 2 or more cars within their household, living in a multi-storey housing type, living in a rental house, and living within a higher distance to a main road, (…). These related levels are associated with a less positive utility towards 'very unlikely' and 'unlikely' to give up private cars, and therefore more positively towards '(very) likely'.

In comparison to one of the municipalities with the lowest potential share in the willingness to give up private cars, the municipality of Leusden (mun. code: 327 - potential share of 7%), clear differences in the characteristics of the respondents can be observed. Figure 30 marks the municipality of Leusden. Most of the respondents from this municipality: are female, above the average age, having an above average income, having 1 car within their household, and living in a row housing type, (…). All these differences in levels are associated with a more positive utility towards ‘very unlikely’ and ‘unlikely’ to give up private cars, and therefore less positively towards ‘(very) likely’. This results in the lower potential share in the willingness to give up private cars.

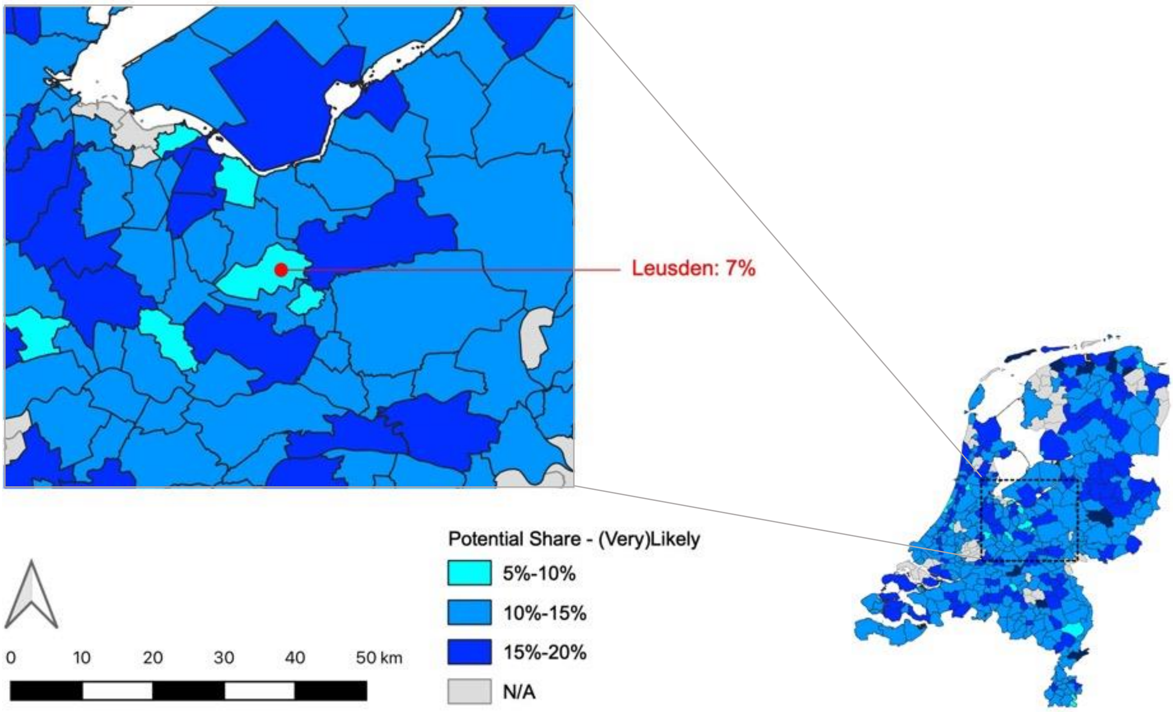


Figure 30 | Map of the potential share (Very) Likely to give up private cars, municipality of Leusden

Appendix XIII presents the overview of the most observed characteristics and levels of the respondents in the municipality of Terschelling and Ferwerderadiel. In addition, Appendix XIV presents the overview of the respondents in the municipality of Leusden.

However, as can be noticed in Figure 28 and Table 32, the municipalities of Terschelling and Ferwerderadiel are not associated with a high reduction in the actual number of cars. This because the municipalities consist of only 2186 (Terschelling) and 3645 (Ferwerderadiel) households, of which respectively 577 and 879 households with the willingness of ‘(very) likely’ to give up their private car(s). This corresponds with only 577 (Terschelling) and 1054 (Ferwerderadiel) private cars that potentially could be reduced, based on the CBS (2012a) statistics of the number of cars per households. Concluding, these two municipalities have the highest potential share in in the willingness to give up private cars within the Netherlands. However, this does not directly result in the highest reduction in the actual number of cars within a municipality.

Potential reduction in the number of Cars

Figure 31 marks the municipalities of Rotterdam (municipality code: 599), Amsterdam (municipality code: 363), ‘s-Gravenhage/The Hague (municipality code: 518), Utrecht (municipality code: 344), and Breda (municipality code: 758), the municipalities with the highest potential reductions in the number of cars, based on the willingness of ‘(very) likely’ to give up private cars.

As mentioned, this is more a result of the municipality size in terms of the number of households, than from the potential share in giving up private cars. Considering the potential share in the willingness to give up private cars, the municipalities scoring respectively lower (12%-16%) than the municipalities of Terschelling and Ferwerderadiel.

The municipalities consist of respectively 47,473 (Rotterdam), 64,609 (Amsterdam), 37,654 (‘s-Gravenhage/The Hague), 26,743 (Utrecht), and 10,284 (Breda) households with the willingness of ‘(very) likely’ to give up private cars. This could result in a private car reduction as stated by Table 33 and Figure 31, based on the statistics of the average number of cars per household.

Concluding, based on the potential *total number of cars* that can be reduced, the five mentioned municipalities have the most potential. However, this is not a result from the *highest share or ratio (%)* in the willingness to give up private cars, with only 12-16%.

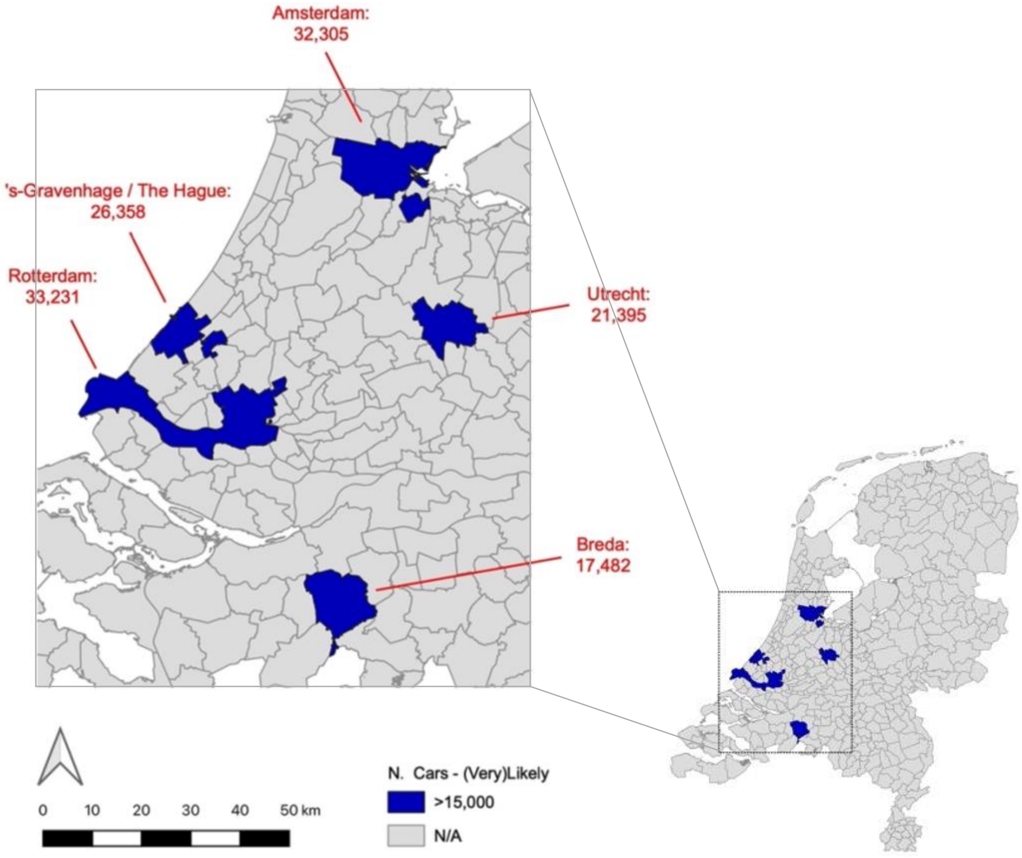


Figure 31 | Map of the potential reduction in the number of cars, Top-5 municipalities

6.4.3. Justification - Representativity Check

For justification, there has to be mentioned that the presented maps and insights are based on the available data and its representativity. As already mentioned in the research approach, the WoON2012 already guaranteed and optimized the data representativity as much as possible. To further investigate the representativity, the WoON2012 is compared to the statistics of CBS (2012a). This could give a short indication of the representativity of the available respondents in the WoON2012 for the actual population distribution within the municipalities. Besides, it indicates the representativity and reliability of the presented maps and insights. The representatives of the municipalities of Terschelling, Ferwerderadiel, and Leusden will be compared to the distributions of the CBS (2012a), as stated in Table 34 and Table 35.

Based on the comparison of the four stated factors in the tables, the available distribution in the WoON2012 can be considered as a good representation for the municipalities, since the levels presented in the WoON2012 are comparable to the actual population distribution as stated by the CBS (2012a).

Table 34 | Comparison of the WoON2012 with the population distribution of CBS (2012a) - Terschelling and Ferwerderadiel

WoON2012 - Terschelling & Ferwerderadiel Most of the respondents:	Comparison with CBS (2012a)	
	Terschelling	Ferwerderadiel
Male	Male: 54%	Male: 52%
< 50 years old	< 50 years old: 51%	< 50 years old: 49%
Education: Primary, Secondary education, or Secondary vocational education (MBO)	77%	81%
Income: ≤ €28,399	Average income: €24,700	Average income: €20,400

Table 35 | Comparison of the WoON2012 with the population distribution of CBS (2012a) - Leusden

WoON2012 - Leusden Most of the respondents:	Comparison with CBS (2012a) Leusden
Female	Female: 52%
> 50 years old	> 50 years old: 49%
Education: Primary, Secondary education, or Secondary vocational education (MBO)	66%
Income: ≥ €28,399	Average income: €29,400

6.5. Conclusion

In this chapter, the multinomial logistic regression model is applied. First, the model is tested and verified with calculations of the utility and the probability a respondent would choose for one of the alternatives of the willingness to give up private cars.

Next, the developed model is applied using the dataset of the WoON2012. Therefore, the utility and potential share is calculated for almost all the municipalities in the Netherlands towards the willingness to give up private cars. These results are translated to the corresponding number of households and the potential reduction in the number of cars per municipality.

Since it is useful to provide insight into the spatial patterns and locations where residents are more or less willing to give up their private cars, maps are created within a geographical information system (GIS) environment to spatially visualize the distribution of the willingness to give up the private car(s) across the municipalities in the Netherlands. These insights visualize the distributions by means of different colours and gives indications in clusters of municipalities with similar potentials. This offers the possibility to effectively study the characteristics and relations between areas and a better clarification of the potential share in the willingness to give up private cars, due to the availability of carsharing.

Insights into the data and maps showing that the potential willingness to give up private cars, related to the willingness of '(very) likely', is between 7% and 26% per municipality. The potential share is dependent on the respondents' characteristics and related utilities. By application of the model using the data of the WoON2012, the municipality of Terschelling and Ferwerderadiel have the highest potential share in the willingness to give up private cars. However, the translation to the potential reduction in the number of cars shows a different pattern. The potential reduction in the number of cars is not only dependent on the municipal's share in giving up private cars. Actually, the number of households in combination with the average number of cars per household within the municipalities, highly determines this potential reduction. Therefore, the major municipalities in the Netherlands are associated with the highest potential reductions in the number of private cars (including a top-5 of Rotterdam, Amsterdam, 's-Gravenhage/The Hague, Utrecht, and Breda). A high potential share in the willingness to give up private cars, does not directly results in a high potential total number of cars that can be reduced.

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Chapter 7

Conclusion

7.1. Conclusions

The challenges of increasements in congestion levels, car ownership rates, and the higher pressure on urban (parking) space and traffic networks result into other mobility requirements and new designs for people's trips and urban areas in the Netherlands. As a reaction, Dutch municipalities stimulate other mobility modes (including carsharing) as an alternative to (the use of) private cars and to change individuals' mobility behaviour. Based on these developments and the lack of knowledge regarding spatial and non-spatial factors related to car ownership, this study aims to explore and develop a model presenting the factors and relations that contribute to the willingness of residents to give up their private cars, due to the availability of carsharing. Besides, the translation into an approach which provides insights into the prediction and distribution of this willingness across the Netherlands. This resulted in the following main research question: *"Which factors contribute to the willingness of residents to give up their private car(s), and how can these factors be translated into an approach which provides insights into the prediction and distribution of the willingness to give up private cars across the Netherlands?"*

A literature study provides insights into the current state-of-the-art and developments around the aspects of car ownership and carsharing, and the general mobility decision making of individuals. An insight into the challenges of the pressure on urban space, increase of car ownership rates, and the increasing use of land that (parked) cars are occupying. The concept of carsharing, referring to services that enable people to rent locally available cars at any desired moment and during short term periods, has the potential to positively contribute to these challenges in the Dutch mobility system. Positive effects are expected towards car ownership, congestion levels, more efficient parking policies, and a sustainable contribution towards social, economic, and ecological aspects of mobility. The study towards the mobility decision making of individuals showed that it is not expected that all car users will instantly switch from private cars to shared mobility systems. Besides the attributes of a carsharing system, the understanding of travel demand characteristics, socio-demographic characteristics, subjective motivations, and urban & living environment characteristics are determined to be crucial in research towards mobility behaviour and private car ownership. Insights into the spatial patterns and locations where residents are more or less willing to give up their private cars, could specify the potential distribution across the Netherlands to lower the car ownership rate and stimulation of carsharing.

To investigate the relations between the willingness to give up private car(s) on the one hand, and the spatial and non-spatial factors on the other hand, the study of van der Waerden (2019b) is introduced. This study started to investigate the most preferable attributes of a carsharing system and local parking situations of residents by means of a stated choice experiment included in an online questionnaire. The 631 respondents, with their individual personal factors, housing and parking situation, and travel behaviour, are asked to indicate if they would consider giving up their private car(s) due to the availability of a particular carsharing system. A descriptive and statistical analysis provided a first insight into the factors and characteristics of the research sample. Besides, it showed that, within the context of this study, most of the respondents are indicating that it is *(very) unlikely* to give up their private cars for a carsharing system. By performing a statistical multicollinearity analysis, to prevent multicollinearity between the independent factors, some factors had to be excluded due to correlations at an unacceptable level. The remaining factors were used as input for the model development towards the residents' willingness to give up private cars.

By means of a multinomial logistic regression analysis, a model is developed which provides insights into the contribution and factors that are able to calculate and predict the willingness of residents to give up their private car(s). Several socio-demographic factors, urban & living environment factors, and travel demand factors, are considered to be good predictors and contributors towards this willingness. However, the factors directly related to a carsharing system (e.g., waiting time, costs per month, or type of parking) do not add significant value to the model which indicates that understanding of the other factors are more crucial in the willingness of people to give up private cars.

In general, the model indicates that people who are willing to give up their private car(s), are male, are younger than the age of 50, have a higher education level, an average or lower income, and owning more than 1 car. Besides, they live in a multi-storey housing type, in a rental house, park their car on the street, live within a very strong urbanized area, on a longer distance from a main road, and closely to a train station. Regarding travel behaviour, they travel a shorter distance for work or shopping activities, a longer distance for grocery or leisure/free time activities, and travel less frequently for all these activities.

The developed multinomial logistic regression model is then applied using the WoON2012 (BZK & CBS, 2012), including 11,323 respondents out of 367 Dutch municipalities. Therefore, an insight is presented into the potential locations and municipalities with a higher share of residents with the willingness to give up their private cars, based on the average utilities and probabilities of the respondents within each municipality. These results are translated to the corresponding number of households that are willing to give up their private cars and the potential reduction in the number of cars. To spatially visualize the distribution of the residents' willingness across the Netherlands, maps are created within a geographical information system (GIS) environment. These insights showing that the potential willingness to give up private cars is between 7% and 26% per municipality in the Netherlands, with several clusters across the Netherlands. Hereby, the potential share is dependent on the respondents' characteristics and related utilities, as specified by the model. However, the translation to the potential reduction in the number of cars shows a different pattern. This is not only dependent on the municipal's share in giving up private cars, but also on the number of households and the average number of cars per household of each municipalities.

This caused that the major Dutch municipalities having the highest potential in the number of reduced private cars. A high potential share of residents with the willingness to give up their private car(s), does not directly results in a high potential total number of cars that can be reduced within a municipality. The study approach, results, and maps could be useful insights for parties as municipalities, policymakers, and mobility organisations, in their questions and research towards car ownership, parking policies, and the stimulation of alternative mobility modes.

7.2. Scientific Relevance

On scientific level, this study enhances more academic understanding of mode choice behaviour, with the focus on car ownership and the relation with alternative carsharing mobility options. The study provides insight in the further elaboration of the data analysis and results of the study of van der Waerden (2019b). The current situation and results of the 631 respondents are translated into a multinomial logistic regression model, presenting the factors contributing to the willingness of people to give up private cars. With this model, the utility and probability can be calculated for a random resident towards the willingness to give up their private car(s).

Previous studies already indicated the most preferable attributes of a carsharing system. However, they stated that it is unclear which additional spatial and non-spatial factors of residents could create a mobility transition away from private car ownership and results in a reduction of the pressure on urban space by used cars. This study is able to positively contribute to this research area, by presenting a model including socio-demographic factors, urban & living environment factors, and travel demand factors that are related to the willingness to give up private cars. Moreover, it showed that, within the assumptions of the available used data, the factors of a carsharing system itself are a less important in the residents' willingness to give up private cars.

By means of the application of the model using the data of the Woononderzoek Nederland (WoON) and related Dutch municipalities, the importance of spatial research towards the willingness is presented by indicating the spatial patterns, clusters, and locations in the Netherlands where residents are more intent to give up their private cars. It could give an indication of the locations with potential to lower the car ownership rate and stimulation of alternative mobility options. The visualization is valuable for communicating the results and messages clearly in an engaging way.

Finally, this research approach showed being suitable to analyse the residents' factors and making the translation into an approach which is able to provide insights into the prediction and distribution of the willingness to give up private cars across the Netherlands. Besides, an indication of the potential reduction in the number of private cars per municipality.

7.3. Societal Relevance

On societal level, this study showed that there is a potential share of residents with the willingness to give up their private cars within each Dutch municipality. Therefore, there is potential for a reduction in car ownership, a reduction in the use of land that (parked) cars are occupying, and a stimulation of alternative mobility solutions. This study and related approach can be suitable for municipalities and related mobility organizations to achieve a higher effectiveness of decision making and a better clarification of the potential share in the willingness to give up private cars. Working towards the ambition to keep investing in an efficient, safe, accessible and smart mobility system, that suits the dynamic requirements of the users.

A better identification of the distribution and factors related to the residents' willingness to give up their private cars, could give a positive impulse to mobility policies to be adjusted or tightened and to speed up processes of mobility behaviour and sharing related mobility options. A guidance and advice to target potential groups with useful measures and providing indications of where to work towards a reduction in the car ownership rates and stimulation of alternative mobility options. And, even more importantly, this study provides insights in the factors on which car ownership can be influenced, and the distribution of the potential share and reduction of private cars in Dutch municipalities.

Municipalities and related organizations should not directly base their investment or policies on the specific results and insights as presented in chapter 6.3 and 6.4 of this study. However, the use and application of the approach and strategy, starting from identifying the individual characteristics, is of added value into the research towards the potential willingness to give up private cars and the distribution across the Netherlands. Besides, mapping of the willingness of giving up private cars per Dutch municipality could be expanded to the application on smaller scale. For example, it could be interesting for a municipality to focus on zip-code or neighbourhood level. This research approach offers the possibility to do this when the particular factors are known for each zip-code or neighbourhood area.

7.4. Limitations & Recommendations

During the research, several limitations and recommendations for future studies have been identified, that will be presented in this section.

7.4.1. Data Availability and Representativity

In this study, datasets are considered including respondents and factors that complement to the presented conceptual model. In a most *optimal* or *ideal situation*, the collected data fully reflects the presented conceptual model and categories, have equal distributions, and consist of respondents being an optimal representation for each Dutch municipality. However, for this study, data is used in a *practical situation*, since it has to deal with the current data availability. Therefore, the data did not fully reflect the conceptual model and equal distributions. This enhanced the advice to not directly implement investment or policies on the specific final results and insights as presented in this study, but apply the presented research approach and strategy using a more optimal research sample.

For improvement of the data, the sample size and included factors of the available datasets could be expanded. A larger research sample size could increase the reliability of the research and a more varied sample distribution (Sarstedt & Mooi, 2011). "The probability of incorrect findings can be controlled for by increasing the sample size" (Sarstedt & Mooi, 2011, p. 152). Besides, not all the factors, as mentioned in the conceptual model, are included in the model development. For example, subjective motivations (e.g., regarding environment or comfort) are considered to be important, but are not directly included in the available datasets. It remains a category that could be included in future studies and research.

The specification of factors and levels could be improved as well. On the basis of the availability of the data, there was no possibility for further adjustments and to vary on the specification of factors and levels. This caused some irregularities in the data distribution. The specification of the levels of factors could be the explanation for the not significant utilities and different interpretations within factors in the model development. It could be interesting to retrieve a better insight into the specification of the factors and the most optimal related distribution in levels.

During the model application, WoON data (BZK & CBS, 2012) of 2012 is used due to privacy reasons and a lack of factors in the more recently conducted versions (2015 and 2018) of the WoON. However, the situations of the respondents and Dutch municipalities may be changed from 2012 until now. The model application can therefore be partly outdated. Besides, a predefined 'fictional' carsharing system is applied in the model application stage. Although the carsharing factors did not add significant value to the model, it could give a slightly distorted outcome of the model application. When it comes to practice, the particular offered carsharing system should be defined and applied in the application of the model.

