The role of pre-transport in travelers' transportation mode choice
A study conducted in the region of the railway station of Eindhoven

Graduation Thesis

Colophon

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Abstract

It is desirable to reduce private car use in the Netherlands because of the consequences it has for environmental and societal costs. The increase of motorized vehicle use brings many problems with it globally, while alternative transportation modes are less harmful for the environment. Travelers changing their transportation mode choice from the private car to less harmful alternatives like the train could contribute to solving the previously mentioned problems. Many travelers are deterred from using the train due to various aspects of the railway journey they do not like. It is important to know which characteristics of different journeys affect transportation mode choice in order to address the problem. A stated preference experiment is used to collect data of travelers transportation mode choice. Data was collected from 415 respondents in the region of Eindhoven. Important is that the research is not conducted from existing railway users only, but from a target group that has divers characteristics and use different types of transportation modes. This data is analyzed using a multinomial logit model to see which characteristics of the journeys affect transportation mode choice most. Time and monetary cost related characteristics proved to be the most important in transportation mode choice. So when it is desired to change travelers transportation mode it would be most effective to make a change in those characteristics of the journeys.

Preface

This report presents my master thesis for the completion of my study Construction Management and Engineering at Eindhoven University of Technology (TU/e). Worldwide there are discussions about sustainability, human behavior and mobility. Those three themes are connected to the environmental problems that have become clear over the past decades. Changes in human behavior in connection with mobility could help the world getting more sustainable where details could make a change to the environmental health of the world. I believe that the present study contributes to the trend of compliance with sustainability. The study describes the role of pre-transportation in transportation mode choice. I take this opportunity to thank those who supported and helped me to complete the thesis .

The completion of my research would not have been possible without the support, advice, and help of others. Therefore I want to show my appreciation to all the people who contributed to this thesis and helped me when I needed it. For his support, mentorship and guidance I would like to thank Peter van der Waerden. I would also want to thank Brano Glumac and Marloes de Bruin for their comments. In addition, I like to thank Mark van Kampen for helping me out in the modeling process and Falco Zeekaf for helping me structuring my thesis.

Last, I want to thank all the respondents who filled in the questionnaires and therefore providing me with the necessary data for the research. Without their input, there would have been no results for the research at all.

Koen Sanders

Eindhoven, August 2015

Summary

Traffic and transportation nowadays are serious causes of an increase of environmental and societal costs. Traffic and therefore vehicle kilometers are increasing every year in the Netherlands. Therefore it is desirable to reduce private car use in the Netherlands. A consequence of reducing private car use is that alternative transportation modes will have to be used to make the necessary travels. For some specific type of long distance travels to cities, the train would be an ideal alternative. But since using the train is considered to be a poor alternative for many car users, travelers will not choose for the train without good journey characteristics. Especially transfers and access and egress modes have a low valuation of time and withhold people from using the train. Therefore the aim of the research is give insights in how potential train users perceive pre-transport, how they make choices for the transportation mode and how these choice are influenced by the characteristics of the different types of pre-transport. To investigate this the following research question has been formulated:

> *"What is the role of the characteristics of pre-transport in the travelers' decision making process of using the train as transportation mode or the car?"*

Two main types of journeys are included in the research, the car journey and the multimodal railway journey. A multimodal railway journey consists out of three main parts; the access trip/pre-transport, the train trip and the egress trip. Because of the low valuation of the pre-transport this part is investigated further in the research. Three types of pre-transport are included in the research, the bus, bicycle and car. There is a certain supply of infrastructure and a demand for different modes of transportation in the Netherlands. For each journey that is made a transportation mode has to be chosen. The transportation mode choice depends on five main factors. Four of those factors are socioeconomic, and are influenced by the socioeconomic characteristics of travelers. The four socioeconomic factors that influence transportation mode choice are; *awareness and availability*, *basic safety and security*, *convenience and costs*, and *enjoyment*. All these factors have their own influence to a certain extent on the decision making in a transportation mode choice. The last non-socioeconomic factor that has an influence is the *habit* of travelers.

A stated preference experiment is conducted to collect data about the role of characteristics of pre-transportation in transportation mode choice. The respondent is presented with four different alternatives of which three are multimodal railway journeys with the three different types of pre-transport and fourth as an alternative mode the car presented. Each transportation mode has its own attributes and attribute levels. With the data of the stated preference experiment a multinomial logit model is used to determine the importance of the characteristics on the transportation mode choice.