The presented results and insights in potentials and maps are based on the available respondents within a municipality in the WoON data (BZK & CBS, 2012). A slightly part of the presented municipalities consisted of only one or two respondents. This could give a disturbed or unreliable outcome in the presented potentials. It is possible that these respondents are not a good representative for the municipality, especially in the municipalities with a limited number of available respondents. The WoON2012 already guaranteed and optimized the data representativity as much as possible by applying weights. However, by the additional data aggregation method in this study of averaging the individual probabilities to municipal shares, results could be slightly doubtful. By the aggregation of data, information loss can occur, because it ignores the individual variation (Rome et al., 2017). A representativity check during the model application, implied that the WoON2012 can be considered as a good representation for the municipalities. Still, for future improvement, the literature covers several alternative aggregation methods. In relation to the used average aggregation method, aggregation based on a *weighted average* can be applied (Anderson, 2013; Bots & Bouwmans, 2020). Weights can be applied to the individual respondents' probabilities for the translation to the municipal share in the willingness to give up private cars. This could cover under- or over-representativity and improves the reliability of the sample. Future research could focus on the most suitable aggregation method for this study.

7.4.2. Theoretical versus Realistic potential

The study assumes to present the theoretical potential for the willingness to give up private cars. However, the research of Jorritsma et al. (2015) towards carsharing in the Netherlands, presents the theory of Prettenthaler & Steininger (1999) and Wilke & Bongardt (2007). This theory assumes that the realistic potential will be lower than the presented theoretical potential. There are several internal and external barriers between the attitude and actual behaviour of people, such as the lack of knowledge or the convenience of having a private car. Therefore, not every respondent who indicates to be willing to give up their private car(s), will actually do this. The is also related to the unobserved component of utility. “It remains impossible to calculate precisely the overall utility that each decision maker will hold for any given alternative.” (Hensher et al., 2015, p. 84). The analyst may not be able to define all the factors that actually will be considered. Since literature about the specific gap between the theoretical and realistic potentials of car ownership is scarce, no further assumptions will be made. Although, the effect of this theory will remain an aspect for further research.

7.4.3. External Validation

Due to time constraints and relatively smaller sample size, the model is not externally validated. Validation by means of cross-validation or data splitting, remains an aspect for further research (Altman & Royston, 2000; Collins et al., 2014; Field, 2009). Cross-validation, a crucial method within models in transportation policies where the accuracy of the model will be tested across different samples and questionnaires. With data splitting, datasets will randomly be split, and a regression function is computed for both halves of the data. The resulting models can be compared and indicate the model performance of the original model (Field, 2009).

7.4.4. COVID-19 Pandemic

Finally, this research is conducted during the world-wide COVID-19 pandemic in 2020. It has affected the lives and behaviour of people and brought more individual (car) related mobility movements within the Dutch mobility system. The extent to which people would change their mobility behaviour in the future, as a direct consequence of the pandemic, was difficult to predict during the execution of this study. The first expectation of COVID-19 mobility research is that people will make as much use of their private car and go back to the same activities as before the pandemic (De Haas, Faber, & Hamersma, 2020; Fatmi, 2020).

However, the methods available are mostly relying on first self-reported experiences and expectations, which do not always result in an overall change of actual mobility behaviour and intentions in the future. Also, Van Haas et al. (2020), Fatmi (2020) and CROW (2020b) concluded that the extent to which people change their mobility behaviour in the future, as a consequence of the pandemic, is currently difficult to predict. This due to the still unknown or uncertain reasons, factors, and consequences of the pandemic. Studies of today can be irrelevant next week because the developments of COVID-19 are changing constantly and are different for each country (De Haas et al., 2020; Fatmi, 2020). These developments should be considered in the future use of the approach and results of this study, since the pandemic brings a certain level of uncertainty in the prediction of the model. Future mobility research could focus on confidential data sources related to the situation and consequences of the COVID-19 pandemic on the Dutch mobility system.

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Appendices

Appendix I - Motives for Carsharing

Cost (TNS-Nipo 2014)	As replacement for second car (Chatterjee et al. 2013)
Availability for the car (TNS-Nipo 2014)	To give up car due to low usage and expense (Chatterjee et al. 2013)
In case of a job elsewhere (TNS-Nipo 2014)	For business travel (Chatterjee et al. 2013)
Quality of the car (TNS-Nipo 2014)	Access to car for occasional travel (Chatterjee et al. 2013)
When car breaks down (TNS-Nipo 2014)	Use car share van for work-related purposes (Chatterjee et al. 2013)
Choice for different cars (TNS-Nipo 2014)	Low mileage, but still occasionally need car (Chatterjee et al. 2013)
Location of the car (TNS-Nipo 2014)	As replacement for infrequently used owned car (Chatterjee et al. 2013)
Possibility to contact service desk of the company (TNS-Nipo 2014)	Low usage (Chatterjee et al. 2013)
Customer service friendliness (TNS-Nipo 2014)	Save money (Chatterjee et al. 2013)
A friend recommended the service (TNS-Nipo 2014)	Occasional access to a car (Chatterjee et al. 2013)
Privacy (other people in my car) (TNS-Nipo 2014)	To maintain driving skills (Chatterjee et al. 2013)
Reliability of the service, e.g. the reservation is often cancelled (TNS-Nipo 2014)	More convenient than hire cars (Chatterjee et al. 2013)
Booking way (Efthymiou et al. 2013)	More convenient than public transport (Chatterjee et al. 2013)
Return vehicle in another station (Efthymiou et al., 2013)	Alternative for taxi (Chatterjee et al. 2013)
Return vehicle without informing in advance when and where (Efthymiou et al., 2013)	Lost job, and therefore gave up car (Chatterjee et al. 2013)
Type of vehicle (Efthymiou et al., 2013)	Trust issues (Ballús-Armet et al. 2014)
Symbol of social status (Efthymiou et al., 2013)	Convenience and availability (Ballus-Armet, et al., 2014)
Time of day (Efthymiou et al., 2013)	Environmental (Ballus-Armet, et al., 2014)
Travel convenience (Efthymiou et al., 2013)	Expand mobility options (Ballus-Armet, et al., 2014)
Comfort of travel (Efthymiou et al., 2013)	Resource sharing (Ballus-Armet, et al., 2014)
Distance of station from house or job (Efthymiou, Antoniou, & Waddell, 2013)	Prefere P2P over big company (Ballus-Armet, et al., 2014)
small size	Prefere a big company over P2P (Ballus-Armet, et al., 2014)
fleet size	Monetary (Ballus-Armet, et al., 2014)
Distinct design	Liability (Ballus-Armet, et al., 2014)
Time of day	No need to own a car (Ballus-Armet, et al., 2014)
Social aspects, personal contact when handing over keys etc.	Personal interaction (Ballus-Armet, et al., 2014)
Time of usage	Vehicle reliability (Ballus-Armet, et al., 2014)
Place of residence	Cleanliness (Ballus-Armet, et al., 2014)
Curiousness (Glind 2013)	Damages (Self)
Practical motives (Glind, 2013)	Insurance (Self)
Social motives (Glind, 2013)	Occasionally need other car, e.g. for moving (Self)
Environmental motives (Glind, 2013)	Status (Self)
Financial motives (Glind, 2013)	Pricing (Self)
Contributing to a healthy natural environment (Glind, 2013)	Practicalities (Self)
Saving money (Glind, 2013)	Flexibility (Self)
Meeting people (Glind 2013)	Personal contact (Self)
Save time (Schaefers 2013)	Travel patterns (Martin et al., 2011)
Reasonable prices (Schaefers, 2013)	Vehicle purchase plans (Martin et al., 2011)
Everything included (Schaefers, 2013)	Commuting time duration (Martin et al., 2011)
Pay per use (Schaefers, 2013)	Commute distance (Martin et al., 2011)
Belonging (Schaefers, 2013)	Major shopping mode (Taxi, Car, Bus, Metro, Bike, Walk) (Martin et al., 2011)
Free parking (Schaefers, 2013)	Convenience (Prettenthaler & Steininger 1999)
Save money (Schaefers, 2013)	Cost (Prettenthaler & Steininger, 1999)
Designated parking (Schaefers, 2013)	Good value for money (Prettenthaler & Steininger, 1999)
Gas efficiency (Schaefers, 2013)	Time demand (Prettenthaler & Steininger, 1999)
Visible labelling (Schaefers, 2013)	Traffic mitigation/reduction (Prettenthaler & Steininger, 1999)
No worries (Schaefers, 2013)	Transparency of cost (Prettenthaler & Steininger, 1999)
No responsibilities (Schaefers, 2013)	Flexibility (Prettenthaler & Steininger, 1999)
Sense of community (Schaefers, 2013)	Cost saving (Dill, 2014)
Thriftiness (Schaefers, 2013)	Convenience of not owning a car (Dill, 2014)
Comfort (Schaefers, 2013)	Affordability (Dill, 2014)
Free parking (Schaefers, 2013)	Personal freedom (Dill, 2014)
Flee-floating (Schaefers, 2013)	All-included insurance and environmentally sound image (Schrader, 1999)
Ad-hoc usage (Schaefers, 2013)	Weather influences (Schmöller & Bogenberger 2014)
Cost savings (Mont 2004)	P2P matching rejected? Volkskrant, 2014 (Velden & Lier 2014)
Lack of initial investment (Mont, 2004)	Provision of free parking spaces, (Mont, 2004)
Maintenance responsibilities (Mont, 2004)	

Figure 32 | Attributes and motives for Carsharing as stated by the study of Dieten (2015, p. 77)

Appendix II - Questionnaire

Welkom bij deze enquête!

Deze enquête maakt deel uit van een onderzoek naar de mogelijkheden om **deelauto's aan te bieden in de woonomgeving**. Met deze enquete willen we meer te weten komen over kenmerken van deelautosystemen in combinatie met de parkeersituatie in de woonomgeving.

De verzamelde gegevens worden volledig anoniem verwerkt en enkel voor dit onderzoek gebruikt. Het volledig invullen van de enquête duurt ongeveer 10 minuten.

Ik wil u bij voorbaat danken voor uw bijdrage aan dit onderzoek,

Peter van der Waerden
Technische Universiteit Eindhoven

In wat voor type woning woont u?

- Etagewoning (flat of appartement)
- Tussenwoning
- Hoekwoning
- Twee-onder-één kap woning
- Vrijstaande woning
- Anders

Namelijk:

Hoeveel auto's bezit uw huishouden?

- Geen
- 1 auto
- 2 auto's
- 3 of meer auto's

Waar parkeert u meestal uw auto?
(indien u meerdere auto's heeft, denk dan aan de auto die u het meest gebruikt)

- Op eigen inrit
- Op straat
- Op een parkeerterrein
- In een parkeergarage
- Anders

Woont u in een koop- of huurwoning?

- Koopwoning
- Huurwoning
- Anders/Niet van toepassing

Huidige verplaatsingsgedrag

Om de achtergrond van uw antwoorden beter te kunnen duiden, is het van belang enkele details van uw huidige verplaatsingsgedrag in kaart te brengen. U kunt deze details in de onderstaande tabel aangeven.

* Wisselt uw verplaatsingsgedrag veel? Vul dan een gemiddelde in per verplaatsingsdoel (werk, boodschappen doen, winkelen, vrije tijd).
* Gebruikt u meerdere vervoermiddelen? Kies dan voor het vervoermiddel waarmee u de telkens de grootste afstand afgelegt.
* Is een verplaatsingsdoel voor u niet van toepassing? Kies dan voor de antwoordmogelijkheid 'Niet van toepassing'.

Vul de details van uw huidige verplaatsingsgedrag in in de onderstaande tabel.

Bestemming	Vervoermiddel	Frequentie	Gemiddelde Afstand	Gemiddelde Reistijd
Werk	Maak een keuze	Maak een keuze	Maak een keuze	Maak een keuze
Boodschappen doen	Maak een keuze	Maak een keuze	Maak een keuze	Maak een keuze
Winkelen (kleding/ apparaten/ funshoppen etc.)	Maak een keuze	Maak een keuze	Maak een keuze	Maak een keuze
Vrije tijd, familie bezoek, recreatie etc.	Maak een keuze	Maak een keuze	Maak een keuze	Maak een keuze

Huidige parkeersituatie

Naast informatie over uw verplaatsingsgedrag is het ook van belang om enkele details te weten over de parkeersituatie in uw woonomgeving. U kunt deze details in de onderstaande tabel aangeven.
* Parkeert u steeds op verschillende plekken? Vul dan de gegevens in van de parkeerplek die u het meest gebruikt.
* Parkeert u op eigen inrit? Vul dan toch de gegevens in.

Vul de details van uw huidige parkeersituatie in in de onderstaande tabel.

Kenmerk	Waarden
Wat is de **loopafstand** naar de dichtstbij gelegen parkeergelegenheid?	Maak een keuze
Heeft u van uit uw woning **zicht** op uw geparkeerde auto?	Maak een keuze
Moet u **betalen** voor het parkeren van uw auto?	Maak een keuze
Is er bij de parkeergelegenheid een soort van **beveiliging** aanwezig?	Maak een keuze
Wordt de parkeergelegenheid die u meestal gebruikt, ook door **anderen** gebruikt?	Maak een keuze

Deelauto

Een **deelauto** is een auto die u met meerdere gebruikers deelt. U kunt de auto huren wanneer het u uitkomt, op elk gewenst moment en voor elke tijdsduur. De deelauto staat in de buurt van uw woning, waardoor u makkelijk toegang heeft tot deze auto.

Om gebruik te kunnen maken van een deelauto moet u vaak een abonnement afsluiten. De opbrengsten van dit abonnement worden gebruikt om de deelauto en het deelautosysteem te onderhouden. Daarnaast betaalt u voor de verplaatsingen die u met de deelauto maakt. U betaalt dan een bepaalde prijs per kilometer en/of per uur, afhankelijk van het bedrijf dat de deelauto's aanbiedt. Hoeveel u voor het gebruik van de deelauto moet betalen is mede afhankelijk van het soort abonnement u heeft.

Op de volgende pagina's wordt uw **reactie** gevraagd op verschillende denkbeeldige deelautosystemen die in een woonomgeving worden aangeboden. Naast een deelautosysteem ziet u een denkbeeldige parkeersituatie die in dezelfde woonomgeving voorkomt. wij vragen aan u om eerst aan te geven of u een gepresenteerde deelautosysteem aantrekkelijk vindt. Daarna vragen we aan u om aan te geven hoe waarschijnlijk het is dat u afscheid neemt van één of meerdere auto's in uw huishouden. Zowel de deelautosystemen als de parkeersituaties worden beschreven aan de hand van verschillende kenmerken. De kenmerken en mogelijke kenmerkwaarden worden op de volgende pagina verder toegelicht.

Toelichting kenmerken

Hieronder vindt u een korte uitleg van de kenmerken die een autodeelsysteem en een parkeersituatie in de woonomgeving beschrijven.
Het aangeboden autodeelsysteem wordt beschreven met de volgende 5 kenmerken:

1. **Gemiddelde wachttijd op een deelauto**: 0 minuten (direct beschikbaar), 15 minuten, 30 minuten;
2. **Loopafstand tot standplaats deelauto**: 0 meter (dichtbij de woning), 50 meter, 100 meter;
3. **Kosten voor abonnement per maand**: 5 euro (gebruikskosten: 6 euro per uur en 0,30 euro per km), 10 euro (gebruikskosten: 4 euro per uur en 0,25 euro per km), 15 euro (gebruikskosten: 2 euro per uur en 0,20 euro per km);
4. **Beschikbaarheid gereserveerde parkeerplek op eindbestemming**: Nee, Ja;
5. **Soort brandstof van de deelauto**: Benzine, Elektrisch, Hybride.

De parkeersituatie in de woonomgeving waarmee u te maken heeft, kent de volgende 3 kenmerken:

6. **Kosten voor parkeren in de woonomgeving**: Gratis, 10 euro per maand, 20 euro per maand;
7. **Loopafstand tot dichtstbij gelegen parkeerplek**: 0 meter (dichtbij de woning), 100 meter, 200 meter;
8. **Type parkeergelegenheid**: aan kant van de straat, parkeerterrein, parkeergarage.

(Set 1)

Veronderstel dat u met de volgende twee combinaties van deelautosysteem en parkeersituatie wordt geconfronteerd. Wij vragen u het getoonde **combinaties** goed door te nemen en de volgende twee vragen te beantwoorden:

* Welke combinatie van deelautosysteem en parkeersituatie trekt u het meest aan?
* Hoe waarschijnlijk is het dat u afscheid neemt van één of meer auto's in uw huishouden?

Kenmerken DEELAUTOSYSTEEM	**Combinatie 1**	**Combinatie 2**
Wachttijd	5 minuten	5 minuten
Loopfstand tot standplaats	50 meter	0 meter
Kosten abonnement en bijbehorende gebruikskosten	15 euro per maand 2 euro per uur 0,20 euro per km	5 euro per maand 6 euro per uur 0,30 euro per km
Beschikbaarheid gereserveerde parkeerplaats	Ja	Nee
Soort brandstof deelauto	Elektrisch	Elektrisch
Kenmerken PARKEERSITUATIE		
Parkeerkosten in de woonomgeving	0 euro per maand	10 euro per maand
Loopafstand tot dichtstbij gelegen parkeerplek	200 meter	100 meter
Type parkeergelegenheid	Parkeerterrein	Parkeerterrein
Welke combinatie trekt u het meest aan?	○	○
Hoe waarschijnlijk is het dat u afscheid neemt van een auto, gegeven uw bovenstaande keuze?	Maak een keuze ▾	

(Set 2)

Veronderstel dat u met de volgende twee combinaties van deelautosysteem en parkeersituatie wordt geconfronteerd. Wij vragen u het getoonde **combinaties** goed door te nemen en de volgende twee vragen te beantwoorden:

* Welke combinatie van deelautosysteem en parkeersituatie trekt u het meest aan?
* Hoe waarschijnlijk is het dat u afscheid neemt van één of meer auto's in uw huishouden?

Kenmerken DEELAUTOSYSTEEM	**Combinatie 1**	**Combinatie 2**
Wachttijd	0 minuten	5 minuten
Loopfstand tot standplaats	50 meter	0 meter
Kosten abonnement en bijbehorende gebruikskosten	10 euro per maand 4 euro per uur 0,25 euro per km	10 euro per maand 4 euro per uur 0,25 euro per km
Beschikbaarheid gereserveerde parkeerplaats	Nee	Ja
Soort brandstof deelauto	Hybride	Hybride
Kenmerken PARKEERSITUATIE		
Parkeerkosten in de woonomgeving	0 euro per maand	0 euro per maand
Loopafstand tot dichtstbij gelegen parkeerplek	0 meter	200 meter
Type parkeergelegenheid	Parkeerterrein	Aan de kant van de straat
Welke combinatie trekt u het meest aan?	○	○
Hoe waarschijnlijk is het dat u afscheid neemt van een auto, gegeven uw bovenstaande keuze?	Maak een keuze ▾	

(In total 6 sets, containing each 2 profiles (/cards) with attributes, are presented to the respondents)

Wat is uw geslacht?

- Man
- Vrouw

Wat is uw leeftijd?

- < 17 jaar
- 18 - 29 jaar
- 30 - 49 jaar
- 50 - 65 jaar
- > 65 jaar

Welke van de onderstaande woonsituatie is het meest op u van toepassing?

- Alleenstaand zonder (inwonende) kinderen
- Alleenstaand met inwonend(e) kind(eren)
- Samenwonend/getrouwd zonder (inwonende) kinderen
- Samenwonend/getrouwd met inwonend(e) kind(eren)
- Thuiswonend bij (groot)ouder(s)/familie
- Wonend met anderen (geen familie)
- Anders, namelijk:

Wat is uw hoogst genoten opleiding?

- Basisschool / Lagere school
- Voortgezet onderwijs
- Middelbare beroepsonderwijs (MBO)
- Hoger beroepsonderwijs (HBO)
- Wetenschappelijk onderwijs (WO)
- Anders, namelijk:

Ben u in bezit van een rijbewijs?

- Ja
- Nee

Wat zijn de 4 cijfers van uw postcode?

bijvoorbeeld 4531

Einde enquête!

Hartelijk dank voor uw deelname aan deze enquête.

Mocht u vragen/opmerkingen hebben met betrekking tot het onderzoek of deze enquête, dan kunt u deze hieronder achterlaten.

Eventuele opmerkingen over het onderzoek of de enquête:

Druk hieronder op **Einde** om de enquête te versturen.

Vorige Einde

Appendix III - Datasets

- **Dataset 1** (Van der Waerden, 2019a)

Table 36 | Dataset 1

Category	Name Factor	Levels & Labels	Measure	Explanation
General	id	None	Scale	ID of respondent
	finished	{0, False} (1, True)	Nominal	Is the Questionnaire finished?
	prop.chosen_set	0-8	Nominal	ID of proposed combination of sets carsharing and parking options --> corresponding with prop.set out of Autbezit_sub
Housing Situation	WoningType	{1, Etagewoning (flat of appartement)} {2, Tussenwoning} {3, Hoekwoning} {4, Twee-onder-één kap woning} {5, Vrijstaande woning} {6, Anders}	Nominal	Housing Type
	Anders_woning	None	Nominal	Option 6 at 'WoningType'
	AantAuto	{0, Geen} {1, 1 auto} {2, 2 auto's} {3, 3 of meer auto's}	Ordinal	Number of owned cars
	Parkeren	{1, Op eigen inrit} {2, Op straat} {3, Op een parkeerterrein} {4, In een parkeergarage} {5, Anders}	Nominal	Most often used location for car parking
	KoopHuur	{1, Koopwoning} {2, Huurwoning}	Nominal	Owner-occupied or rental property
Travel behaviour - Work	B1WerkVervoermiddel	{1, Niet van toepassing} {2, Fiets} {3, Auto} {4, Trein} {5, Bus, tram, metro} {6, Lopen} {9, Anders}	Nominal	Most used mode for work
	B1WerkFrequentie	{1, Niet van toepassing} {2, 3 dagen per week of minder} {3, 4 dagen per week} (4, 5 dagen per week} {5, 6 dagen per week of meer}	Ordinal	Number of days to work
	B1Werk GemiddeldeAfstand	{1, Niet van toepassing} {2, 0 - 2,5 km} {3, 2,5 - 5km} {4, 5 - 10km} {5, 10 - 20km} {6, 20 - 30km} {7, 30 - 50km} {8, 50 - 100km} {9, 100km of meer}	Ordinal	Average travel distance to work

	B1Werk GemiddeldeReistijd	{1, Niet van toepassing} {2, 5 min of minder} {3, 6 - 15 minuten} (4, 16 - 30 minuten} {5, 31 - 60 minuten} {6, 61 minuten of meer}	Ordinal	Average traveltime to work
Travel behaviour - Grocery	B2Boodschappen Vervoermiddel	{1, Niet van toepassing} {2, Fiets} {3, Auto} {4, Trein} {5, Bus, tram, metro} {6, Lopen} {9, Anders}	Nominal	Most used mode for grocery
	B2Boodschappen Frequentie	{1, Niet van toepassing} {2, 1 keer per maand of minder} {3, 1-2 keer per maand} {4, 3-4 keer per maand} {5, 1-2 keer per week} {6, 3-4 keer per week} {7, 5 keer per week of meer}	Ordinal	Number of days to grocery
	B2Boodschappen GemiddeldeAfstand	{1, Niet van toepassing} {2, 0 - 2,5 km} {3, 2,5 - 5km} {4, 5 - 10km} {5, 10 - 20km} {6, 20 - 30km} {7, 30 - 50km} {8, 50 - 100km} {9, 100km of meer}	Ordinal	Average travel distance to grocery
	B2Boodschappen GemiddeldeReistijd	{1, Niet van toepassing} {2, 5 min of minder} {3, 6 - 15 minuten} (4, 16 - 30 minuten} {5, 31 - 60 minuten} {6, 61 minuten of meer}	Ordinal	Average traveltime to grocery
Travel behaviour - Shopping	B3WinkelenVervoermiddel	{1, Niet van toepassing} {2, Fiets} {3, Auto} {4, Trein} {5, Bus, tram, metro} {6, Lopen} {9, Anders}	Nominal	Most used mode for shopping
	B3WinkelenFrequentie	{1, Niet van toepassing} {2, 1 keer per maand of minder} {3, 1-2 keer per maand} {4, 3-4 keer per maand} {5, 1-2 keer per week}{ 6, 3-4 keer per week} {7, 5 keer per week of meer}	Ordinal	Number of days to shopping
	B3Winkelen GemiddeldeAfstand	{1, Niet van toepassing} {2, 0 - 2,5 km} {3, 2,5 - 5km} {4, 5 - 10km} {5, 10 - 20km} {6, 20 - 30km} {7, 30 - 50km} {8, 50 - 100km} {9, 100km of meer}	Ordinal	Average travel distance to shopping
	B3Winkelen GemiddeldeReistijd	{1, Niet van toepassing} {2, 5 min of minder} {3, 6 - 15 minuten} (4, 16 - 30 minuten} {5, 31 - 60 minuten} {6, 61 minuten of meer}	Ordinal	Average traveltime to shopping

Travel behaviour - Leisure/Free time	B4VrijetijdVervoermiddel	{1, Niet van toepassing} {2, Fiets} {3, Auto} {4, Trein} {5, Bus, tram, metro} {6, Lopen} {9, Anders}	Nominal	Most used mode for leisure/free time
	B4VrijetijdFrequentie	{1, Niet van toepassing} {2, 1 keer per maand of minder} {3, 1-2 keer per maand} {4, 3-4 keer per maand} {5, 1-2 keer per week} {6, 3-4 keer per week} {7, 5 keer per week of meer}	Ordinal	Number of days to leisure/free time
	B4Vrijetijd GemiddeldeAfstand	{1, Niet van toepassing} {2, 0 - 2,5 km} {3, 2,5 - 5km} {4, 5 - 10km} {5, 10 - 20km} {6, 20 - 30km} {7, 30 - 50km} {8, 50 - 100km} {9, 100km of meer}	Ordinal	Average travel distance to leisure/free time
	B4Vrijetijd GemiddeldeReistijd	{1, Niet van toepassing} {2, 5 min of minder} {3, 6 - 15 minuten} (4, 16 - 30 minuten} {5, 31 - 60 minuten} {6, 61 minuten of meer}	Ordinal	Average travel time to leisure/free time
Parking situation	LoopParkeren	{1, 50 meter of minder} {2, Tussen 50 en 100 meter} {3, 100 meter of meer}	Ordinal	Walking distance to closest parking opportunity
	ZichtParkeren	{1, Ja} {2, Nee}	Nominal	Does the respondent have a clear view on his parked area from his house
	BetaalParkeren	{1, Ja} {2, Nee}	Nominal	Does the person have to pay for parking
	BeveiligingParkeren	{1, Ja} {2, Nee}	Nominal	Is security available at the parking area
	AnderenParkeren	{1, Ja} {2, Nee}	Nominal	Is the parking area/spot also used by others
General Info Respondent	Geslacht	{1, Man} {2, Vrouw}	Nominal	Gender
	Leeftijd	{1, < 17 jaar} {2, 18 - 29 jaar} {3, 30 - 49 jaar} {4, 50 - 65 jaar} {5, > 65 jaar}	Ordinal	Age
	huishouden	{1, Alleenstaand zonder (inwonende) kinderen} {2, Alleenstaand met inwonend€ kind(eren)} {3, Samenwonend/getrouwd zonder (inwonende) kinderen} {4, Samenwonend/getrouwd met (inwonende) kind(eren)} {5, Thuiswonend bij (groot)ouder(s)/familie} {6, Wonend met anderen (geen familie} {7, Anders, namelijk:}	Nominal	Household composition

	huishouden_anders	None	Nominal	Option 7 at 'huishouden'
	Opleiding	{1, Basisschool / Lagere school} {2, Voortgezet onderwijs} {3, Middelbare beroepsonderwijs (MBO)} {4, Hoger beroepsonderwijs (HBO)} {5, Wetenschappelijk onderwijs (WO)} (6, Anders, namelijk:}	Ordinal	Highest education Level
	OpleidingAnders	None	Nominal	Option 6 at 'Opleiding'
	Driving_License	{1, Ja} {2, Nee}	Nominal	Does the respondent have a driving license
	Postcode	None	Scale	Zipcode in PC4 format (numeric part of zipcode)
Others	VragenOpm	None	Nominal	Any comments on the research or questionnaire

- **Dataset 2** (Van der Waerden, 2019a)

Consist of data regarding the stated choice sets and profiles presented to each respondent

Table 37 | Dataset 2

Category	Name Variable	Levels & Labels	Measure	Explanation
General	id	None	Scale	ID of respondent
	finished	{0, False} {1, True}	Nominal	Is the Questionnaire finished?
	Parent_id	None	Scale	ID of respondent --> corresponding with id out of Autobezit_Autobezit.sav
	sub_position	0 - 5	Scale	Number of set (0-5): every respondent has 6 sets of choices
	prop.Set	1 - 9	Nominal	ID of the combination of the 6 sets (Set = combination of 2 cards/profiles) --> corresponding with prop.chosen_Set out of Autbezit_Autobezit.sav
	prop.Card1	1 - 27	Nominal	ID of the profile/card that is presented. In total, 27 cards were available. (Set = combination of 2 cards/profiles)
	prop.Card2		Nominal	
Characteristics Carsharing	prop.Wacht1	{1, 0min (direct beschikbaar)} {2, 5min} {3, 10min}	Ordinal	Waiting time for shared car
	prop.Wacht2		Ordinal	
	prop.Loop1	{1, 0m (dicht bij woning)} {2, 50m} {3, 100m}	Ordinal	Walking distance to location shared car
	prop.Loop2		Ordinal	
	prop.Abon1a /2a	{1, 5 euro per maand} {2, 10 euro per maand} {3, 15 euro per maand}	Ordinal	Costs for carsharing subscription per month
	prop.Abon1b /2b	{1, 2 euro per uur} {2, 4 euro per uur} {3, 6 euro per uur}	Ordinal	Additional usage costs per hour
	prop.Abon1c /2c	{1, 0,20 euro per km} {2, 0,25 euro per km} {3, 0,30 euro per km}	Ordinal	Additional usage costs per km
	prop.Pplaats1	{1, Ja} {2. Nee}	Nominal	Reserved parking spot at destination?
	prop.Pplaats2		Nominal	
	prop.Brand1	{1, Benzine}	Nominal	Fuel type of shared car

	prop.Brand2	{2, Elektrisch} {3, Hybride}	Nominal	
Characteristics Parking	prop.KostenP1	{1, 0 euro per maand} {2, 10euro per maand} {3, 20euro per maand}	Ordinal	Costs of parking in living surrounding
	prop.KostenP2		Ordinal	
	prop.LoopP1	{1, 0m (dicht bij woning)} {2, 100m} {3, 200m}	Ordinal	Walking distance to closest located parking spot
	prop.LoopP2		Ordinal	
	prop.TypeP1	{1, aan de kant vd straat} {2, Parkeerterrein} {3, parkeergarage}	Nominal	Type of parking area/spot
	prop.TypeP2		Nominal	
Final choices	KeuzeOptie_CarSharing_ Option	{1, Combinatie1} {2, Combinatie2}	Nominal	Which combination (card/profile) does the respondent prefer?
	KeuzeOptie_ Waarschijnlijkheid	{1, Zeer onwaarschijnlijk} {2, Onwaarschijnlijk} {3, Waarschijnlijk} {4, Zeer waarschijnlijk}	Ordinal	How likely is it for the respondent to give up their private car, given the presented carsharing profile?

Appendix IV - Data Preparation & Cleaning

- ## Matching factors to Conceptual model

Table 38 | Allocation of factors into categories of conceptual model

Category	Name variable	Description
Socio-demographic characteristics	Geslacht	Gender
	Leeftijd	Age
	Huishouden	Household composition
	Huishouden_anders	Other at Household composition
	Opleiding	Education level
	OpleidingAnders	Other at Education level
	Income	Income level
	AantAuto	Number of cars
Urban & Living Environment characteristics	WoningType	Housing type
	Anders_woning	Other at Housing type
	KoopHuur	Owner-occupied or renting
	Parkeren	Location parking
	LoopParkeren	Walking distance to parking
	ZichtParkeren	Clear view on parking
	BetaalParkeren	Payed parking
	BeveiligingParkeren	Security parking
	AnderenParkeren	Parking also used by others
	Urbanity	Urbanity level
	prox_superm	Distance to closest large supermarket
	prox_groc	Distance to closest grocery store
	prox_restau	Distance to closest restaurant or take-away
	prox_road	Distance to closest road entrance way
	prox_train	Distance to closest train station
	Postcode	Zip code (PC4)
Travel demand characteristics	Driving_License	Driving license
	B1WerkVervoermiddel	Most used mode for work
	B1WerkFrequentie	Number of days to work
	B1WerkGemiddeldeAfstand	Average travel distance to work
	B1WerkGemiddeldeReistijd	Average travel time to work
	B2BoodschappenVervoermiddel	Most used mode for grocery
	B2BoodschappenFrequentie	Number of days to grocery
	B2BoodschappenGemiddeldeAfstand	Average travel distance to grocery
	B2BoodschappenGemiddeldeReistijd	Average travel time to grocery
	B3WinkelenVervoermiddel	Most used mode for shopping
	B3WinkelenFrequentie	Number of days to shopping
	B3WinkelenGemiddeldeAfstand	Average travel distance to shopping
	B3WinkelenGemiddeldeReistijd	Average travel time to shopping
	B4VrijetijdVervoermiddel	Most used mode for leisure/free time
	B4VrijetijdFrequentie	Number of days to leisure/free time
	B4VrijetijdGemiddeldeAfstand	Average travel distance to leisure/free time
	B4VrijetijdGemiddeldeReistijd	Average travel time to leisure/free time
Carsharing characteristics	prop.Set	ID of the combination of the 6 sets
	prop.Card1 /2	ID of the profile/card that is presented
	prop.Wacht1 /2	Waiting time for shared car
	prop.Loop1 /2	Walking distance to location shared car
	prop.Abon1a /2a	Costs for carsharing subscription per month
	prop.Abon1b /2b	Additional usage costs per hour
	prop.Abon1c /2c	Additional usage costs per km
	prop.Pplaats1 /2	Reserved parking spot at destination?
	prop.Brand1 /2	Fuel type of shared car
	prop.KostenP1 /P2	Costs of parking in living surrounding
	prop.LoopP1 /P2	Walking distance to closest located parking spot
	prop.TypeP1 /P2	Type of parking area/spot
	KeuzeOptie_CarSharing_Option	Preferable combination (card/profile)
Likeliness	KeuzeOptie_Waarschijnlijkheid	Likeliness to give up their private car
Others	Id	ID of respondent
	VragenOpm	Final questions or comments

- **Removing and Merging**

The following factors are *removed* since the distribution of the factor is skewed:

- Driving License;
- LoopParkeren;
- ZichtParkeren;
- BetaalParkeren;
- BeveiligingParkeren;
- AnderenParkeren.

The following levels of factors are *removed* since they are not presented in the sample:

- Age: <17-years old;
- Number of cars: 0 cars;
- Parking location: op eigen oprit (on own driveway).

The following levels of factors are *merged* into a new level, since the individual distributions of these levels are determined to be small:

Table 39 | Merged Levels - Descriptive Analysis

Factor	Old Level	New merged Level
Opleiding/Education	- Primary education - Secondary education	Primary or Secondary education
	- Higher professional education (HBO) - University education (WO)	Higher professional education (HBO) or University education (WO)
Huishouden/Household	- Living at home with parents/family - Living with others	Other
AantAuto/Number of cars	- 2 cars - 3 or more cars	2 or more cars
Income	- Low: < €16,800; - Below Average: €16,800 - €22,199;	Below Average: ≤€22,199
KoopHuur/Housing Type	- Corner house - Semi-detached house - Detached house - Other	Other
Parkeren/Parking location	- On parking area/car park - In parking garage	Off street (garage, car park, etc.)
LoopParkeren/Distance to parking	- 50-100 meter - 100 meter or more	> 50 meters
B1WerkVervoermiddel B2BoodschappenVervoersmiddel B3WinkelenVervoersmiddel B4VrijetijdVervoersmiddel	- Train - Bus/Tram/Metro - Walking - Other/NA	Other
B1WerkFrequentie	- 5 days per week - ≥ 6 days per week	≥ 5 days per week
B2BoodschappenFrequentie B3WinkelenFrequentie B4VrijetijdFrequentie	- <1x per month - 1-2x per month - 3-4x per month	≤ 1x per week
	- 3-4x per week - ≥ 5x per week	≥ 3x per week
B1WerkGemiddeldeAfstand B2BoodschappenGemiddeldeAfstand B3WinkelenGemiddeldeAfstand B4VrijetijdGemiddeldeAfstand	- 0-2.5km - 2.5-5km - 5-10km	< 10km
	- 10-20km - 20-30km	10-30km
	- 50-100km - ≥ 100km	> 50km

Appendix V - Descriptive Analysis

- Parking Characteristics

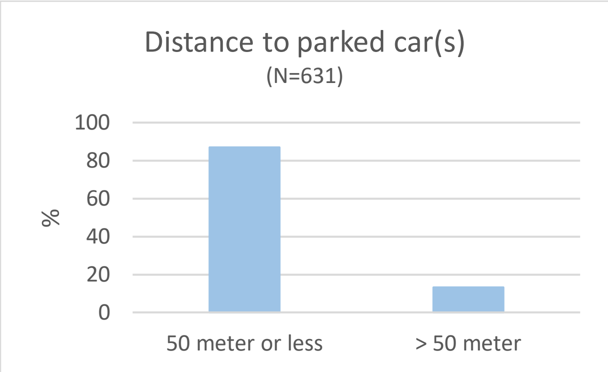

Figure 33 | Distance to parked car(s)

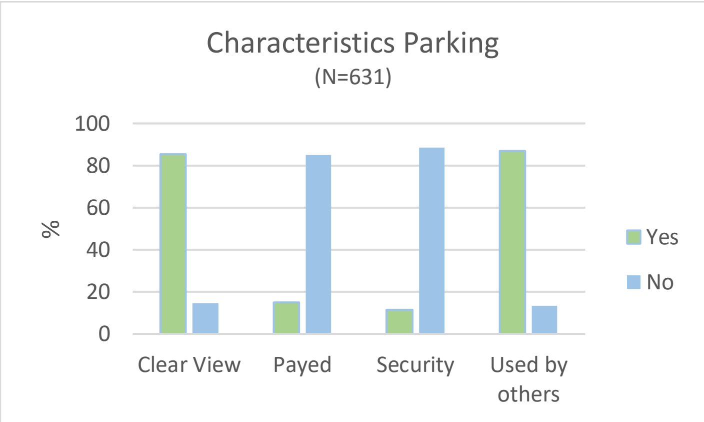

Figure 34 | Characteristics Parking - Clear View, Payed, Security, and Used by others

- Travel behaviour - Frequencies

Table 40 | Frequency Work - All mobility modes

	Work	
Frequency	Frequency	Percentage (%)
≤ 3 days per week	115	18.2
4 days per week	144	22.8
≥ 5 days per week	229	36,3
N/A	143	22.7
Total	*631*	*100%*

Table 41 | Frequency Grocery, Shopping, Leisure/Free Time - All mobility modes

	Grocery		Shopping		Leisure/Free time	
Frequency	Freq.	%	Freq.	%	Freq.	%
< 1x per week	78	12.4	490	77.7	369	58.5
1-2x per week	308	48.8	78	12.4	200	31.7
≥ 3x per week	230	36.5	11	1.7	49	7.8
N/A	15	2.4	52	8.2	13	2.1
Total	*631*	*100%*	*631*	*100%*	*631*	*100%*

- ## Travel behaviour - Travel distances

Table 42 | Average travel distances per Activity - All mobility modes

	Work		Grocery		Shopping		Leisure/Free time	
Travel distances	Freq.	%	Freq.	%	Freq.	%	Freq.	%
< 10km	197	31.2	590	93.5	340	53.9	199	31.5
10-30 km	176	27.9	25	4.0	192	30.5	194	30.7
30-50 km	75	11.9	0	0	29	4.6	81	12.8
> 50 km	47	7.4	2	0.3	7	1.1	133	21.1
N/A	136	21.6	14	2.2	63	10.0	24	3.8
Total	*631*	*100%*	*631*	*100%*	*631*	*100%*	*631*	*100%*

- ## Travel behaviour - Travel times

Table 43 | Average travel time per Activity - All mobility modes

	Work		Grocery		Shopping		Leisure/Free time	
Travel times	Freq.	%	Freq.	%	Freq.	%	Freq.	%
≤ 5min	21	3.3	274	43.4	34	5.4	30	4.8
6-15 min	133	21.1	285	45.2	216	34.2	132	20.9
16-30 min	176	27.9	39	6.2	231	36.6	178	28.2
31-60 min	138	21.9	13	2.1	71	11.3	157	24.9
≥ 61 min	25	4.0	0	0	13	2.1	108	17.1
N/A	138	21.9	20	3.2	66	10.5	26	4.1
Total	*631*	*100%*	*631*	*100%*	*631*	*100%*	*631*	*100%*

- ## Carsharing Profiles

Sorted on most preferred and frequently chosen profiles.