It is concluded that time and monetary cost related characteristics influence transportation mode choice the most. The train has no significant characteristics which indicates that the characteristics of the pre-transport are more important in the transportation mode choice than the characteristics of the train trip itself. For some of the transportation modes also safety and uncertainty related characteristics were of importance.

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1 Introduction

This chapter introduces the research design of the graduation thesis. First the research problem is identified and defined. After that the recent trends about the subject of the research are described. Following that, the focus of the research is given and the research question is formulated. Then the practical and theoretical relevance explained. Finally the total research design is illustrated and explained.

1.1 Problem identification

Car ownership and use in the Netherlands have increased tremendously since the 1960's. Between 80% and 90% of all passenger kilometers are made by car. Traffic and transportation nowadays are serious causes of an increase of environmental and societal costs such as congestion, noise, air pollution, depletion of energy, and substantial use of land. In many urban areas these consequences already lead to urgent problems e.g. (Exel & Rietveld, 2009; Gärling, et al., 2002; Nordfjærn, et al., 2014; Raney, et al., 2000; Redman, et al., 2013). Especially congestion is a major issue. It is often cited as the most important concern of urban dwellers of large metropolitan areas. Congestion involves not only personal costs, but also major social costs (Salomon & Mokhtarian, 1997).

The amount of road traffic in the Netherlands increased relative steadily over the last decade as is shown in Figure 1a. The vehicle hours lost on the other hand fluctuated decently over the last decade, as can be seen in Figure 1b. Since 2004 the vehicle hours lost rose till 2007. This was due to the rise of the amount of road traffic, and the capacity of the main road network staying the same. But from the year 2007 some things changed. First, the financial crisis in the Netherlands and the rest of the world made the economy and therefore factors as international transport and traffic decrease after 2007. Second, the vehicle hours lost on the main road network have decreased tremendously because of the completion of additional traffic lanes. The addition lanes caused a radical decrease of the vehicle hours lost because the capacity of the roads became larger. But most of the constructions have been completed now and the economy will pick up again in the near future. So predictions, which are shown in Figures 1a and 1b, show that the vehicle kilometers as well as the vehicle hours lost will rise in the coming few years (Ministerie van Infrastructuur en Milieu (1), 2014).

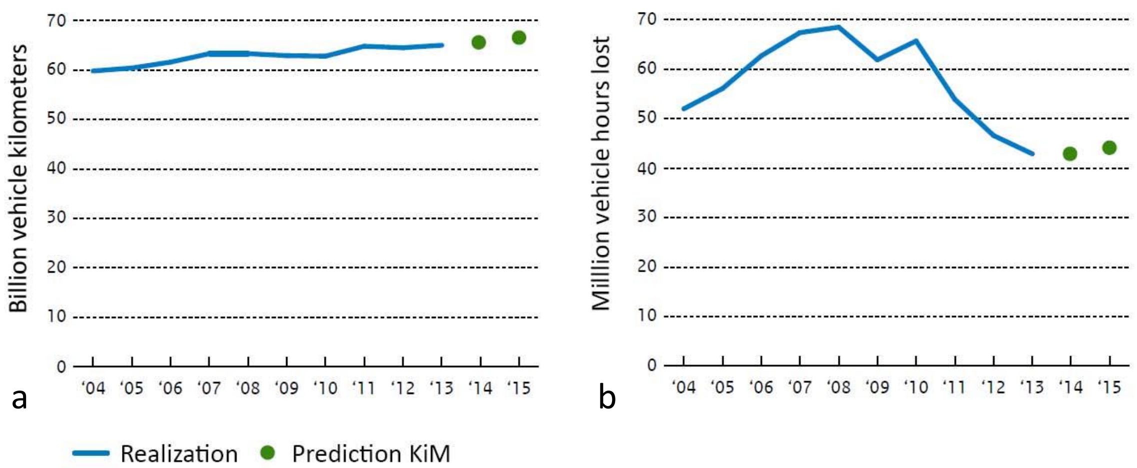


Figure 1. Amount of traveled kilometers in the Netherlands (left) and the amount of vehicle hours lost in the Netherlands (right), adapted from (Ministerie van Infrastructuur en Milieu (1), 2014).