Table 44 | Most preferable carsharing profiles

Ranking	Profile ID	Frequency assigned	Frequency - chosen as most preferred ∨	Percentage (%) - chosen as most preferred ∨
1	9	280	202	72.1
2	15	281	200	71.2
3	1	280	194	69.3
4	5	280	184	65.7
5	11	280	180	64.3
6	26	281	172	61.2
7	21	282	170	60.3
8	3	280	168	60.0
9	7	280	162	57.9
10	22	281	155	55.2
11	16	280	152	54.3
12	10	280	149	53.2
13	14	280	137	48.9
14	6	280	132	47.1
15	8	280	131	46.8
16	27	280	128	45.7
17	4	281	126	44.8
18	25	280	124	44.3
19	20	281	122	43.4
20	18	280	120	42.9
21	24	282	119	42.2

22	13	280	114	40.7
23	17	280	109	38.9
24	2	281	96	34.2
25	12	280	93	33.2
26	23	281	84	29.9
27	19	281	63	22.4
	Total	7572	3786	

Appendix VI - Multicollinearity Analysis Outputs

- Bivariate Correlation Analysis within Categories

Table 45 | Bivariate correlation Analysis Output SPSS - Socio-demographic characteristics

Correlations

		Geslacht	Leeftijd_FP	huishouden_FP	Opleiding_FP	Income_FP	AantAuto_FP
Geslacht	Pearson Correlation	1	-,192**	,058	-,016	,032	,082*
	Sig. (2-tailed)		,000	,145	,686	,417	,039
	N	631	631	631	631	631	631
Leeftijd_FP	Pearson Correlation	-,192**	1	-,230**	-,202**	,084*	-,239**
	Sig. (2-tailed)	,000		,000	,000	,034	,000
	N	631	631	631	631	631	631
huishouden_FP	Pearson Correlation	,058	-,230**	1	,046	,021	,323**
	Sig. (2-tailed)	,145	,000		,247	,607	,000
	N	631	631	631	631	631	631
Opleiding_FP	Pearson Correlation	-,016	-,202**	,046	1	-,022	,056
	Sig. (2-tailed)	,686	,000	,247		,583	,158
	N	631	631	631	631	631	631
Income_FP	Pearson Correlation	,032	,084*	,021	-,022	1	,117**
	Sig. (2-tailed)	,417	,034	,607	,583		,003
	N	631	631	631	631	631	631
AantAuto_FP	Pearson Correlation	,082*	-,239**	,323**	,056	,117**	1
	Sig. (2-tailed)	,039	,000	,000	,158	,003	
	N	631	631	631	631	631	631

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 46 | Bivariate correlation Analysis Output SPSS - Urban & Living Environment characteristics

Correlations

		WoningType_FP	KoopHuur	Parkeren_FP	Urbanity_FP	prox_supern_FP	prox_groc_FP	prox_restau_FP	prox_road_FP	prox_train_FP
WoningType_FP	Pearson Correlation	1	-,285**	-,133**	,289**	,243**	,211**	,219**	-,034	,159**
	Sig. (2-tailed)		,000	,001	,000	,000	,000	,000	,398	,000
	N	631	631	631	631	631	631	631	631	631
KoopHuur	Pearson Correlation	-,285**	1	,038	-,028	-,055	-,037	-,054	-,012	-,018
	Sig. (2-tailed)	,000		,345	,487	,169	,354	,173	,771	,659
	N	631	631	631	631	631	631	631	631	631
Parkeren_FP	Pearson Correlation	-,133**	,038	1	,055	,125**	,076	,058	-,065	,088*
	Sig. (2-tailed)	,001	,345		,171	,002	,058	,148	,101	,027
	N	631	631	631	631	631	631	631	631	631
Urbanity_FP	Pearson Correlation	,289**	-,028	,055	1	,597**	,614**	,568**	-,289**	,484**
	Sig. (2-tailed)	,000	,487	,171		,000	,000	,000	,000	,000
	N	631	631	631	631	631	631	631	631	631
prox_supern_FP	Pearson Correlation	,243**	-,055	,125**	,597**	1	,792**	,658**	-,156**	,318**
	Sig. (2-tailed)	,000	,169	,002	,000		,000	,000	,000	,000
	N	631	631	631	631	631	631	631	631	631
prox_groc_FP	Pearson Correlation	,211**	-,037	,076	,614**	,792**	1	,727**	-,198**	,371**
	Sig. (2-tailed)	,000	,354	,058	,000	,000		,000	,000	,000
	N	631	631	631	631	631	631	631	631	631
prox_restau_FP	Pearson Correlation	,219**	-,054	,058	,568**	,658**	,727**	1	-,147**	,349**
	Sig. (2-tailed)	,000	,173	,148	,000	,000	,000		,000	,000
	N	631	631	631	631	631	631	631	631	631
prox_road_FP	Pearson Correlation	-,034	-,012	-,065	-,289**	-,156**	-,198**	-,147**	1	-,061
	Sig. (2-tailed)	,398	,771	,101	,000	,000	,000	,000		,128
	N	631	631	631	631	631	631	631	631	631
prox_train_FP	Pearson Correlation	,159**	-,018	,088*	,484**	,318**	,371**	,349**	-,061	1
	Sig. (2-tailed)	,000	,659	,027	,000	,000	,000	,000	,128	
	N	631	631	631	631	631	631	631	631	631

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 47 | Bivariate correlation Analysis Output SPSS - Travel Demand characteristics

Correlations

		B1WerkVervoermiddel_FP	B1WerkFrequentie_FP	B1WerkGemiddeldeAfstand_FP	B1WerkGemiddeldeReistijd	B2BoodschappenVervoermiddel_FP	B2BoodschappenFrequentie_FP	B2BoodschappenGemiddeldeAfstand_FP	B2BoodschappenGemiddeldeReistijd	B3WinkelenVervoermiddel_FP	B3WinkelenFrequentie_FP	B3WinkelenGemiddeldeAfstand_FP	B3WinkelenGemiddeldeReistijd	B4VrijetijdVervoermiddel_FP	B4VrijetijdFrequentie_FP	B4VrijetijdGemiddeldeAfstand_FP	B4VrijetijdGemiddeldeReistijd
B1WerkVervoermiddel_FP	Pearson Correlation	1	-,497**	-,262**	-,403**	,053	,122**	,007	,064	,088*	,104**	-,042	-,006	,078	-,017	,019	,062
	Sig. (2-tailed)		,000	,000	,000	,185	,002	,860	,109	,028	,009	,291	,886	,051	,663	,637	,119
	N	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631
B1WerkFrequentie_FP	Pearson Correlation	-,497**	1	,527**	,679**	,001	-,064	-,027	-,176**	,035	-,049	,084*	,022	-,049	-,013	-,045	-,064
	Sig. (2-tailed)	,000		,000	,000	,979	,111	,492	,000	,384	,217	,035	,575	,219	,748	,257	,111
	N	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631
B1WerkGemiddeldeAfstand_FP	Pearson Correlation	-,262**	,527**	1	,843**	,016	-,014	,078	-,081*	-,040	-,022	,105**	,018	,019	,029	,072	,035
	Sig. (2-tailed)	,000	,000		,000	,697	,732	,051	,041	,320	,585	,008	,647	,634	,466	,073	,374
	N	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631
B1WerkGemiddeldeReistijd	Pearson Correlation	-,403**	,679**	,843**	1	,017	-,035	,044	-,095*	-,032	-,086*	,056	,031	,019	-,042	,030	,029
	Sig. (2-tailed)	,000	,000	,000		,668	,384	,275	,017	,424	,031	,159	,432	,642	,289	,448	,472
	N	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631
B2BoodschappenVervoermiddel_FP	Pearson Correlation	,053	,001	,016	,017	1	-,054	-,060	-,061	,283**	-,116**	-,056	-,047	,099*	,021	-,045	-,015
	Sig. (2-tailed)	,185	,979	,697	,668		,179	,130	,129	,000	,003	,160	,239	,013	,601	,264	,705
	N	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631
B2BoodschappenFrequentie_FP	Pearson Correlation	,122**	-,064	-,014	-,035	-,054	1	,031	,081*	-,091*	,247**	,007	,122**	-,003	,070	,141**	,179**
	Sig. (2-tailed)	,002	,111	,732	,384	,179		,432	,041	,022	,000	,858	,002	,932	,077	,000	,000
	N	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631
B2BoodschappenGemiddeldeAfstand_FP	Pearson Correlation	,007	-,027	,078	,044	-,060	,031	1	,520**	-,025	,118**	,169**	,108**	,063	,085*	,059	,060
	Sig. (2-tailed)	,860	,492	,051	,275	,130	,432		,000	,537	,003	,000	,007	,117	,032	,142	,130
	N	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631
B2BoodschappenGemiddeldeReistijd	Pearson Correlation	,064	-,176**	-,081*	-,095*	-,061	,081*	,520**	1	-,071	,090*	,119**	,249**	,026	,082*	,102*	,191**
	Sig. (2-tailed)	,109	,000	,041	,017	,129	,041	,000		,075	,023	,003	,000	,507	,040	,010	,000
	N	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631
B3WinkelenVervoermiddel_FP	Pearson Correlation	,088*	,035	-,040	-,032	,283**	-,091*	-,025	-,071	1	-,215**	-,165**	-,218**	,112**	-,039	-,058	-,032
	Sig. (2-tailed)	,028	,384	,320	,424	,000	,022	,537	,075		,000	,000	,000	,005	,333	,145	,425
	N	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631
B3WinkelenFrequentie_FP	Pearson Correlation	,104**	-,049	-,022	-,086*	-,116**	,247**	,118**	,090*	-,215**	1	,169**	,282**	,027	,098*	,064	,095*
	Sig. (2-tailed)	,009	,217	,585	,031	,003	,000	,003	,023	,000		,000	,000	,500	,014	,109	,017
	N	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631
B3WinkelenGemiddeldeAfstand_FP	Pearson Correlation	-,042	,084*	,105**	,056	-,056	,007	,169**	,119**	-,165**	,169**	1	,679**	-,020	,055	,158**	,134**
	Sig. (2-tailed)	,291	,035	,008	,159	,160	,858	,000	,003	,000	,000		,000	,622	,169	,000	,001
	N	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631
B3WinkelenGemiddeldeReistijd	Pearson Correlation	-,006	,022	,018	,031	-,047	,122**	,108**	,249**	-,218**	,282**	,679**	1	-,011	,031	,168**	,244**
	Sig. (2-tailed)	,886	,575	,647	,432	,239	,002	,007	,000	,000	,000	,000		,789	,440	,000	,000
	N	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631
B4VrijetijdVervoermiddel_FP	Pearson Correlation	,078	-,049	,019	,019	,099*	-,003	,063	,026	,112**	,027	-,020	-,011	1	-,146**	,110**	,057
	Sig. (2-tailed)	,051	,219	,634	,642	,013	,932	,117	,507	,005	,500	,622	,789		,000	,006	,154
	N	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631
B4VrijetijdFrequentie_FP	Pearson Correlation	-,017	-,013	,029	-,042	,021	,070	,085*	,082*	-,039	,098*	,055	,031	-,146**	1	-,241**	-,170**
	Sig. (2-tailed)	,663	,748	,466	,289	,601	,077	,032	,040	,333	,014	,169	,440	,000		,000	,000
	N	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631
B4VrijetijdGemiddeldeAfstand_FP	Pearson Correlation	,019	-,045	,072	,030	-,045	,141**	,059	,102*	-,058	,064	,158**	,168**	,110**	-,241**	1	,835**
	Sig. (2-tailed)	,637	,257	,073	,448	,264	,000	,142	,010	,145	,109	,000	,000	,006	,000		,000
	N	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631
B4VrijetijdGemiddeldeReistijd	Pearson Correlation	,062	-,064	,035	,029	-,015	,179**	,060	,191**	-,032	,095*	,134**	,244**	,057	-,170**	,835**	1
	Sig. (2-tailed)	,119	,111	,374	,472	,705	,000	,130	,000	,425	,017	,001	,000	,154	,000	,000	
	N	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631	631

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 48 | Bivariate correlation Analysis Output SPSS - Carsharing characteristics

Correlations

		prop.Wacht1	prop.Wacht2	prop.Loop1	prop.Loop2	prop.Abon1a	prop.Abon1b	prop.Abon1c	prop.Abon2a	prop.Abon2b	prop.Abon2c	prop.Pplaats1	prop.Pplaats2	prop.Brand1	prop.Brand2	prop.KostenP1	prop.KostenP2	prop.LoopP1	prop.LoopP2	prop.TypeP1	prop.TypeP2	KeuzeOptie_CarSharing_Option	KeuzeOptie_Waarschijnlijkheid
prop.Wacht1	Pearson Correlation	1	-,055**	-,001	-,084**	,000	,000	,000	-,082**	,082**	,082**	,000	,145**	,000	-,055**	,000	-,056**	,000	-,221**	,000	,112**	,081**	,011
	Sig. (2-tailed)		,001	,942	,000	1,000	1,000	1,000	,000	,000	,000	1,000	,000	1,000	,001	1,000	,001	1,000	,000	1,000	,000	,000	,497
	N	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786
prop.Wacht2	Pearson Correlation	-,055**	1	,111**	,000	-,166**	,166**	,166**	,001	-,001	-,001	-,048**	,000	,137**	,001	-,195**	-,001	,166**	-,001	-,001	,000	-,089**	-,002
	Sig. (2-tailed)	,001		,000	,981	,000	,000	,000	,942	,942	,942	,003	,978	,000	,961	,000	,942	,000	,961	,942	,981	,000	,908
	N	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786
prop.Loop1	Pearson Correlation	-,001	,111**	1	,111**	,000	,000	,000	-,195**	,195**	,195**	,000	-,001	,000	,111**	,000	,167**	,000	-,111**	,000	,111**	-,033*	,003
	Sig. (2-tailed)	,942	,000		,000	1,000	1,000	1,000	,000	,000	,000	1,000	,966	1,000	,000	1,000	,000	1,000	,000	1,000	,000	,043	,839
	N	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786
prop.Loop2	Pearson Correlation	-,084**	,000	,111**	1	,027	-,027	-,027	,000	,000	,000	-,145**	-,001	-,195**	,000	,166**	,000	,167**	,000	,027	,000	,011	-,026
	Sig. (2-tailed)	,000	,981	,000		,097	,097	,097	,981	,981	,981	,000	,944	,000	,981	,000	,981	,000	1,000	,093	,981	,511	,110
	N	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786
prop.Abon1a	Pearson Correlation	,000	-,166**	,000	,027	1	-1,000**	-1,000**	-,027	,027	,027	,001	,242**	,000	,333**	,000	-,027	-,001	-,223**	,000	-,250**	-,044**	,022
	Sig. (2-tailed)	1,000	,000	1,000	,097		,000	,000	,097	,097	,097	,933	,000	,981	,000	,981	,097	,961	,000	,981	,000	,007	,185
	N	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786
prop.Abon1b	Pearson Correlation	,000	,166**	,000	-,027	-1,000**	1	1,000**	,027	-,027	-,027	-,001	-,242**	,000	-,333**	,000	,027	,001	,223**	,000	,250**	,044**	-,022
	Sig. (2-tailed)	1,000	,000	1,000	,097	,000		,000	,097	,097	,097	,933	,000	,981	,000	,981	,097	,961	,000	,981	,000	,007	,185
	N	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786
prop.Abon1c	Pearson Correlation	,000	,166**	,000	-,027	-1,000**	1,000**	1	,027	-,027	-,027	-,001	-,242**	,000	-,333**	,000	,027	,001	,223**	,000	,250**	,044**	-,022
	Sig. (2-tailed)	1,000	,000	1,000	,097	,000	,000		,097	,097	,097	,933	,000	,981	,000	,981	,097	,961	,000	,981	,000	,007	,185
	N	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786
prop.Abon2a	Pearson Correlation	-,082**	,001	-,195**	,000	-,027	,027	,027	1	-1,000**	-1,000**	,048**	,001	-,139**	,000	-,084**	-,001	-,167**	,000	-,029	,000	,016	,039*
	Sig. (2-tailed)	,000	,942	,000	,981	,097	,097	,097		,000	,000	,003	,955	,000	,981	,000	,961	,000	,981	,075	,981	,336	,017
	N	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786
prop.Abon2b	Pearson Correlation	,082**	-,001	,195**	,000	,027	-,027	-,027	-1,000**	1	1,000**	-,048**	-,001	,139**	,000	,084**	,001	,167**	,000	,029	,000	-,016	-,039*
	Sig. (2-tailed)	,000	,942	,000	,981	,097	,097	,097	,000		,000	,003	,955	,000	,981	,000	,961	,000	,981	,075	,981	,336	,017
	N	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786
prop.Abon2c	Pearson Correlation	,082**	-,001	,195**	,000	,027	-,027	-,027	-1,000**	1,000**	1	-,048**	-,001	,139**	,000	,084**	,001	,167**	,000	,029	,000	-,016	-,039*
	Sig. (2-tailed)	,000	,942	,000	,981	,097	,097	,097	,000	,000		,003	,955	,000	,981	,000	,961	,000	,981	,075	,981	,336	,017
	N	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786
prop.Pplaats1	Pearson Correlation	,000	-,048**	,000	-,145**	,001	-,001	-,001	,048**	-,048**	-,048**	1	,001	,001	,000	-,001	,049**	-,001	-,001	,000	,193**	,008	-,010
	Sig. (2-tailed)	1,000	,003	1,000	,000	,933	,933	,933	,003	,003	,003		,942	,966	,989	,966	,002	,966	,955	1,000	,000	,628	,550
	N	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786
prop.Pplaats2	Pearson Correlation	,145**	,000	-,001	-,001	,242**	-,242**	-,242**	,001	-,001	-,001	,001	1	,096**	,000	,047**	,000	,095**	-,001	-,240**	,000	-,014	-,010
	Sig. (2-tailed)	,000	,978	,966	,944	,000	,000	,000	,955	,955	,955	,942		,000	,989	,004	,978	,000	,955	,000	1,000	,389	,527
	N	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786
prop.Brand1	Pearson Correlation	,000	,137**	,000	-,195**	,000	,000	,000	-,139**	,139**	,139**	,001	,096**	1	,055**	,001	,168**	,000	,111**	,001	,056**	-,054**	,006
	Sig. (2-tailed)	1,000	,000	1,000	,000	,981	,981	,981	,000	,000	,000	,966	,000		,001	,961	,000	,981	,000	,961	,001	,001	,718
	N	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786
prop.Brand2	Pearson Correlation	-,055**	,001	,111**	,000	,333**	-,333**	-,333**	,000	,000	,000	,000	,000	,055**	1	-,112**	,000	,000	,000	,083**	,001	-,030	,034*
	Sig. (2-tailed)	,001	,961	,000	,981	,000	,000	,000	,981	,981	,981	,989	,989	,001		,000	,981	1,000	,981	,000	,961	,067	,035
	N	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786
prop.KostenP1	Pearson Correlation	,000	-,195**	,000	,166**	,000	,000	,000	-,084**	,084**	,084**	-,001	,047**	,001	-,112**	1	-,028	,001	,223**	,000	-,028	,173**	-,006
	Sig. (2-tailed)	1,000	,000	1,000	,000	,981	,981	,981	,000	,000	,000	,966	,004	,961	,000		,088	,961	,000	,981	,084	,000	,700
	N	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786
prop.KostenP2	Pearson Correlation	-,056**	-,001	,167**	,000	-,027	,027	,027	-,001	,001	,001	,049**	,000	,168**	,000	-,028	1	,083**	,000	-,277**	,000	-,234**	-,008
	Sig. (2-tailed)	,001	,942	,000	,981	,097	,097	,097	,961	,961	,961	,002	,978	,000	,981	,088		,000	,981	,000	,981	,000	,623
	N	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786
prop.LoopP1	Pearson Correlation	,000	,166**	,000	,167**	-,001	,001	,001	-,167**	,167**	,167**	-,001	,095**	,000	,000	,001	,083**	1	-,166**	,000	,167**	,012	-,017
	Sig. (2-tailed)	1,000	,000	1,000	,000	,961	,961	,961	,000	,000	,000	,966	,000	,981	1,000	,961	,000		,000	,981	,000	,472	,289
	N	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786
prop.LoopP2	Pearson Correlation	-,221**	-,001	-,111**	,000	-,223**	,223**	,223**	,000	,000	,000	-,001	-,001	,111**	,000	,223**	,000	-,166**	1	-,055**	,000	-,007	-,003
	Sig. (2-tailed)	,000	,961	,000	1,000	,000	,000	,000	,981	,981	,981	,955	,955	,000	,981	,000	,981	,000		,001	1,000	,647	,851
	N	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786
prop.TypeP1	Pearson Correlation	,000	-,001	,000	,027	,000	,000	,000	-,029	,029	,029	,000	-,240**	,001	,083**	,000	-,277**	,000	-,055**	1	-,083**	,102**	-,001
	Sig. (2-tailed)	1,000	,942	1,000	,093	,981	,981	,981	,075	,075	,075	1,000	,000	,961	,000	,981	,000	,981	,001		,000	,000	,942
	N	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786
prop.TypeP2	Pearson Correlation	,112**	,000	,111**	,000	-,250**	,250**	,250**	,000	,000	,000	,193**	,000	,056**	,001	-,028	,000	,167**	,000	-,083**	1	,043**	-,003
	Sig. (2-tailed)	,000	,981	,000	,981	,000	,000	,000	,981	,981	,981	,000	1,000	,001	,961	,084	,981	,000	1,000	,000		,008	,877
	N	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786
KeuzeOptie_CarSharing_Option	Pearson Correlation	,081**	-,089**	-,033*	,011	-,044**	,044**	,044**	,016	-,016	-,016	,008	-,014	-,054**	-,030	,173**	-,234**	,012	-,007	,102**	,043**	1	-,015
	Sig. (2-tailed)	,000	,000	,043	,511	,007	,007	,007	,336	,336	,336	,628	,389	,001	,067	,000	,000	,472	,647	,000	,008		,371
	N	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786
KeuzeOptie_Waarschijnlijkheid	Pearson Correlation	,011	-,002	,003	-,026	,022	-,022	-,022	,039*	-,039*	-,039*	-,010	-,010	,006	,034*	-,006	-,008	-,017	-,003	-,001	-,003	-,015	1
	Sig. (2-tailed)	,497	,908	,839	,110	,185	,185	,185	,017	,017	,017	,550	,527	,718	,035	,700	,623	,289	,851	,942	,877	,371	
	N	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

• Correlation Analysis

Table 49 | Correlation Analysis Output - Correlation values and p-values

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1																							
2	p 0.000																						
3	p 0.034	p 0.000																					
4	p 0.683	c -0.185	p 0.001																				
5	p 0.417	c 0.074	p 0.418	c -0.011																			
6	p 0.037	c -0.242	p 0.000	c 0.062	c 0.120																		
7	p 0.225	p 0.220	p 0.000	p 0.475	p 0.000	p 0.001																	
8	p 0.239	p 0.219	p 0.000	p 0.000	p 0.008	p 0.008	p 0.000																
9	p 0.459	p 0.001	p 0.043	p 0.072	p 0.959	p 0.339	p 0.000	p 0.124															
10	p 0.088	c 0.044	p 0.867	c -0.115	c 0.592	c 0.127	p 0.000	p 0.505	p 0.478														
11	p 0.348	c -0.026	p 0.735	c 0.034	c -0.168	c -0.049	p 0.841	p 0.789	p 0.132	c -0.310													
12	p 0.079	c 0.093	p 0.390	c -0.115	c 0.311	c 0.064	p 0.002	p 0.622	p 0.096	c 0.453	c -0.072												
13	p 0.461	p 0.000	p 0.000	p 0.000	p 0.572	p 0.000	p 0.016	p 0.021	p 0.030	p 0.088	p 0.239	p 0.304											
14	p 0.155	c -0.320	p 0.000	c 0.214	c 0.019	c 0.198	p 0.176	p 0.002	p 0.003	c 0.020	c 0.031	c 0.012	p 0.000										
15	p 0.410	p 0.356	p 0.024	p 0.053	p 0.007	p 0.101	p 0.000	p 0.041	p 0.001	p 0.001	p 0.004	p 0.180	p 0.030	p 0.981									
16	p 0.293	c 0.175	p 0.054	c 0.064	c 0.004	c -0.046	p 0.664	p 0.667	p 0.335	c -0.074	c -0.009	c -0.033	p 0.001	c -0.049	p 0.000								
17	p 0.300	c 0.037	p 0.142	c 0.062	c -0.052	c -0.076	p 0.646	p 0.354	p 0.709	c -0.005	c -0.107	c 0.034	p 0.960	c 0.063	p 0.000	c 0.080							
18	p 0.965	p 0.040	p 0.002	p 0.014	p 0.000	p 0.372	p 0.000	p 0.058	p 0.073	p 0.000	p 0.033	p 0.000	p 0.010	p 0.535	p 0.000	p 0.008	p 0.491						
19	p 0.054	c 0.095	p 0.104	c -0.010	c -0.105	c -0.034	p 0.854	p 0.846	p 0.534	c -0.183	c -0.008	c -0.102	p 0.004	c -0.012	p 0.041	c 0.228	c 0.122	p 0.000					
20	p 0.319	c 0.018	p 0.604	c -0.051	c 0.140	c 0.062	p 0.073	p 0.101	p 0.069	c 0.225	c -0.083	c 0.188	p 0.276	c 0.101	p 0.003	c 0.020	x 0.186	p 0.000	c 0.223				
21	p 0.009	p 0.417	p 0.004	p 0.115	p 0.187	p 0.137	p 0.565	p 0.120	p 0.342	p 0.002	p 0.170	p 0.056	p 0.107	p 0.830	p 0.006	p 0.003	p 0.007	p 0.004	p 0.517	p 0.917			
22	p 0.156	c -0.111	p 0.433	c 0.007	c 0.086	c 0.038	p 0.133	p 0.877	p 0.114	c 0.105	c -0.041	c -0.006	p 0.887	c 0.004	p 0.290	c 0.079	c 0.078	p 0.493	c 0.089	c 0.057	p 0.000		
23	p 0.976	c 0.151	p 0.023	c 0.084	c -0.015	c -0.085	p 0.495	p 0.265	p 0.068	c -0.002	c 0.014	c 0.010	p 0.935	c 0.064	p 0.013	c 0.134	c 0.094	p 0.632	c 0.075	c 0.160	p 0.000	c -0.252	

c = correlation value   *p = p-value*

1. Gender (nominal - 2 levels)
2. Age (ordinal)
3. Household (nominal)
4. Education (ordinal)
5. Income (ordinal)
6. N. of cars (ordinal)
7. Housing type (ordinal)
8. Owning or renting (nominal - 2 levels)
9. Location parking (nominal - 2 levels)
10. Urbanity level (ordinal)
11. Distance to closest road entrance way (ordinal)
12. Distance to closest train station (ordinal)
13. Most used mode for work (nominal)
14. Average travel distance to work (ordinal)
15. Most used mode for grocery (nominal)
16. Number of days to grocery (ordinal)
17. Average travel distance to grocery (ordinal)
18. Most used mode for shopping (nominal)
19. Number of days to shopping (ordinal)
20. Average travel distance to shopping (ordinal)
21. Most used mode for leisure/free time (nominal)
22. Number of days to leisure/free time (ordinal)
23. Average travel distance to leisure/free time (ordinal)

Appendix VII - Excluded and Included factors

Factors that are **excluded**, after the multicollinearity analysis:

- Households composition;
- The mobility modes for activities (work, grocery, shopping, and leisure/free time);
- Average travel times (to work, grocery, shopping, and leisure/free time);
- Number of days to work;
- Distance to a large supermarket - grocery store - restaurant/take-away;
- Additional usage costs per hour of carsharing system;
- Additional usage costs per km of carsharing system.

Factors that are **included**:

Dependent factor:

- Likeliness to give up their private car(s).

Independent factors:

- Gender;
- Age;
- Education level;
- Income level;
- Number of cars;
- Housing type;
- Owning or renting the House;
- Location parking;
- Urbanity level;
- Distance to closest road entrance way;
- Distance to closest train station;
- Average travel distance to work;
- Number of days to grocery;
- Average travel distance to grocery;
- Number of days to shopping;
- Average travel distance to shopping;
- Number of days to leisure/free time;
- Average travel distance to leisure/free time.

- Waiting time for shared car;
- Walking distance to location shared car;
- Costs for carsharing subscription per month;
- Reserved parking spot at destination trip;
- Fuel type of shared car;
- Costs of parking in living surrounding;
- Walking distance to closest located parking spot carsharing;
- Type of parking area/spot.

Appendix VIII - Outputs Base Model

- Ordinal Logistic Regression - Base Model

Table 50 | Case Summary - Ordinal Regression Base Model

Warnings

There are 6946 (66,2%) cells (i.e., dependent variable levels by observed combinations of predictor variable values) with zero frequencies.

Case Processing Summary

		N	Marginal Percentage
KeuzeOptie_Waars_FP_3 cat	Zeer Onwaarschijnlijk	1620	42,8%
	Onwaarschijnlijk	1388	36,7%
	(Zeer) Waarschijnlijk	778	20,5%
Valid		3786	100,0%
Missing		0	
Total		3786	

Table 51 | Model Performances - Ordinal Regression Base Model

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	7923,210			
Final	7396,292	526,918	63	,000

Link function: Logit.

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	7456,498	6935	,000
Deviance	7321,432	6935	,001

Link function: Logit.

Pseudo R-Square

Cox and Snell	,130
Nagelkerke	,148
McFadden	,066

Link function: Logit.

Table 52 | Test of Parallel Lines - Ordinal Regression Base Model

Test of Parallel Lines[a]

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	7396,292			
General	6790,975[b]	605,317[c]	63	,000

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.

a. Link function: Logit.

b. The log-likelihood value cannot be further increased after maximum number of step-halving.

c. The Chi-Square statistic is computed based on the log-likelihood value of the last iteration of the general model. Validity of the test is uncertain.

- ## Multinomial Logistic Regression - Base Model

Table 53 | Case Summary - Multinomial Logistic Regression Base Model

Case Processing Summary

		N	Marginal Percentage
KeuzeOptie_Waars_FP_3 cat	Zeer Onwaarschijnlijk	1620	42,8%
	Onwaarschijnlijk	1388	36,7%
	(Zeer) Waarschijnlijk	778	20,5%
Valid		3786	100,0%
Missing		0	
Total		3786	
Subpopulation		3500[a]	

a. The dependent variable has only one value observed in 3446 (98,5%) subpopulations.

Table 54 | Model Performances - Multinomial Logistic Regression Base Model

Model Fitting Information

Model	Model Fitting Criteria: -2 Log Likelihood	Likelihood Ratio Tests: Chi-Square	df	Sig.
Intercept Only	7923,210			
Final	7132,368	790,842	126	,000

Pseudo R-Square

Cox and Snell	,189
Nagelkerke	,214
McFadden	,099

Table 55 | Parameter Estimates - Multinomial Logistic Regression Base Model

Parameter Estimates

KeuzeOptie_Waars_FP_3cat[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B): Lower Bound	Upper Bound
Zeer Onwaarschijnlijk	Intercept	1,431	,311	21,218	1	,000			
	Geslacht	-,398	,051	59,885	1	,000	,672	,607	,743
	Leeftijd_FP_1	-,215	,114	3,581	1	,058	,806	,645	1,008
	Leeftijd_FP_2	-,326	,081	16,210	1	,000	,722	,616	,846
	Leeftijd_FP_3	,374	,093	16,030	1	,000	1,453	1,210	1,745
	Opleiding_FP_1	,036	,101	,129	1	,720	1,037	,850	1,265
	Opleiding_FP_2	,091	,071	1,634	1	,201	1,095	,953	1,258
	Income_FP_1	-,339	,184	3,392	1	,066	,713	,497	1,022
	Income_FP_2	,083	,105	,623	1	,430	1,086	,884	1,334
	Income_FP_3	,290	,098	8,702	1	,003	1,337	1,102	1,621
	AantAuto_FP	,152	,059	6,602	1	,010	1,165	1,037	1,308
	WoningType_FP_1	-,157	,080	3,882	1	,049	,854	,731	,999
	WoningType_FP_2	,222	,072	9,632	1	,002	1,249	1,085	1,437
	KoopHuur	,083	,054	2,417	1	,120	1,087	,978	1,208
	Parkeren_loc_FP	-,074	,056	1,787	1	,181	,928	,832	1,035
	Urbanity_FP_1	-,057	,164	,122	1	,727	,944	,685	1,302
	Urbanity_FP_2	,394	,121	10,562	1	,001	1,483	1,169	1,880
	Urbanity_FP_3	,044	,112	,151	1	,697	1,045	,838	1,302
	Urbanity_FP_4	,117	,093	1,580	1	,209	1,124	,937	1,348
	prox_road_FP_1	,234	,097	5,850	1	,016	1,264	1,045	1,528
	prox_road_FP_2	-,253	,077	10,788	1	,001	,777	,668	,903
	prox_road_FP_3	-,024	,094	,066	1	,797	,976	,812	1,174
	prox_train_FP_1	-,001	,085	,000	1	,991	,999	,845	1,181
	prox_train_FP_2	,199	,090	4,871	1	,027	1,220	1,023	1,456
	prox_train_FP_3	,136	,120	1,267	1	,260	1,145	,904	1,450
	B1_WerkGemAfstand_FP_1	-,361	,090	16,227	1	,000	,697	,584	,831
	B1_WerkGemAfstand_FP_2	,310	,094	10,813	1	,001	1,363	1,133	1,639
	B1_WerkGemAfstand_FP_3	,017	,126	,019	1	,890	1,017	,795	1,302
	B1_WerkGemAfstand_FP_4	,014	,145	,009	1	,925	1,014	,763	1,347

	B2BoodschappenFreq_FP_1	,060	,170	,126	1	,723	1,062	,761	1,482
	B2BoodschappenFreq_FP_2	,758	,156	23,652	1	,000	2,133	1,572	2,895
	B2BoodschappenFreq_FP_3	,337	,158	4,520	1	,033	1,400	1,027	1,910
	B2BoodschappenGemAfstand_FP_1	-,729	,293	6,173	1	,013	,483	,272	,857
	B2BoodschappenGemAfstand_FP_2	-1,080	,333	10,542	1	,001	,340	,177	,652
	B2BoodschappenGemAfstand_FP_3	,041	,633	,004	1	,949	1,042	,301	3,602
	B3WinkelenFreq_FP_1	,135	,166	,662	1	,416	1,145	,827	1,585
	B3WinkelenFreq_FP_2	-,490	,190	6,644	1	,010	,613	,422	,889
	B3WinkelenFreq_FP_3	,763	,345	4,875	1	,027	2,144	1,089	4,220
	B3WinkelenGemAfstand_FP_1	-,385	,155	6,168	1	,013	,680	,502	,922
	B3WinkelenGemAfstand_FP_2	-,298	,158	3,546	1	,060	,742	,544	1,012
	B3WinkelenGemAfstand_FP_3	-1,429	,220	42,089	1	,000	,240	,156	,369
	B3WinkelenGemAfstand_FP_4	,361	,423	,729	1	,393	1,435	,627	3,285
	B4VrijetijdFreq_FP_1	-,292	,156	3,507	1	,061	,747	,550	1,014
	B4VrijetijdFreq_FP_2	,151	,164	,844	1	,358	1,163	,843	1,604
	B4VrijetijdFreq_FP_3	,714	,206	12,070	1	,001	2,043	1,365	3,057
	B4VrijeTijdGemAfstand_FP_1	-,150	,120	1,541	1	,214	,861	,680	1,090
	B4VrijeTijdGemAfstand_FP_2	-,074	,119	,386	1	,535	,929	,735	1,173
	B4VrijeTijdGemAfstand_FP_3	-,419	,136	9,560	1	,002	,657	,504	,858
	B4VrijeTijdGemAfstand_FP_4	-,110	,126	,763	1	,382	,896	,701	1,146
	prop.Wacht_FP_1	,024	,066	,131	1	,718	1,024	,899	1,166
	prop.Wacht_FP_2	-,066	,070	,887	1	,346	,937	,817	1,073
	prop.Loop_FP_1	-,046	,068	,457	1	,499	,955	,835	1,092
	prop.Loop_FP_2	,074	,068	1,184	1	,277	1,077	,942	1,230
	prop.Abon_FP_1	,044	,068	,425	1	,514	1,045	,915	1,194
	prop.Abon_FP_2	,016	,069	,052	1	,820	1,016	,887	1,164
	prop.Pplaats_FP	-,043	,050	,735	1	,391	,958	,868	1,057
	prop.Brand_FP_1	,069	,068	1,035	1	,309	1,072	,938	1,225
	prop.Brand_FP_2	-,001	,068	,000	1	,987	,999	,874	1,141
	prop.KostenPark_FP_1	-,069	,064	1,176	1	,278	,933	,823	1,058
	prop.KostenPark_FP_2	-,036	,069	,276	1	,599	,964	,843	1,104
	prop.LoopPark_FP_1	-,062	,067	,861	1	,354	,940	,824	1,072
	prop.LoopPark_FP_2	-,032	,068	,223	1	,637	,969	,848	1,106
	prop.TypePark_FP_1	-,126	,067	3,493	1	,062	,882	,773	1,006
	prop.TypePark_FP_2	,122	,067	3,341	1	,068	1,130	,991	1,288
Onwaarschijnlijk	Intercept	,593	,323	3,374	1	,066			
	Geslacht	-,154	,051	9,111	1	,003	,857	,775	,947
	Leeftijd_FP_1	,257	,112	5,287	1	,021	1,293	1,039	1,610
	Leeftijd_FP_2	-,345	,081	18,175	1	,000	,708	,604	,830
	Leeftijd_FP_3	,086	,094	,845	1	,358	1,090	,907	1,311
	Opleiding_FP_1	-,306	,105	8,537	1	,003	,736	,600	,904
	Opleiding_FP_2	,085	,073	1,372	1	,242	1,089	,944	1,255
	Income_FP_1	-,215	,179	1,438	1	,231	,807	,568	1,146
	Income_FP_2	-,228	,105	4,745	1	,029	,796	,648	,977
	Income_FP_3	,495	,097	26,064	1	,000	1,641	1,357	1,984
	AantAuto_FP	,087	,060	2,107	1	,147	1,090	,970	1,226
	WoningType_FP_1	-,123	,080	2,370	1	,124	,884	,756	1,034
	WoningType_FP_2	,279	,072	15,071	1	,000	1,322	1,148	1,522
	KoopHuur	,110	,054	4,205	1	,040	1,116	1,005	1,240
	Parkeren_loc_FP	-,109	,056	3,832	1	,050	,896	,804	1,000
	Urbanity_FP_1	,012	,164	,006	1	,940	1,012	,734	1,395
	Urbanity_FP_2	,133	,124	1,157	1	,282	1,143	,896	1,457
	Urbanity_FP_3	-,069	,113	,378	1	,539	,933	,748	1,164
	Urbanity_FP_4	-,108	,095	1,285	1	,257	,898	,745	1,082
	prox_road_FP_1	,000	,101	,000	1	1,000	1,000	,820	1,219
	prox_road_FP_2	,050	,076	,422	1	,516	1,051	,905	1,221
	prox_road_FP_3	,177	,094	3,581	1	,058	1,194	,994	1,434
	prox_train_FP_1	-,319	,086	13,872	1	,000	,727	,614	,860
	prox_train_FP_2	-,107	,091	1,373	1	,241	,899	,752	1,074
	prox_train_FP_3	,465	,118	15,399	1	,000	1,592	1,262	2,008
	B1_WerkGemAfstand_FP_1	-,154	,089	2,982	1	,084	,857	,719	1,021
	B1_WerkGemAfstand_FP_2	,096	,096	,987	1	,321	1,100	,911	1,329
	B1_WerkGemAfstand_FP_3	,023	,125	,033	1	,855	1,023	,801	1,307
	B1_WerkGemAfstand_FP_4	-,245	,151	2,642	1	,104	,783	,582	1,052

	B2BoodschappenFreq_FP_1	-,232	,161	2,087	1	,149	,793	,579	1,086
	B2BoodschappenFreq_FP_2	,209	,145	2,085	1	,149	1,233	,928	1,638
	B2BoodschappenFreq_FP_3	,027	,146	,035	1	,852	1,028	,771	1,369
	B2BoodschappenGemAfstand_FP_1	,297	,303	,959	1	,328	1,346	,743	2,439
	B2BoodschappenGemAfstand_FP_2	-,586	,352	2,767	1	,096	,557	,279	1,110
	B2BoodschappenGemAfstand_FP_3	-,449	,635	,500	1	,480	,638	,184	2,216
	B3WinkelenFreq_FP_1	-,517	,168	9,493	1	,002	,596	,429	,829
	B3WinkelenFreq_FP_2	-,657	,187	12,324	1	,000	,519	,359	,748
	B3WinkelenFreq_FP_3	,955	,335	8,112	1	,004	2,599	1,347	5,015
	B3WinkelenGemAfstand_FP_1	-,025	,167	,022	1	,882	,975	,704	1,352
	B3WinkelenGemAfstand_FP_2	,143	,171	,703	1	,402	1,154	,826	1,612
	B3WinkelenGemAfstand_FP_3	-,812	,227	12,795	1	,000	,444	,284	,693
	B3WinkelenGemAfstand_FP_4	,068	,473	,021	1	,886	1,070	,424	2,703
	B4VrijetijdFreq_FP_1	-,085	,173	,240	1	,624	,919	,654	1,290
	B4VrijetijdFreq_FP_2	-,112	,181	,384	1	,535	,894	,627	1,275
	B4VrijetijdFreq_FP_3	,022	,225	,010	1	,922	1,022	,658	1,587
	B4VrijeTijdGemAfstand_FP_1	,116	,131	,784	1	,376	1,123	,869	1,451
	B4VrijeTijdGemAfstand_FP_2	,490	,128	14,716	1	,000	1,632	1,271	2,096
	B4VrijeTijdGemAfstand_FP_3	-,264	,146	3,270	1	,071	,768	,577	1,022
	B4VrijeTijdGemAfstand_FP_4	,051	,135	,144	1	,705	1,053	,807	1,372
	prop.Wacht_FP_1	-,035	,067	,281	1	,596	,965	,847	1,100
	prop.Wacht_FP_2	-,009	,069	,017	1	,897	,991	,865	1,135
	prop.Loop_FP_1	-,038	,068	,308	1	,579	,963	,843	1,100
	prop.Loop_FP_2	,085	,068	1,559	1	,212	1,089	,953	1,244
	prop.Abon_FP_1	-,043	,068	,386	1	,534	,958	,838	1,096
	prop.Abon_FP_2	,129	,069	3,517	1	,061	1,137	,994	1,301
	prop.Pplaats_FP	-,009	,051	,034	1	,854	,991	,897	1,094
	prop.Brand_FP_1	,000	,068	,000	1	,996	1,000	,874	1,143
	prop.Brand_FP_2	,013	,068	,037	1	,847	1,013	,887	1,157
	prop.KostenPark_FP_1	-,172	,064	7,181	1	,007	,842	,742	,955
	prop.KostenPark_FP_2	,036	,068	,282	1	,595	1,037	,907	1,185
	prop.LoopPark_FP_1	-,112	,067	2,762	1	,097	,894	,783	1,020
	prop.LoopPark_FP_2	,024	,067	,126	1	,723	1,024	,898	1,169
	prop.TypePark_FP_1	-,095	,067	2,008	1	,156	,909	,797	1,037
	prop.TypePark_FP_2	,077	,067	1,343	1	,247	1,080	,948	1,231

a. The reference category is: (Zeer) Waarschijnlijk.

Appendix IX - Optimization: Merging Levels

Table 56 | Merged Levels - Model Development

Factor	Old Level	New merged Level
KeuzeOptie_Waarschijnlijkheid (dependent factor)	- Waarschijnlijk (Likely) - Zeer Waarschijnlijk (Very Likely)	(Zeer) Waarschijnlijk - (Very) Likely
Leeftijd/Age	- 18-29 years old - 30-49 years old	< 50 years old
	- 50-65 years old - >65 years old	≥ 50 years old
Opleiding/Education	- Primary or Secondary education - Secondary vocational education (MBO)	Primary, Secondary education, or Secondary vocational education (MBO)
Income	- Below Average: ≤€22,199 - Average: €22,200 - €28,399	Average or below: ≤ €28,399
	- Above Average: €28,400 - €36,599 - High: ≥ €36,600	Above average: ≥ €28,400
Urbanity	- Non-urbanity - Small urbanity - Moderate urbanity	Moderate or lower urbanity
prox_road	- 2.0 - 2.9 km - ≥ 3.0 km	≥ 2.0 km
prox_train	- < 2.0 km - 2.0 - 3.9 km	< 4.0 km
	- 4.0 - 5.9 km - ≥ 6.0 km	≥ 4.0 km
B1WerkGemiddeldeAfstand B2BoodschappenGemiddeldeAfstand B3WinkelenGemiddeldeAfstand	- 10 - 30 km - 30 - 50 km - > 50 km	≥ 10km
B3WinkelenFrequentie	- < 1x per week - 1-2x per week	≤ 2x per week
B4VrijetijdGemiddeldeAfstand	- < 10 km - 10-30 km	< 30 km
	- 30-50 km - > 50km	≥ 30 km

Appendix X - Outputs Multinomial Logistic Regression Model

Table 57 | Case Summary - Multinomial Logistic Regression Model

Case Processing Summary

		N	Marginal Percentage
KeuzeOptie_Waars_FP_3 levels	Zeer Onwaarschijnlijk	1620	42,8%
	Onwaarschijnlijk	1388	36,7%
	(Zeer) Waarschijnlijk	778	20,5%
Valid		3786	100,0%
Missing		0	
Total		3786	
Subpopulation		3491[a]	

a. The dependent variable has only one value observed in 3431 (98,3%) subpopulations.