The predicted increase of road traffic in the Netherlands has already proven itself in the busiest traffic area, the Randstad. Figure 2 shows an infographic that Rijkswaterstaat (2015) published in June of 2015. The infographic shows that from December 2014 to April 2015 the amount of traffic jams rose with 12.1% in the Randstad. Several factors caused the rise of congestion, in particular the increase of traffic during rush hours. The Randstad is the first area where it is noticeable that the amount of traffic and congestion is rising because of its crowded characteristics. The graphic in Figure 2 shows that the amount of traffic jams remained about the same in 2014 and even decreased leading up to that year. This was due to the enormous amount of new traffic lanes that has been built during this cabinet period. More than 780 Kilometers of new traffic lanes have been constructed in this small period of time to compensate the increase of traffic bustle.

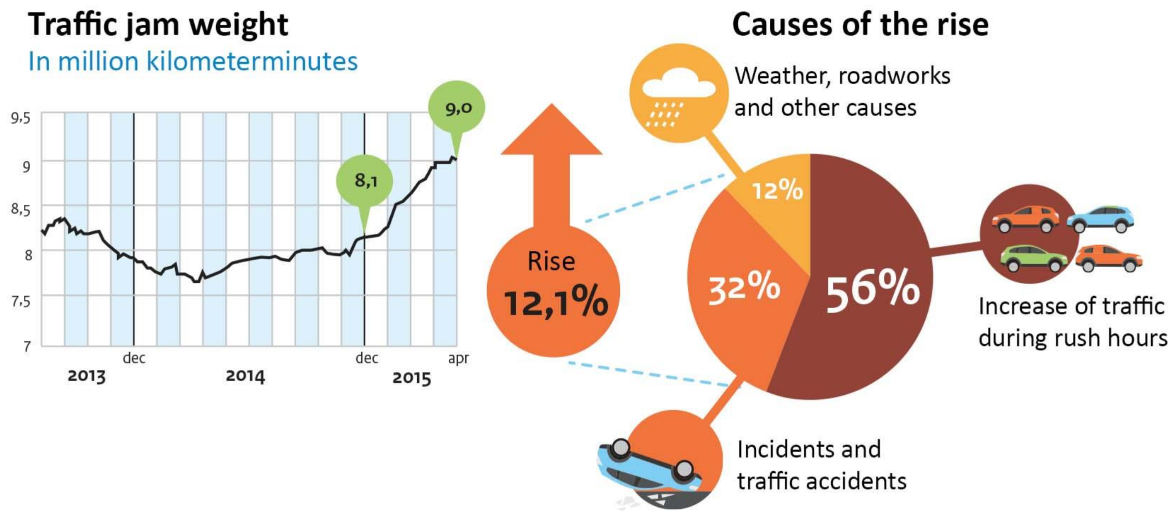


Figure 2. Infographic about the traffic jam weight in the Randstad and its causes, adapted from (Rijkswaterstaat(1), 2015).

The amount of vehicle kilometers and vehicle hours lost will remain to rise if no more additional lanes will be built according to the prediction of the 'Ministerie van Infrastructuur en Milieu (1)' (2014). And even if there would be built more lanes, this would cause more people to use the private car and therefore increase pollution and other environmental disadvantages. Therefore it would be desirable to promote an alternative transportation mode that is more sustainable and safer. The most commonly used alternative for the car is public transport. Nederlandse Spoorwegen (NS), the Dutch Railway company, is a large public transport facilitator of the Netherlands. They should respond to this situation, because the train could be a relevant alternative for many people that currently use the private car as main transportation mode. But public transport is considered by travelers to be a poor alternative for car use. Especially fervent car users do not like public transport. For them not only the instrumental function of the car outperforms that of the public transport, but the car also represents cultural and psychological values. They consider the car as a symbol of freedom and independence, a status symbol and many of them find driving pleasurable. People who do not use the car as frequently are less positive about the car and less negative about public transport. They may be open to more regularly use the public transport. But to stimulate fervent car users to travel by public transport more efforts are needed. The policies of functional, psychological and cultural values of private cars should be aimed to reduce, while the performance of the public transport should be increased (Steg, 2003). To increase public transport usage and attract potential users, service should be designed in a way that accommodates the required service level of customers. Several factors influence the choice of transportation, such as individual characteristics and lifestyle, the type of journey, the perceived service performance of all different transportation modes and situational variables e.g. (Beirao & Cabral, 2007; Brons, et al., 2009). In Figure 3 the development of the customer opinion of the Dutch railway users is shown. It shows that for some of the services the opinion becomes more negative from 2009. This indicates that gains can be achieved in improving these services and the total satisfaction of the train users in the Netherlands (Ministerie van Infrastructuur en Milieu (1), 2014).

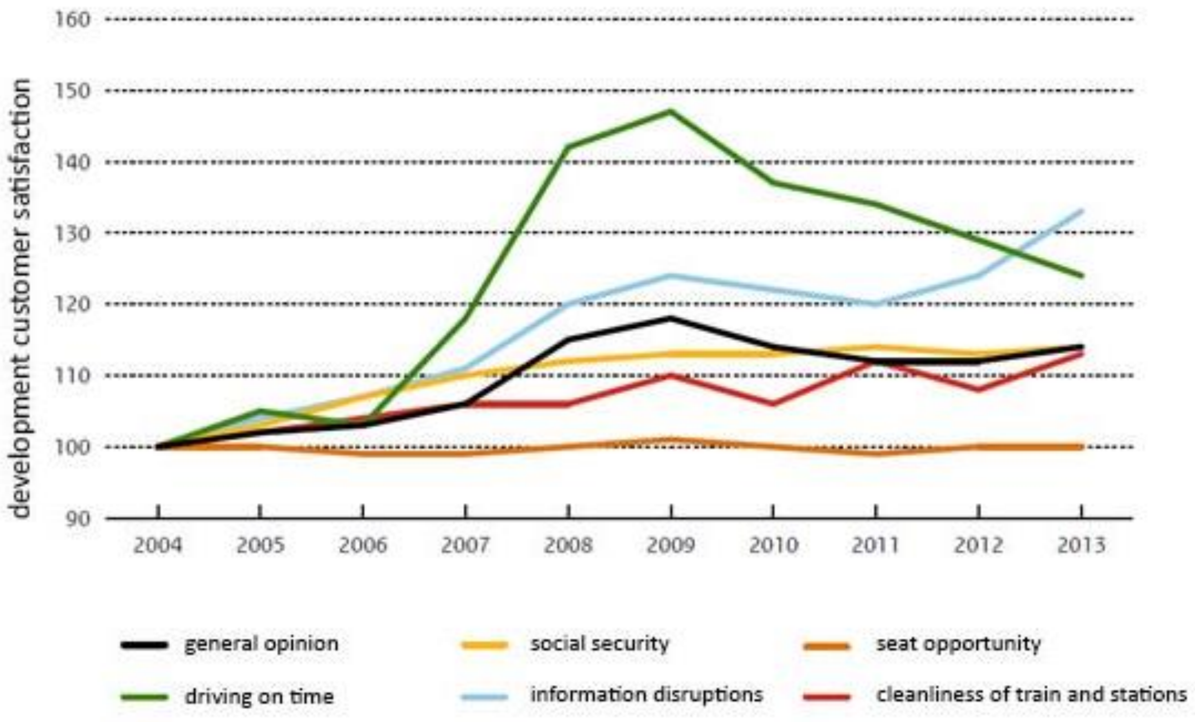


Figure 3. the development of the customer opinion of the Dutch railway users, adapted from (Ministerie van Infrastructuur en Milieu (1), 2014).

Within a railway journey the pre-transport and transfers are valuated very low by travelers according to Hagen (2011). The pre-transport is the access trip from home to the railway station. The low appreciation of this pre-transport is a problem and causes travelers to use other transportation modes instead of the train. Up until this moment not much is known about the appreciation of pre-transportation modes, and even less is known about the valuation of characteristics of different modes of pre-transport. The lack of information about pre-transport and its characteristics is a probable cause of the low appreciation of it and therefore a vulnerable part of the railway journey.

1.2 Trends

Private car use increased tremendously in the past decades, the transportation sector is a major contributor to air and noise pollution, congestion and places considerable demand of fossil fuel resources. Governments and people are increasingly interested in a sustainable and healthy environment in the future. Therefore transportation policies in the Netherlands and Europe are differencing. The new policies will make private car use less attractive for travelers. This will be combined with policies that promote and improve the quality and convenience of alternative transportation modes (Buehler, 2011). Cycling is increasingly seen as alternative for private car users for the shorter distances, which particularly in smaller cities has the potential to achieve less automobile kilometers e.g. (Alpkokin, 2012). Due to the developments in road and air transport in the second half of the 20th century, railway use experienced a rapid decline, a trend that policy makers aim to reverse. From the policy perspective, improving railway use is not the main goal, but to change the transportation mode choice of travelers from car to train once they have decided to travel. So the main purpose is to reduce car use and a good alternative for car on long distance travel is the train. To attract potential train users, already efforts are made to improve the level of service at railways like a wider network coverage, lower travel times and higher service reliability (Brons, et al., 2009).