Table 58 | Model Performances - Multinomial Logistic Regression Model

Model Fitting Information

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	7911,884			
Final	7294,965	616,919	90	,000

Pseudo R-Square

Cox and Snell	,150
Nagelkerke	,171
McFadden	,077

Table 59 | Parameter Estimates - Model 2, Multinomial Logistic Regression Model

Parameter Estimates

KeuzeOptie_Waars_FP_3levels[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
Zeer Onwaarschijnlijk	Intercept	1,848	,258	51,237	1	,000			
	Geslacht	-,373	,049	58,846	1	,000	,688	,626	,757
	Leeftijd_FP_b	-,294	,058	26,121	1	,000	,745	,666	,834
	Opleiding_FP_b	,084	,050	2,893	1	,089	1,088	,987	1,199
	Income_FP_b	-,043	,064	,446	1	,092	,958	,845	1,087
	AantAuto_FP	,098	,057	2,980	1	,084	1,103	,987	1,233
	WoningType_FP_1	-,135	,076	3,179	1	,075	,873	,753	1,014
	WoningType_FP_2	,239	,068	12,233	1	,000	1,270	1,111	1,452
	KoopHuur	,061	,051	1,435	1	,231	1,063	,962	1,176
	Parkeren_loc_FP	-,083	,054	2,366	1	,124	,920	,828	1,023
	Urbanity_FP_1b	,155	,082	3,565	1	,059	1,168	,994	1,372
	Urbanity_FP_2b	,240	,070	11,892	1	,001	1,272	1,109	1,458
	prox_road_FP_1b	,223	,079	7,997	1	,005	1,249	1,071	1,458
	prox_road_FP_2b	-,244	,065	14,221	1	,000	,784	,691	,890
	prox_train_FP_b	,090	,057	2,536	1	,111	1,095	,979	1,224
	B1WerkGemAfstand_FP_1b	-,187	,073	6,662	1	,010	,829	,719	,956
	B1WerkGemAfstand_FP_2b	,207	,070	8,774	1	,003	1,230	1,073	1,411
	B2BoodschappenFreq_FP_1	,072	,169	,182	1	,670	1,075	,772	1,495
	B2BoodschappenFreq_FP_2	,767	,152	25,440	1	,000	2,154	1,598	2,901
	B2BoodschappenFreq_FP_3	,352	,155	5,121	1	,024	1,421	1,048	1,928
	B2Boodschappen_GemAfstand_FP_1c	-,713	,249	8,224	1	,004	,490	,301	,798
	B2Boodschappen_GemAfstand_FP_2c	-1,118	,273	16,794	1	,000	,327	,191	,558
	B3WinkelenFreq_FP_1b	-,061	,208	,088	1	,767	,940	,626	1,412
	B3WinkelenFreq_FP_2b	,516	,318	2,628	1	,105	1,676	,898	3,129

	B3WinkelenGemAfst_FP 1b	-,725	,152	22,821	1	,000	,484	,360	,652
	B3WinkelenGemAfst_FP 2b	-,717	,153	21,952	1	,000	,488	,362	,659
	B4VrijetijdFreq_FP_1	-,230	,151	2,309	1	,129	,794	,590	1,069
	B4VrijetijdFreq_FP_2	,148	,158	,871	1	,351	1,159	,850	1,580
	B4VrijetijdFreq_FP_3	,738	,198	13,948	1	,000	2,092	1,420	3,082
	B4VrijeTijdGemAfstand _FP_1c	-,244	,147	2,752	1	,097	,783	,587	1,045
	B4VrijeTijdGemAfstand _FP_2c	-,400	,150	7,150	1	,007	,670	,500	,899
	prop.Wacht_FP_1	,026	,065	,153	1	,695	1,026	,903	1,166
	prop.Wacht_FP_2	-,067	,068	,961	1	,327	,935	,818	1,069
	prop.Loop_FP_1	-,059	,067	,760	1	,383	,943	,827	1,076
	prop.Loop_FP_2	,054	,067	,658	1	,417	1,056	,926	1,203
	prop.Abon_FP_1	,055	,067	,681	1	,409	1,057	,927	1,205
	prop.Abon_FP_2	,012	,068	,029	1	,865	1,012	,885	1,157
	prop.Pplaats_FP	-,042	,050	,704	1	,401	,959	,870	1,057
	prop.Brand_FP_1	,078	,067	1,356	1	,244	1,081	,948	1,234
	prop.Brand_FP_2	-,001	,067	,000	1	,991	,999	,876	1,139
	prop.KostenPark_FP_1	-,065	,063	1,073	1	,300	,937	,828	1,060
	prop.KostenPark_FP_2	-,037	,068	,305	1	,581	,963	,843	1,100
	prop.LoopPark_FP_1	-,054	,066	,671	1	,413	,947	,832	1,078
	prop.LoopPark_FP_2	-,025	,067	,141	1	,707	,975	,856	1,112
	prop.TypePark_FP_1	-,137	,066	4,290	1	,038	,872	,766	,993
	prop.TypePark_FP_2	,124	,066	3,533	1	,060	1,132	,995	1,287
Onwaarschijnlijk	Intercept	1,123	,267	17,684	1	,000			
	Geslacht	-,158	,049	10,561	1	,001	,854	,776	,939
	Leeftijd_FP_b	-,120	,058	4,263	1	,039	,887	,792	,994
	Opleiding_FP_b	-,118	,050	5,662	1	,017	,889	,806	,979
	Income_FP_b	-,220	,065	11,517	1	,001	,802	,707	,911
	AantAuto_FP	,043	,057	,561	1	,454	1,043	,933	1,166
	WoningType_FP_1	-,078	,076	1,052	1	,305	,925	,797	1,074
	WoningType_FP_2	,265	,069	14,957	1	,000	1,304	1,140	1,491
	KoopHuur	,099	,051	3,763	1	,052	1,104	,999	1,221
	Parkeren_loc_FP	-,103	,054	3,674	1	,055	,902	,812	1,002
	Urbanity_FP_1b	-,098	,082	1,435	1	,231	,907	,773	1,064
	Urbanity_FP_2b	-,029	,071	,161	1	,688	,972	,846	1,117
	prox_road_FP_1b	-,047	,082	,332	1	,564	,954	,813	1,120
	prox_road_FP_2b	,047	,065	,537	1	,464	1,049	,924	1,190
	prox_train_FP_b	-,200	,057	12,399	1	,000	,819	,732	,915
	B1WerkGemAfstand_FP_ 1b	-,103	,072	2,052	1	,152	,903	,784	1,038
	B1WerkGemAfstand_FP_ 2b	-,049	,070	,488	1	,485	,952	,830	1,093
	B2BoodschappenFreq_F P_1	-,146	,155	,887	1	,346	,864	,638	1,171
	B2BoodschappenFreq_F P_2	,322	,138	5,425	1	,020	1,379	1,052	1,808
	B2BoodschappenFreq_F P_3	,118	,141	,699	1	,403	1,125	,854	1,483
	B2Boodschappen_GemA fstand_FP_1c	,015	,251	,003	1	,954	1,015	,621	1,658
	B2Boodschappen_GemA fstand_FP_2c	-,877	,275	10,204	1	,001	,416	,243	,712
	B3WinkelenFreq_FP_1b	-,628	,207	9,217	1	,002	,533	,356	,800
	B3WinkelenFreq_FP_2b	,512	,310	2,736	1	,098	1,669	,910	3,064
	B3WinkelenGemAfst_FP 1b	-,283	,159	3,179	1	,075	,753	,552	1,029
	B3WinkelenGemAfst_FP 2b	-,202	,160	1,586	1	,208	,817	,597	1,119
	B4VrijetijdFreq_FP_1	-,018	,169	,011	1	,915	,982	,706	1,367
	B4VrijetijdFreq_FP_2	-,039	,175	,050	1	,823	,962	,682	1,356
	B4VrijetijdFreq_FP_3	,151	,216	,487	1	,485	1,162	,762	1,774
	B4VrijeTijdGemAfstand _FP_1c	,316	,167	3,571	1	,059	1,371	,988	1,902
	B4VrijeTijdGemAfstand _FP_2c	-,116	,169	,468	1	,494	,891	,639	1,241
	prop.Wacht_FP_1	-,035	,065	,291	1	,589	,965	,849	1,097
	prop.Wacht_FP_2	-,018	,068	,068	1	,795	,982	,860	1,122
	prop.Loop_FP_1	-,045	,067	,448	1	,503	,956	,839	1,090
	prop.Loop_FP_2	,062	,067	,854	1	,355	1,064	,933	1,212
	prop.Abon_FP_1	-,039	,067	,329	1	,566	,962	,843	1,098
	prop.Abon_FP_2	,125	,068	3,428	1	,064	1,133	,993	1,294
	prop.Pplaats_FP	-,012	,050	,058	1	,810	,988	,896	1,089
	prop.Brand_FP_1	,006	,067	,009	1	,924	1,006	,882	1,149
	prop.Brand_FP_2	,018	,067	,073	1	,787	1,018	,893	1,161
	prop.KostenPark_FP_1	-,166	,063	6,867	1	,009	,847	,749	,959
	prop.KostenPark_FP_2	,026	,067	,148	1	,700	1,026	,899	1,171
	prop.LoopPark_FP_1	-,106	,066	2,558	1	,110	,899	,790	1,024
	prop.LoopPark_FP_2	,039	,066	,348	1	,555	1,040	,913	1,184
	prop.TypePark_FP_1	-,114	,066	2,972	1	,085	,892	,784	1,016
	prop.TypePark_FP_2	,078	,066	1,421	1	,233	1,082	,951	1,231

a. The reference category is: (Zeer) Waarschijnlijk.

Appendix XI - Overview Application per Municipality

- ## Potential Share, Households, & Cars per Municipality

Table 60 | Overview Potential Share, N. of Households, N. of Cars - Per Municipality

Mun. Code*	Municipality Name	Share** Very Unlikely	Share** Unlikely	Share** (Very) Likely	Households Very Unlikely	Households Unlikely	Households (Very) Likely	N.Cars / House-hold	N. Cars (Very) Likely
3	Appingedam	0.76	0.14	0.09	4216	778	523	1.0	523
5	Bedum	0.53	0.34	0.13	2297	1474	563	1.1	619
9	Ten Boer	0.53	0.26	0.21	1556	753	622	1.2	746
10	Delfzijl	0.67	0.20	0.13	8002	2390	1514	1.0	1514
14	Groningen	0.38	0.42	0.19	44249	48732	22066	0.6	13240
15	Grootegast	0.64	0.22	0.14	3023	1033	671	1.3	873
17	Haren	0.57	0.28	0.16	4669	2296	1294	1.4	1811
22	Leek	0.56	0.29	0.14	4536	2341	1154	1.2	1385
24	Loppersum	0.58	0.24	0.18	2547	1067	772	1.1	849
25	Marum	0.69	0.21	0.11	2827	856	443	1.3	576
34	Almere	0.59	0.26	0.15	47231	20702	11702	1.0	11702
37	Stadskanaal	0.56	0.31	0.13	8105	4475	1948	1.1	2143
47	Veendam	0.66	0.19	0.15	8189	2366	1841	1.1	2025
50	Zeewolde	0.45	0.37	0.18	3674	3012	1456	1.5	2184
53	Winsum	0.56	0.22	0.22	3270	1285	1289	1.2	1547
56	Zuidhorn	0.71	0.16	0.13	5344	1231	954	1.2	1145
58	Dongeradeel	0.46	0.36	0.18	4693	3656	1848	1.1	2032
59	Achtkarspelen	0.53	0.33	0.15	6035	3714	1664	1.2	1997
60	Ameland	0.59	0.25	0.16	914	393	248	1.0	248
72	Harlingen	0.61	0.25	0.14	4337	1744	1029	0.9	926
74	Heerenveen	0.51	0.34	0.16	9899	6528	3022	1.1	3324
79	Kollumerland en Nieuwkruisland	0.47	0.31	0.22	2489	1616	1151	1.2	1382
80	Leeuwarden	0.64	0.23	0.12	31815	11534	6056	0.7	4239
85	Ooststellingwerf	0.50	0.33	0.17	5478	3678	1890	1.2	2268
86	Opsterland	0.62	0.27	0.12	7522	3251	1448	1.2	1738
90	Smallingerland	0.58	0.29	0.14	14095	6945	3321	1.2	3986
93	Terschelling	0.44	0.29	0.26	970	639	577	1.0	577
98	Weststellingwerf	0.46	0.35	0.19	5008	3883	2090	1.2	2508
106	Assen	0.68	0.18	0.14	20224	5391	4040	1.1	4444
109	Coevorden	0.48	0.37	0.15	7384	5676	2294	1.2	2753
114	Emmen	0.57	0.30	0.14	27170	14152	6465	1.1	7112
118	Hoogeveen	0.55	0.31	0.14	12689	7265	3206	1.1	3527
119	Meppel	0.58	0.27	0.15	8284	3839	2170	1.0	2170
141	Almelo	0.66	0.20	0.14	20827	6415	4356	1.0	4356
147	Borne	0.65	0.18	0.17	5883	1625	1494	1.1	1643
148	Dalfsen	0.46	0.38	0.16	4932	4048	1725	1.4	2415
150	Deventer	0.59	0.26	0.15	26302	11611	6670	1.0	6670
153	Enschede	0.60	0.25	0.15	46157	19164	11839	0.9	10655

158	Haaksbergen	0.57	0.30	0.13	5613	2927	1324	1.2	1589
160	Hardenberg	0.46	0.37	0.17	10493	8523	3967	1.3	5158
163	Hellendoorn	0.61	0.23	0.16	8604	3224	2300	1.3	2990
164	Hengelo	0.66	0.21	0.13	24037	7663	4545	1.2	5454
166	Kampen	0.60	0.26	0.15	12038	5156	2993	1.0	2993
168	Losser	0.57	0.30	0.13	5181	2740	1223	1.2	1467
171	Noordoostpolder	0.49	0.35	0.16	9318	6594	3120	1.2	3743
173	Oldenzaal	0.64	0.22	0.13	8788	3067	1825	1.4	2555
175	Ommen	0.52	0.32	0.16	3660	2281	1107	1.3	1438
177	Raalte	0.58	0.25	0.17	8583	3668	2431	1.2	2917
180	Staphorst	0.54	0.32	0.14	2895	1721	722	1.5	1083
183	Tubbergen	0.49	0.33	0.18	3763	2586	1406	1.4	1969
184	Urk	0.62	0.28	0.10	3410	1562	570	1.1	627
189	Wierden	0.56	0.27	0.18	5020	2401	1613	1.4	2258
193	Zwolle	0.66	0.22	0.12	36547	12402	6531	0.9	5878
197	Aalten	0.57	0.28	0.15	6349	3146	1701	1.2	2041
200	Apeldoorn	0.67	0.21	0.12	45408	13976	8394	1.1	9234
202	Arnhem	0.58	0.27	0.14	43578	20625	10873	0.8	8698
203	Barneveld	0.58	0.26	0.16	11287	5033	3127	1.3	4065
209	Beuningen	0.57	0.30	0.14	5886	3090	1410	1.2	1692
213	Brummen	0.53	0.32	0.15	4765	2927	1321	1.2	1586
214	Buren	0.53	0.33	0.14	5364	3372	1443	1.4	2020
216	Culemborg	0.61	0.25	0.14	7053	2932	1564	1.0	1564
221	Doesburg	0.50	0.36	0.15	2543	1825	757	1.5	1135
222	Doetinchem	0.63	0.22	0.15	15431	5347	3631	1.1	3994
225	Druten	0.54	0.33	0.13	3820	2379	936	1.3	1217
226	Duiven	0.68	0.19	0.13	6998	1975	1325	1.2	1590
228	Ede	0.61	0.24	0.15	27317	10930	6496	1.1	7145
230	Elburg	0.60	0.28	0.12	5147	2444	1032	1.2	1239
232	Epe	0.48	0.37	0.15	6597	5002	2022	1.2	2426
233	Ermelo	0.61	0.24	0.15	6597	2662	1610	1.1	1771
236	Geldermalsen	0.71	0.17	0.13	7248	1692	1307	1.3	1699
243	Harderwijk	0.58	0.26	0.16	10979	4956	3026	1.1	3328
244	Hattem	0.55	0.31	0.14	2618	1489	685	1.2	822
246	Heerde	0.58	0.29	0.13	4227	2097	972	1.3	1263
252	Heumen	0.58	0.30	0.12	3913	2035	794	1.3	1032
262	Lochem	0.40	0.39	0.21	5632	5438	2934	1.3	3814
263	Maasdriel	0.43	0.36	0.21	4112	3491	1970	1.3	2561
267	Nijkerk	0.62	0.23	0.15	9825	3662	2318	1.2	2781
268	Nijmegen	0.65	0.23	0.12	57790	20157	10872	0.7	7610
269	Oldebroek	0.60	0.23	0.16	5149	1995	1372	1.3	1783
273	Putten	0.69	0.19	0.13	6359	1709	1154	1.2	1385
274	Renkum	0.61	0.24	0.14	8625	3386	2021	1.1	2223
275	Rheden	0.72	0.17	0.11	14584	3518	2196	1.0	2196
279	Scherpenzeel	0.74	0.17	0.09	2648	622	308	1.3	401
281	Tiel	0.61	0.24	0.15	10690	4213	2706	1.2	3247

285	Voorst	0.73	0.17	0.11	6859	1556	1008	1.3	1310
289	Wageningen	0.47	0.38	0.14	9848	8063	3035	0.6	1821
293	Westervoort	0.68	0.19	0.13	4426	1224	816	1.1	897
294	Winterswijk	0.55	0.26	0.19	6814	3244	2386	1.1	2624
296	Wijchen	0.60	0.24	0.15	10142	4136	2614	1.2	3137
297	Zaltbommel	0.55	0.33	0.12	5588	3410	1235	1.3	1606
299	Zevenaar	0.50	0.34	0.15	7228	4936	2195	1.1	2414
301	Zutphen	0.71	0.18	0.11	15003	3752	2317	0.9	2085
302	Nunspeet	0.65	0.21	0.14	6509	2152	1420	1.2	1704
303	Dronten	0.52	0.34	0.14	8811	5806	2468	1.1	2714
304	Neerijnen	0.45	0.40	0.15	2057	1789	676	1.5	1014
307	Amersfoort	0.61	0.25	0.14	39391	15808	8965	1.2	10758
308	Baarn	0.58	0.26	0.16	6428	2853	1829	1.0	1829
310	De Bilt	0.58	0.28	0.14	10939	5217	2586	1.1	2844
312	Bunnik	0.81	0.12	0.07	4957	717	415	1.2	498
313	Bunschoten	0.60	0.30	0.09	4442	2244	685	1.4	959
317	Eemnes	0.44	0.40	0.16	1576	1433	582	1.3	756
321	Houten	0.70	0.17	0.13	13092	3194	2329	2.4	5589
327	Leusden	0.69	0.24	0.07	8333	2936	816	1.2	979
331	Lopik	0.46	0.39	0.15	2426	2050	796	1.3	1034
335	Montfoort	0.76	0.17	0.07	4055	892	382	1.2	458
339	Renswoude	0.62	0.28	0.11	1071	480	186	1.4	261
340	Rhenen	0.66	0.22	0.12	5032	1643	947	1.2	1136
342	Soest	0.64	0.23	0.13	12790	4561	2597	1.1	2856
344	Utrecht	0.46	0.38	0.16	74953	62972	26743	0.8	21395
345	Veenendaal	0.64	0.22	0.13	16439	5691	3414	1.1	3755
351	Woudenberg	0.64	0.24	0.12	2933	1077	563	1.3	732
352	Wijk bij Duurstede	0.55	0.33	0.11	5157	3121	1073	1.2	1288
353	IJsselstein	0.49	0.38	0.13	6910	5279	1793	1.0	1793
355	Zeist	0.60	0.26	0.14	16609	7369	3869	1.4	5417
356	Nieuwegein	0.53	0.35	0.12	14467	9348	3281	1.0	3281
358	Aalsmeer	0.49	0.37	0.14	6072	4578	1701	1.2	2042
361	Alkmaar	0.59	0.27	0.14	26540	11934	6206	0.9	5585
362	Amstelveen	0.49	0.39	0.13	19545	15565	5184	0.9	4666
363	Amsterdam	0.45	0.41	0.15	192729	175274	64609	0.5	32305
370	Beemster	0.38	0.42	0.20	1375	1492	712	1.2	854
373	Bergen (NH.)	0.47	0.36	0.17	6468	4931	2323	1.1	2555
375	Beverwijk	0.42	0.40	0.18	7688	7258	3268	1.0	3268
376	Blaricum	0.44	0.37	0.19	1768	1476	742	1.5	1113
377	Bloemendaal	0.55	0.29	0.16	5076	2710	1469	1.2	1762
383	Castricum	0.56	0.27	0.17	8192	4050	2513	1.0	2513
384	Diemen	0.58	0.29	0.12	7078	3547	1504	0.8	1203
385	Edam-Volendam	0.48	0.36	0.16	5395	4082	1845	0.9	1660
388	Enkhuizen	0.60	0.26	0.14	4933	2157	1156	0.9	1040
392	Haarlem	0.41	0.42	0.17	30609	30780	12524	0.9	11272

393	Haarlemmerliede en Spaarnwoude	0.75	0.15	0.10	1710	350	222	1.2	266
394	Haarlemmermeer	0.62	0.25	0.13	36769	14708	7643	1.6	12229
396	Heemskerk	0.68	0.21	0.11	11629	3503	1867	1.0	1867
397	Heemstede	0.63	0.24	0.13	7225	2733	1512	1.1	1663
398	Heerhugowaard	0.59	0.26	0.16	12443	5482	3327	1.1	3660
399	Heiloo	0.66	0.23	0.11	6411	2204	1079	1.0	1079
400	Den Helder	0.56	0.28	0.15	15345	7757	4176	0.9	3758
402	Hilversum	0.62	0.25	0.13	25065	10311	5275	1.0	5275
405	Hoorn	0.58	0.26	0.15	18481	8272	4901	1.3	6371
406	Huizen	0.62	0.30	0.09	11124	5339	1587	1.1	1745
415	Landsmeer	0.42	0.41	0.17	1857	1800	731	1.2	877
416	Langedijk	0.52	0.34	0.14	5626	3658	1503	1.2	1804
417	Laren	0.49	0.38	0.14	2561	1995	713	1.2	856
420	Medemblik	0.58	0.30	0.12	10175	5224	2156	1.2	2587
431	Oostzaan	0.47	0.36	0.17	1747	1356	641	1.1	705
432	Opmeer	0.43	0.39	0.18	1958	1783	816	1.2	979
437	Ouder-Amstel	0.50	0.30	0.20	2863	1735	1180	1.0	1180
439	Purmerend	0.63	0.25	0.12	21558	8695	4198	1.1	4618
441	Schagen	0.44	0.41	0.15	3644	3355	1264	1.0	1264
448	Texel	0.61	0.27	0.12	3743	1641	703	1.1	773
450	Uitgeest	0.50	0.30	0.20	2626	1570	1026	1.1	1128
451	Uithoorn	0.49	0.38	0.13	5988	4620	1634	1.2	1961
453	Velsen	0.66	0.22	0.12	19790	6517	3467	1.0	3467
457	Weesp	0.59	0.29	0.13	5005	2439	1078	0.9	971
473	Zandvoort	0.63	0.25	0.12	5253	2035	1016	1.0	1016
479	Zaanstad	0.62	0.24	0.13	40927	16100	8770	0.9	7893
482	Alblasserdam	0.60	0.29	0.11	4726	2260	870	1.1	957
484	Alphen aan den Rijn	0.60	0.26	0.14	18819	8140	4258	1.3	5535
489	Barendrecht	0.52	0.34	0.14	9771	6265	2579	1.2	3094
498	Drechterland	0.62	0.21	0.17	4808	1658	1289	1.2	1547
501	Brielle	0.58	0.30	0.12	4111	2144	844	1.2	1013
502	Capelle aan den IJssel	0.68	0.21	0.11	20278	6275	3338	1.0	3338
503	Delft	0.41	0.42	0.17	22266	22935	9511	0.6	5707
505	Dordrecht	0.60	0.26	0.14	32423	14397	7612	1.0	7612
512	Gorinchem	0.60	0.25	0.14	9386	3895	2242	1.0	2242
513	Gouda	0.61	0.26	0.13	19016	8041	4074	0.8	3260
518	's-Gravenhage	0.46	0.39	0.15	114931	95973	37654	0.7	26358
523	Hardinxveld-Giessendam	0.53	0.28	0.19	3609	1902	1301	1.2	1561
530	Hellevoetsluis	0.54	0.34	0.12	9347	5917	2051	1.1	2256
531	Hendrik-Ido-Ambacht	0.62	0.25	0.13	6860	2774	1502	1.1	1652
532	Stede Broec	0.70	0.18	0.12	6163	1574	1046	1.0	1046
534	Hillegom	0.53	0.29	0.17	4823	2628	1565	1.1	1721
537	Katwijk	0.52	0.36	0.13	12583	8699	3129	1.5	4694
542	Krimpen aan den IJssel	0.66	0.25	0.10	7759	2934	1130	1.1	1244

545	Leerdam	0.60	0.25	0.15	5037	2108	1308	1.0	1308
546	Leiden	0.47	0.37	0.16	29576	23359	10087	0.7	7061
547	Leiderdorp	0.52	0.34	0.13	6130	4040	1552	1.0	1552
553	Lisse	0.53	0.32	0.15	5235	3152	1425	1.1	1568
556	Maassluis	0.56	0.32	0.12	8004	4532	1639	1.0	1639
569	Nieuwkoop	0.64	0.25	0.11	7016	2703	1193	1.4	1670
575	Noordwijk	0.55	0.35	0.10	6244	3909	1164	1.3	1513
576	Noordwijkerhout	0.47	0.37	0.15	3106	2440	1017	1.1	1119
579	Oegstgeest	0.52	0.33	0.15	5196	3273	1537	1.0	1537
580	Oostflakkee	0.38	0.42	0.20	8032	8878	4228	1.0	4228
584	Oud-Beijerland	0.47	0.41	0.13	4373	3831	1189	1.2	1426
585	Binnenmaas	0.50	0.36	0.14	6165	4481	1682	1.2	2018
588	Korendijk	0.48	0.33	0.19	2059	1413	832	1.3	1082
589	Oudewater	0.48	0.36	0.16	1866	1395	622	1.2	747
590	Papendrecht	0.52	0.36	0.12	7160	4901	1644	1.1	1808
597	Ridderkerk	0.56	0.32	0.12	11209	6563	2423	1.1	2665
599	Rotterdam	0.47	0.38	0.15	146762	119059	47473	0.7	33231
603	Rijswijk	0.44	0.41	0.15	10568	9771	3698	1.3	4807
606	Schiedam	0.44	0.39	0.16	15947	14035	5920	0.8	4736
610	Sliedrecht	0.60	0.27	0.13	5962	2655	1342	1.1	1476
611	Cromstrijen	0.48	0.36	0.16	2612	1951	857	1.2	1029
613	Albrandswaard	0.45	0.39	0.16	4459	3877	1538	1.2	1846
614	Westvoorne	0.56	0.31	0.13	3455	1942	776	1.3	1008
617	Strijen	0.55	0.30	0.15	2063	1133	557	1.2	668
620	Vianen	0.47	0.38	0.15	3822	3081	1198	1.3	1558
622	Vlaardingen	0.34	0.52	0.15	11339	17364	4955	0.9	4459
626	Voorschoten	0.59	0.26	0.15	6218	2703	1570	1.1	1727
627	Waddinxveen	0.71	0.19	0.11	7353	1943	1102	1.2	1323
629	Wassenaar	0.58	0.30	0.11	6645	3469	1284	1.2	1541
632	Woerden	0.65	0.23	0.13	13341	4655	2573	1.1	2830
637	Zoetermeer	0.68	0.21	0.11	36539	11083	5773	1.0	5773
638	Zoeterwoude	0.64	0.26	0.10	2004	822	321	1.2	385
642	Zwijndrecht	0.62	0.26	0.12	12316	5142	2424	1.0	2424
654	Borsele	0.43	0.40	0.17	3947	3687	1614	1.3	2098
664	Goes	0.59	0.25	0.16	9940	4252	2605	1.1	2866
668	West Maas en Waal	0.49	0.35	0.16	3664	2581	1189	1.3	1546
677	Hulst	0.50	0.35	0.15	6308	4368	1818	1.2	2182
678	Kapelle	0.68	0.19	0.13	3337	921	663	1.3	862
687	Middelburg	0.61	0.25	0.14	13608	5483	3038	1.3	3949
689	Giessenlanden	0.55	0.26	0.18	3111	1494	1035	1.3	1345
703	Reimerswaal	0.57	0.26	0.17	4773	2205	1417	1.2	1700
707	Zederik	0.55	0.33	0.12	2796	1685	613	1.3	797
715	Terneuzen	0.55	0.31	0.13	13790	7746	3340	1.1	3674
716	Tholen	0.58	0.29	0.13	5890	2929	1263	1.2	1516
717	Veere	0.48	0.38	0.14	4391	3496	1310	1.2	1573

718	Vlissingen	0.61	0.25	0.14	13260	5365	3103	0.9	2793
733	Lingewaal	0.55	0.28	0.17	2326	1175	727	1.3	945
736	De Ronde Venen	0.48	0.36	0.16	8469	6343	2918	1.2	3502
737	Tytsjerksteradiel	0.52	0.32	0.16	6891	4268	2171	1.2	2605
738	Aalburg	0.48	0.37	0.15	2214	1714	672	1.4	940
743	Asten	0.47	0.35	0.19	3139	2324	1253	1.2	1503
744	Baarle-Nassau	0.45	0.41	0.15	1301	1187	433	1.3	563
748	Bergen op Zoom	0.68	0.21	0.11	19876	6058	3330	1.0	3330
753	Best	0.60	0.24	0.17	6928	2738	1957	1.2	2349
755	Boekel	0.51	0.31	0.17	1889	1149	633	1.3	823
756	Boxmeer	0.67	0.20	0.13	7709	2283	1524	1.2	1829
757	Boxtel	0.54	0.29	0.17	6935	3662	2172	1.1	2389
758	Breda	0.64	0.23	0.12	53753	19635	10284	1.7	17482
762	Deurne	0.69	0.18	0.13	8784	2328	1698	1.2	2037
765	Pekela	0.54	0.29	0.17	3098	1647	978	1.1	1076
766	Dongen	0.55	0.33	0.12	5710	3446	1275	1.2	1530
770	Eersel	0.55	0.32	0.13	4019	2322	922	1.4	1290
772	Eindhoven	0.62	0.24	0.14	68741	26180	15166	0.9	13650
777	Etten-Leur	0.62	0.25	0.13	10988	4466	2258	1.2	2709
779	Geertruidenberg	0.51	0.34	0.15	4664	3110	1380	1.2	1657
784	Gilze en Rijen	0.61	0.23	0.16	6382	2395	1728	1.2	2074
785	Goirle	0.52	0.35	0.14	4885	3264	1285	1.2	1542
786	Grave	0.64	0.25	0.11	3435	1367	575	1.2	690
788	Haaren	0.45	0.37	0.18	2335	1935	963	1.3	1252
794	Helmond	0.67	0.20	0.13	25532	7549	4998	1.1	5498
796	's-Hertogenbosch	0.59	0.27	0.15	38850	17620	9712	1.1	10684
797	Heusden	0.50	0.37	0.13	8818	6471	2322	1.4	3250
798	Hilvarenbeek	0.48	0.37	0.15	2810	2192	905	1.4	1266
809	Loon op Zand	0.58	0.28	0.14	5449	2658	1273	1.2	1527
815	Mill en Sint Hubert	0.52	0.32	0.16	2264	1393	678	1.4	949
820	Nuenen. Gerwen en Nederwetten	0.62	0.27	0.11	5957	2604	1086	1.3	1412
823	Oirschot	0.64	0.25	0.11	4469	1783	757	2.3	1740
824	Oisterwijk	0.68	0.21	0.12	7454	2270	1278	1.2	1534
826	Oosterhout	0.51	0.35	0.14	11839	8214	3238	1.3	4209
828	Oss	0.67	0.21	0.13	24110	7448	4540	1.1	4994
840	Rucphen	0.48	0.33	0.18	4505	3106	1704	1.3	2216
845	Sint-Michielsgestel	0.53	0.33	0.14	5866	3678	1565	1.3	2034
847	Someren	0.59	0.30	0.11	4423	2258	828	1.2	993
848	Son en Breugel	0.52	0.34	0.15	3384	2218	957	1.3	1244
851	Steenbergen	0.56	0.31	0.12	5550	3107	1236	1.2	1483
852	Waterland	0.59	0.26	0.15	4265	1850	1081	1.4	1514
855	Tilburg	0.48	0.36	0.16	48475	35802	16259	0.9	14633
856	Uden	0.49	0.37	0.14	8418	6410	2360	1.3	3068
858	Valkenswaard	0.62	0.27	0.11	8523	3680	1577	1.1	1735
861	Veldhoven	0.54	0.31	0.14	10250	5906	2689	1.3	3496

865	Vught	0.66	0.23	0.10	7126	2500	1125	1.1	1238
866	Waalre	0.46	0.34	0.20	3203	2397	1405	1.3	1827
867	Waalwijk	0.51	0.33	0.16	10298	6596	3218	1.2	3862
870	Werkendam	0.56	0.30	0.14	5731	3035	1439	1.2	1727
873	Woensdrecht	0.52	0.34	0.15	4745	3112	1345	1.3	1749
874	Woudrichem	0.54	0.33	0.13	3036	1841	756	1.3	982
879	Zundert	0.46	0.38	0.17	4160	3396	1496	1.2	1796
880	Wormerland	0.55	0.29	0.16	3672	1938	1084	1.1	1192
881	Onderbanken	0.54	0.33	0.13	1852	1118	452	1.3	587
882	Landgraaf	0.58	0.26	0.16	10073	4464	2843	1.1	3127
888	Beek	0.65	0.23	0.12	4718	1681	909	1.3	1182
889	Beesel	0.68	0.19	0.13	3944	1102	787	1.3	1023
893	Bergen (L.)	0.56	0.30	0.14	3093	1661	748	1.3	972
899	Brunssum	0.48	0.36	0.16	6624	4887	2197	1.1	2416
907	Gennep	0.60	0.28	0.12	4259	1950	872	1.3	1134
917	Heerlen	0.58	0.27	0.15	26187	11882	6720	1.0	6720
928	Kerkrade	0.65	0.22	0.13	14863	4968	3039	1.0	3039
935	Maastricht	0.66	0.22	0.12	43277	14284	7961	0.7	5573
938	Meerssen	0.55	0.29	0.16	4601	2399	1304	1.2	1565
944	Mook en Middelaar	0.70	0.19	0.12	2360	626	390	1.3	507
946	Nederweert	0.56	0.30	0.14	3872	2046	943	1.3	1226
951	Nuth	0.56	0.29	0.15	3802	1966	996	1.3	1295
957	Roermond	0.61	0.24	0.15	15946	6192	4032	1.0	4032
962	Schinnen	0.69	0.20	0.11	3991	1149	661	1.3	859
965	Simpelveld	0.45	0.45	0.10	2144	2157	483	1.3	628
971	Stein	0.61	0.25	0.14	6815	2861	1583	1.2	1900
981	Vaals	0.71	0.20	0.09	3428	990	423	1.0	423
983	Venlo	0.63	0.24	0.13	28519	10837	6116	1.0	6116
984	Venray	0.62	0.24	0.13	11157	4318	2399	1.2	2879
986	Voerendaal	0.63	0.25	0.11	3473	1389	630	1.3	819
988	Weert	0.59	0.25	0.15	12591	5401	3265	1.1	3592
994	Valkenburg aan de Geul	0.71	0.17	0.12	5499	1336	932	1.1	1026
995	Lelystad	0.68	0.19	0.13	22306	6133	4153	1.0	4153
1507	Horst aan de Maas	0.51	0.35	0.14	8510	5929	2380	1.3	3094
1509	Oude IJsselstreek	0.54	0.30	0.16	8873	5021	2667	1.2	3200
1525	Teylingen	0.57	0.27	0.16	8221	3832	2317	1.1	2549
1581	Utrechtse Heuvelrug	0.49	0.34	0.16	10276	7220	3455	1.2	4147
1586	Oost Gelre	0.59	0.29	0.13	7045	3461	1512	1.2	1814
1598	Koggenland	0.48	0.38	0.15	4248	3359	1328	1.2	1594
1621	Lansingerland	0.53	0.35	0.13	11047	7327	2645	1.3	3439
1640	Leudal	0.48	0.37	0.16	7188	5525	2372	1.3	3084
1641	Maasgouw	0.53	0.33	0.14	5347	3364	1462	1.3	1900
1651	Eemsmond	0.68	0.18	0.14	4686	1241	978	1.1	1076
1652	Gemert-Bakel	0.47	0.35	0.17	5577	4161	2019	1.3	2624
1655	Halderberge	0.57	0.24	0.19	7045	2941	2279	1.2	2735

1658	Heeze-Leende	0.63	0.22	0.15	3942	1366	911	1.4	1275
1659	Laarbeek	0.39	0.40	0.21	3417	3461	1830	1.3	2379
1663	De Marne	0.47	0.36	0.17	2185	1677	801	1.1	881
1667	Reusel-De Mierden	0.62	0.25	0.13	3070	1260	658	1.3	855
1669	Roerdalen	0.43	0.36	0.21	3939	3281	1911	1.3	2485
1674	Roosendaal	0.62	0.24	0.14	21207	8008	4822	1.1	5304
1676	Schouwen-Duiveland	0.49	0.35	0.16	7389	5339	2410	1.2	2892
1680	Aa en Hunze	0.55	0.30	0.15	6174	3374	1670	1.2	2003
1681	Borger-Odoorn	0.57	0.30	0.12	6262	3328	1333	1.3	1733
1684	Cuijk	0.59	0.23	0.18	6119	2437	1816	1.2	2179
1685	Landerd	0.27	0.53	0.20	1546	3006	1154	1.4	1615
1690	De Wolden	0.64	0.24	0.12	6167	2337	1127	1.3	1466
1695	Noord-Beveland	0.54	0.29	0.18	1881	1002	613	1.2	735
1696	Wijdemeren	0.58	0.29	0.13	5719	2905	1278	1.3	1661
1699	Noordenveld	0.53	0.32	0.15	7045	4318	1937	1.2	2325
1700	Twenterand	0.61	0.24	0.15	7741	2997	1940	1.3	2522
1701	Westerveld	0.61	0.26	0.13	5043	2159	1060	1.3	1378
1702	Sint Anthonis	0.44	0.38	0.17	1977	1714	782	1.3	1016
1705	Lingewaard	0.50	0.34	0.15	9388	6413	2871	1.2	3446
1706	Cranendonck	0.61	0.29	0.11	5162	2450	917	1.3	1193
1708	Steenwijkerland	0.53	0.32	0.15	9798	5986	2769	1.1	3046
1709	Moerdijk	0.50	0.37	0.13	7640	5608	2043	1.3	2657
1711	Echt-Susteren	0.71	0.18	0.11	10028	2463	1581	1.2	1897
1714	Sluis	0.50	0.34	0.15	5650	3866	1716	1.2	2060
1719	Drimmelen	0.56	0.30	0.14	6115	3242	1482	1.4	2074
1721	Bernheze	0.54	0.32	0.14	6178	3620	1588	1.3	2064
1722	Ferwerderadiel	0.42	0.34	0.24	1512	1244	879	1.2	1054
1723	Alphen-Chaam	0.50	0.36	0.14	1901	1360	527	1.4	738
1724	Bergeijk	0.62	0.24	0.14	4490	1726	1042	1.3	1354
1728	Bladel	0.57	0.30	0.13	4522	2340	1048	1.3	1362
1729	Gulpen-Wittem	0.55	0.32	0.13	3490	2010	857	1.2	1028
1730	Tynaarlo	0.59	0.25	0.16	7999	3439	2178	1.5	3267
1731	Midden-Drenthe	0.49	0.32	0.19	6818	4553	2662	1.2	3195
1734	Overbetuwe	0.60	0.25	0.16	11014	4536	2863	1.2	3436
1735	Hof van Twente	0.63	0.22	0.16	9129	3143	2303	1.3	2994
1740	Neder-Betuwe	0.56	0.25	0.19	4513	1984	1492	1.4	2088
1742	Rijssen-Holten	0.62	0.22	0.17	8409	2957	2285	1.3	2970
1771	Geldrop-Mierlo	0.70	0.18	0.12	11854	3074	2054	1.1	2260
1773	Olst-Wijhe	0.55	0.26	0.18	3919	1848	1308	1.2	1569
1774	Dinkelland	0.47	0.36	0.17	4617	3491	1631	1.3	2121
1783	Westland	0.61	0.28	0.12	25320	11665	4807	1.2	5768
1842	Midden-Delfland	0.59	0.30	0.12	4203	2113	842	1.2	1010
1859	Berkelland	0.50	0.35	0.15	9137	6398	2752	1.3	3578
1876	Bronckhorst	0.50	0.35	0.15	7642	5297	2253	1.3	2930
1883	Sittard-Geleen	0.65	0.22	0.14	28472	9472	6025	1.1	6628

1884	Kaag en Braassem	0.49	0.35	0.15	5177	3685	1603	1.2	1923
1891	Dantumadiel	0.57	0.30	0.13	4370	2299	1003	1.2	1203
1892	Zuidplas	0.60	0.25	0.14	9797	4110	2311	1.2	2774
1894	Peel en Maas	0.63	0.27	0.10	10845	4586	1745	1.3	2268
1895	Oldambt	0.55	0.26	0.19	9857	4571	3378	1.1	3716
1896	Zwartewaterland	0.55	0.30	0.15	4484	2463	1229	1.2	1475
1900	Súdwest-Fryslân	0.54	0.31	0.15	19064	10943	5390	1.1	5929
1901	Bodegraven-Reeuwijk	0.60	0.25	0.14	7873	3322	1870	1.2	2244
1903	Eijsden-Margraten	0.53	0.35	0.13	5373	3536	1298	1.3	1688
1904	Stichtse Vecht	0.60	0.24	0.16	15988	6434	4390	1.1	4829
1911	Hollands Kroon	0.48	0.36	0.16	9560	7113	3153	1.2	3783
1916	Leidschendam-Voorburg	0.42	0.41	0.16	14884	14488	5658	1.0	5658
1926	Pijnacker-Nootdorp	0.49	0.37	0.14	9263	7063	2709	1.1	2980
1955	Montferland	0.53	0.32	0.15	7632	4692	2211	1.2	2654

** Coding based on Dutch municipality coding 2012*
*** Values are rounded to the second decimal place*

• Missing Municipalities

Table 61 | Missing Municipalities

Mun. Code*	Municipality Name	Mun. Code*	Municipality Name
7	Bellingwedde	476	Zijpe
18	Hoogezand-Sappemeer	478	Zeevang
40	Slochteren	491	Bergambacht
48	Vlagtwedde	499	Boskoop
51	Skarsterlân	504	Dirksland
55	Boarnsterhim	511	Goedereede
63	het Bildt	559	Middelharnis
70	Franekeradeel	568	Bernisse
81	Leeuwarderadeel	571	Nieuw-Lekkerland
82	Lemsterland	608	Schoonhoven
88	Schiermonnikoog	612	Spijkenisse
96	Vlieland	623	Vlist
140	Littenseradiel	643	Nederlek
196	Rijnwaarden	644	Ouderkerk
241	Groesbeek	653	Gaasterlân-Sleat
265	Millingen aan de Rijn	693	Graafstroom
277	Rozendaal	694	Liesveld
282	Ubbergen	844	Schijndel
365	Graft-De Rijp	846	Sint-Oedenrode
381	Bussum	860	Veghel
395	Harenkarspel	1671	Maasdonk
424	Muiden	1672	Rijnwoude
425	Naarden	1908	Menameradiel
458	Schermer	1987	Menterwolde

** Coding based on Dutch municipality coding 2012*

Appendix XII - Mapping including Values

- Potential share to give up private cars - (Very) Likely - With Values

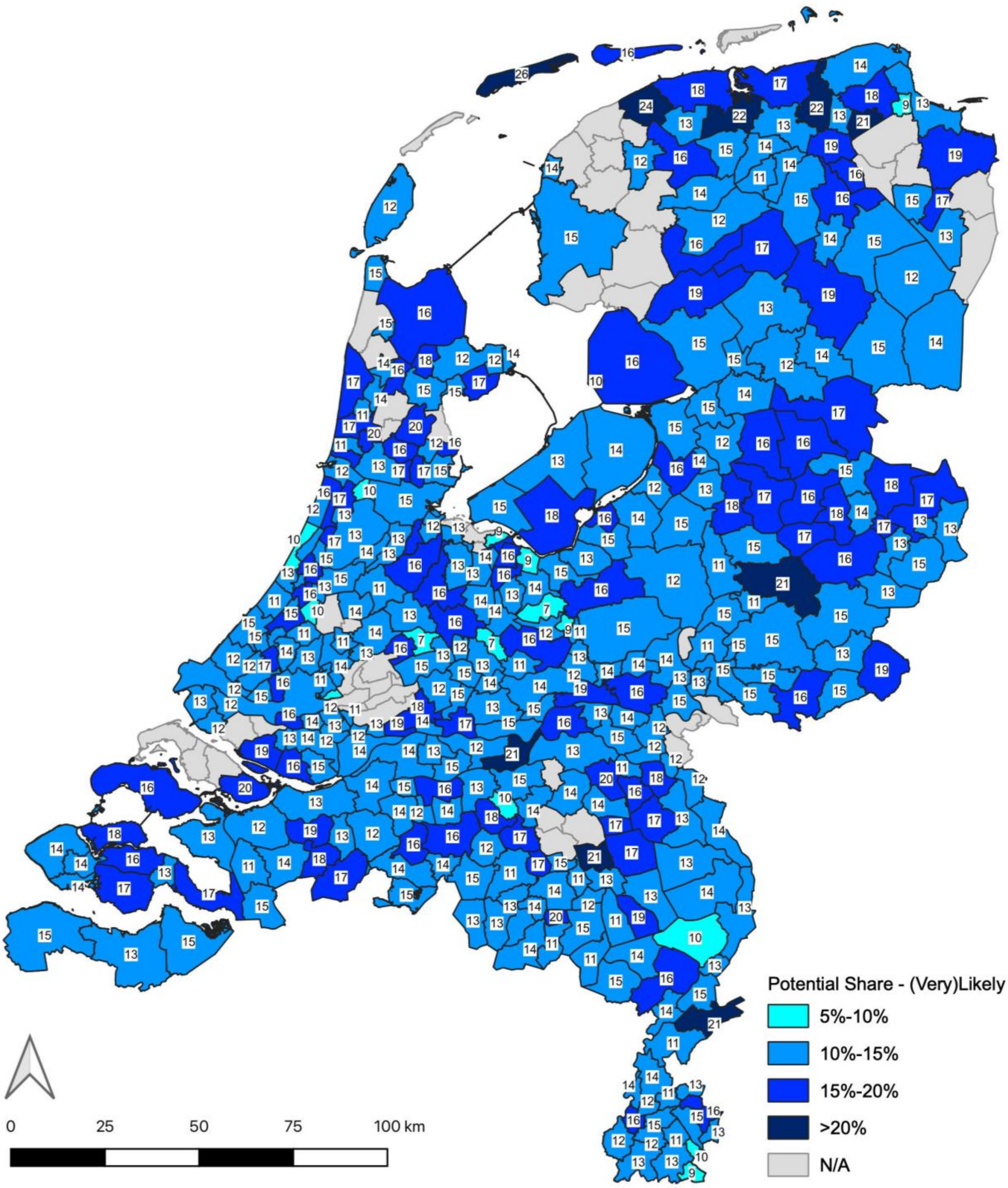

Figure 35 | Map presenting the share of (Very)Likely to give up private cars per municipality - With Values

- Share of *Unlikely* to give up private cars - With Values

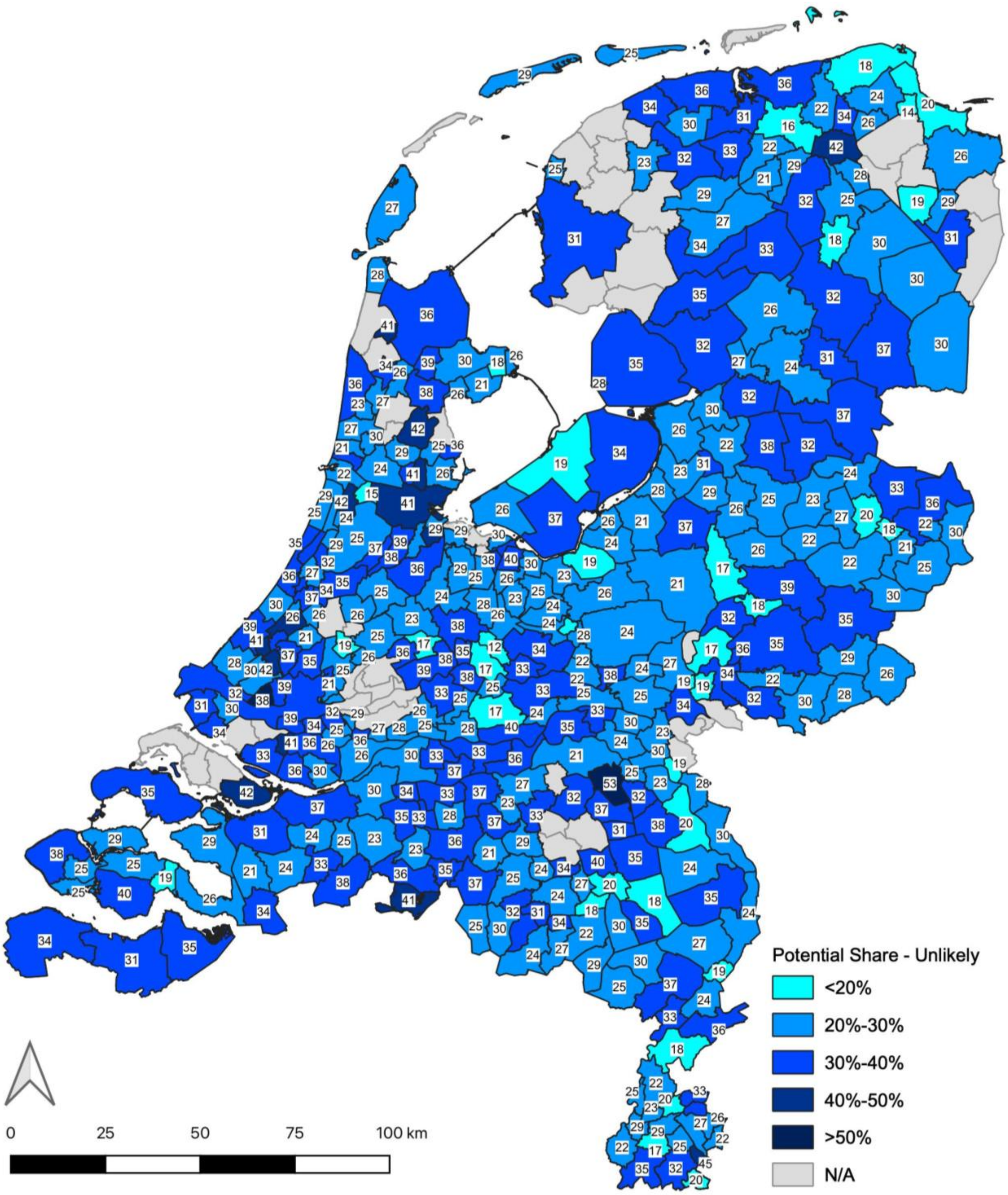

Figure 36 | Map presenting the share of Unlikely to give up private cars per municipality - With Values

- Share of *Very Unlikely* to give up private cars - With Values

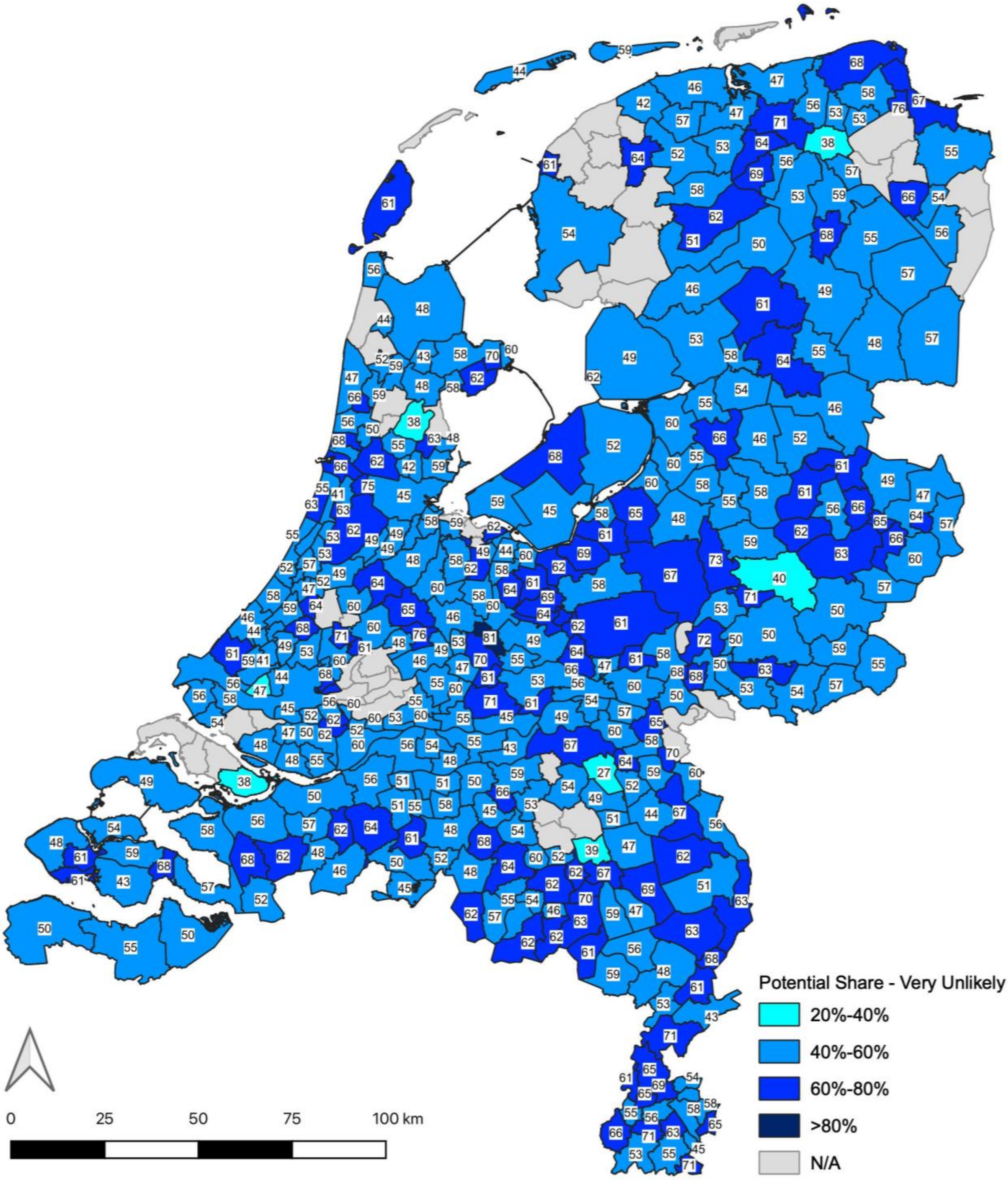

Figure 37 | Map presenting the share of Very Unlikely to give up private cars per municipality - With Values

- Number of Households that are willing to give up private car(s) - With Values

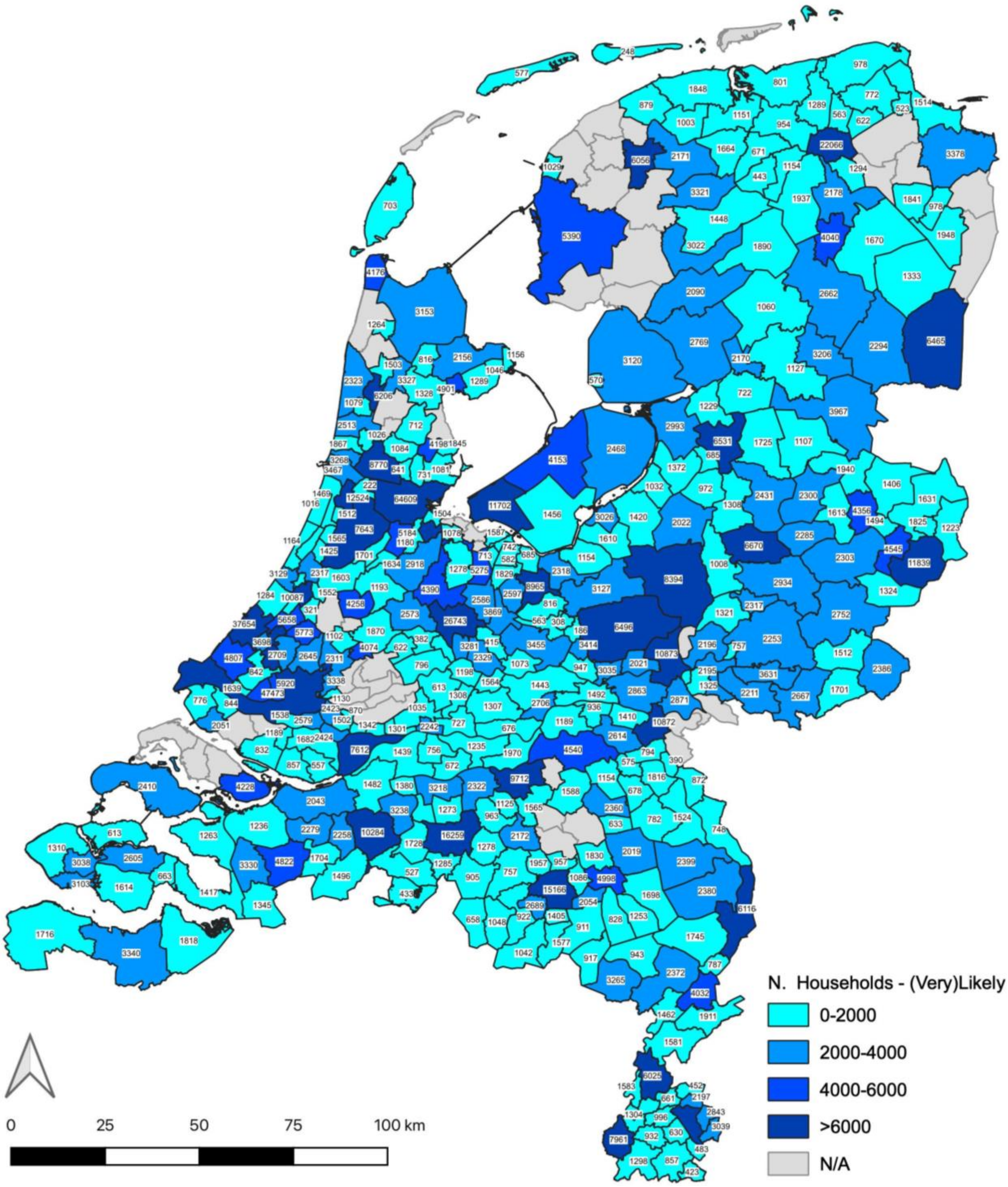

Figure 38 | Map presenting the number of households that are willing to give up private car(s) per municipality - With Values

- Reduction in number of Cars - With Values

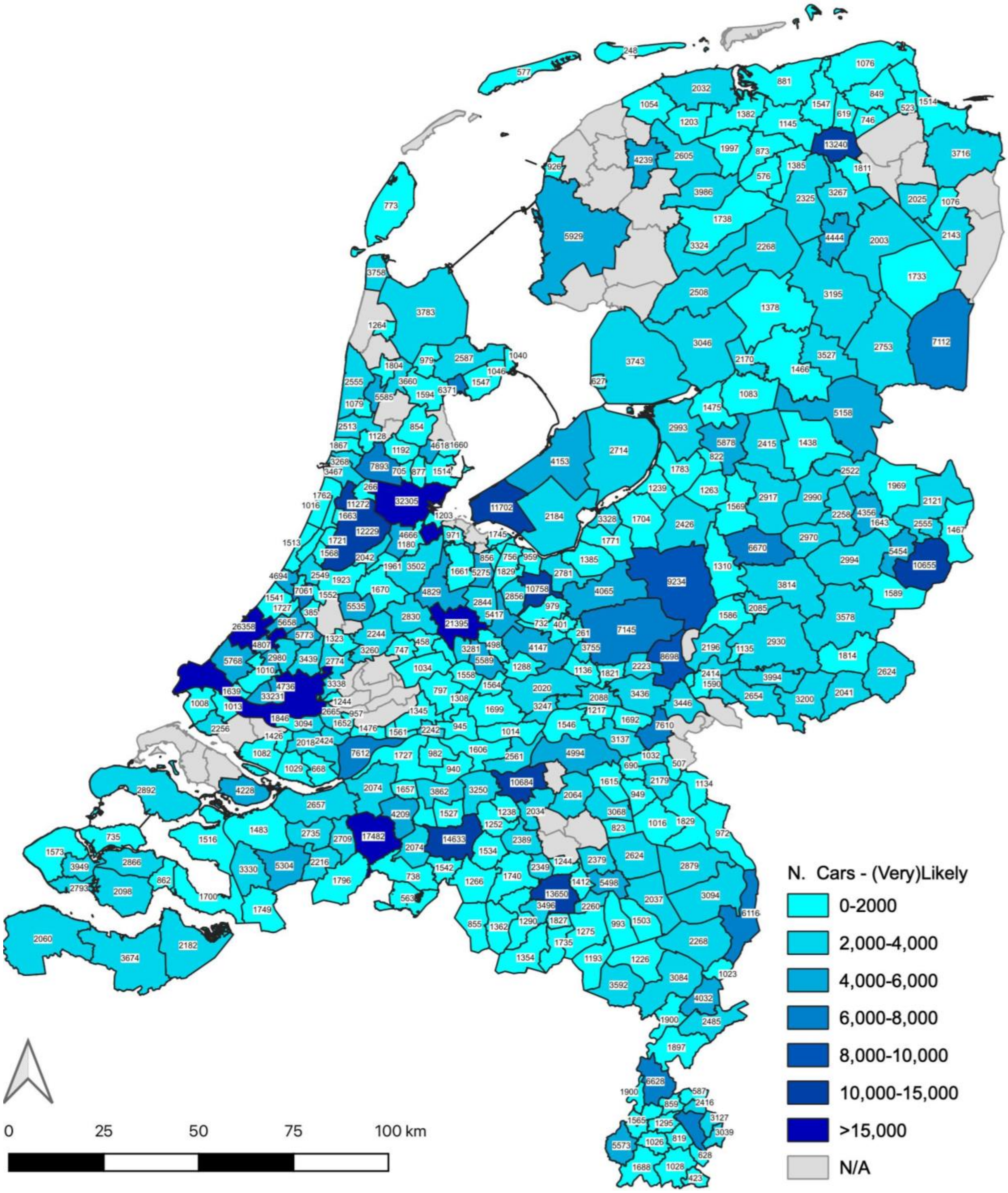

Figure 39 | Map presenting the potential reduction in the number of cars by each municipality - With Values

Appendix XIII - Characteristics Terschelling and Ferwerderadiel

Most observed levels among the respondents of the municipalities of Terschelling (municipality code: 93) and Ferwerderadiel (municipality code: 1722).

Table 62 | Most observed levels among the respondents of the municipalities of Terschelling and Ferwerderadiel

Category	Terschelling (mun. code: 93)	Ferwerderadiel (mun. code: 1722)
Socio-demographic characteristics	Gender: Male	Gender: Male
	Age: <50 years old	Age: <50 years old
	Education: Primary, Secondary education, or Secondary vocational education (MBO)	Education: Primary, Secondary education, or Secondary vocational education (MBO)
	Income: Average or below: ≤ €28,399	Income: Average or below: ≤ €28,399
	Number of cars: 2 or more cars	Number of cars: 1 car *and* Number of cars: 2 or more cars
Urban & Living Environment characteristics	Housing Type: Multi-storey	Housing Type: Multi-storey
	Housing Type: Renting	Housing Type: Renting
	Parking Location: Off street	Parking Location: On street *and* Parking Location: Off street
	Urbanity: Moderate or lower	Urbanity: Moderate or lower
	Proximity Road: ≥ 2.0 km	Proximity Road: 1.1-1.9 km
	Proximity Train: ≥ 4.0 km	Proximity Train: ≥ 4.0 km
Travel demand characteristics	Work - Average distance: ≥ 10km	Work - Average distance: ≥ 10km
	Grocery - Freq: ≥ 3x per week	Grocery - Freq: ≥ 3x per week
	Grocery - Average distance: < 10 km	Grocery - Average distance: < 10 km
	Shopping - Freq: ≤ 2x per week	Shopping - Freq: ≤ 2x per week
	Shopping - Average distance: < 10 km	Shopping - Average distance: < 10 km
	Leisure/Free time - Freq: < 1x per week	Leisure/Free time - Freq: < 1x per week
	Leisure/Free time - Av. distance: < 30 km	Leisure/Free time - Av. distance: < 30 km
*Carsharing characteristics**	Waiting time: 5 min	Waiting time: 5 min
	Walking distance to shared car: 50 m	Walking distance to shared car: 50 m
	Costs per month: 10 euro	Costs per month: 10 euro
	Reserved parking spot: Yes	Reserved parking spot: Yes
	Fuel type: Benzine	Fuel type: Benzine
	Cost parking per month: 10 euro	Cost parking per month: 10 euro
	Walking distance to parking: 100 m	Walking distance to parking: 100 m
	Type of parking: On street	Type of parking: On street

* A single predefined carsharing system is applied to all the respondents, based on average levels.

Appendix XIV - Characteristics Leusden

Most observed levels among the respondents of the municipality of Leusden (municipality code: 327).

Table 63 | Most observed levels among the respondents of the municipality of Leusden

Category	Leusden (mun. code: 327)
Socio-demographic characteristics	Gender: Female
	Age: >50 years old
	Education: Primary, Secondary education, or Secondary vocational education (MBO)
	Income: Above average: ≥ €28,400
	Number of cars: 1 car
Urban & Living Environment characteristics	Housing Type: Row house
	Housing Type: Renting
	Parking Location: Off street
	Urbanity: Moderate or lower
	Proximity Road: ≥ 2.0 km
	Proximity Train: ≥ 4.0 km
Travel demand characteristics	Work - Average distance: ≥ 10km
	Grocery - Frequency: ≥ 3x per week
	Grocery - Average distance: < 10 km
	Shopping - Frequency: ≤ 2x per week
	Shopping - Average distance: < 10 km
	Leisure/Free time - Frequency: < 1x per week
	Leisure/Free time - Average distance: < 30 km
*Carsharing characteristics**	Waiting time: 5 min
	Walking distance to shared car: 50 m
	Costs per month: 10 euro
	Reserved parking spot: Yes
	Fuel type: Benzine
	Cost parking per month: 10 euro
	Walking distance to parking: 100 m
	Type of parking: On street

* A single predefined carsharing system is applied to all the respondents, based on average levels.