The economy is recovering from the crisis that has been present since 2007. The economic prospects for the coming years are better than before. The international and national commerce is slowly recovering. It is difficult to predict the precise growth of the economy and the influence it has on the growth of traffic, but it is sure that it does influence the traffic density. It is predicted by the 'Ministerie van Infrastructuur en Milieu (1)'(2014) that the road traffic will increase with 0.5 to 1 percent per year in the coming few years because of the influence of the recovering economy. This will especially be noticeable on the main through roads of the Dutch road networks.

Pre-transport as an access mode to the railway station has been researched for the last decades. In these past decades the amount of use of different modes of pre-transportation shifted over time. Researches of Givoni and Rietveld (2) (2007) and Rietveld (2000) showed that walking as pre-transportation mode has decreased over the past decades and car use increased. Those are the most important shift of pre-transportation modes over the last decades. Because of the introduction of the high speed train (HST) lines, and the increase of fast train lines in the Netherlands the pre-transport trip is valued different than before. Train trips are getting faster due to increase of the amount of HST lines and faster trains. If there is a pre-transport connection to a HST line, this could change travelers transportation mode choice. When a HST line is accessible well, it could reduce the total travel time of travelers and therefore be more interesting to choose (Givoni & Banister, 2012). So getting good pre-transport to HST lines could open up new possibilities for transportation companies and travelers.

1.3 Research focus and questions

The aim of the research is to investigate how potential train users perceive pre-transport, how they make choices for the transportation mode they tend to use and how are these choices influenced by the characteristics/attributes of the different types of pre-transport. The most important objective of this research is to determine the influence of different pre-transportation modes on the choice between train and car, for a large distance (50 to 150 kilometers) journey, of travelers. The research is done in a Dutch context to examine the Dutch travel behavior. The results of the research are intended to contribute to the improvement of the use of the Dutch railway system and pre-transportation systems. This is achieved by giving insights in the current travel behavior of respondents and their travel behavior in hypothetical situations. The gain of this research is that with the results new strategies related to railway travel can be created for the government and the Dutch railways.

Schakenbos (2014) conducted a research for his master thesis in which he investigated the valuation of a transfer in a multimodal public transport trip. He used stated preference to research the disutility of a transfer between bus/tram/metro and train within the Netherlands. Givoni, Rietveld and Keijer did number of researches about pre-transportation modes and the use of them. But most researches of them were about current travel behavior and their researches all focused on the data from railway users. So most previous researches about transportation mode choices and pre-transport are conducted from actual railway travelers and use revealed preference data. The group of people that use other transportation modes are often not questioned and included in the researches. Therefore no information is gathered about this group of people. While this group of non-railway users is the group of potential customers for the Dutch Railways. So in the research that is done, a 'random' and diverse group of people from a specific chosen area will be questioned. The specific chosen area makes sure the respondents can relate to the hypothetical travel situations that will be presented to them. Personal questions will be asked to determine what characteristics the respondents have. These characteristics can be linked to the results of the research.

The aim of the thesis you are reading now is to investigate the role of pre-transport and its characteristics in a multimodal railway trip and to what extent it influences transportation mode choice. Important is that the research is not conducted from existing railway users only, but from a target group that has divers characteristics and use many types of transportation modes.

Research question:

- *"What is the role of the characteristics of pre-transport in the travelers' decision making process of using the train as transportation mode or the car?"*

In order to give an complete answer on the main research question, the following sub questions have been formulated:
- What influences transportation mode choice?
- What is pre-transport?
- What forms of pre-transport exist and how much are they used in the Netherlands and the region of Eindhoven?
- What influence does the accessibility and environment of railway stations have on transportation mode choice?
- Does Transit Oriented Development influence the role of pre-transport in the accessibility of railway stations?

1.4 Practical and theoretical relevance

The practical relevance of the research consists of different aspects. The first aspect that is relevant for a stakeholder like the Dutch railways, concerns the insights in the current travel behavior and conclusions about transportation mode choices of travelers. Also the public transport companies in the region of Eindhoven could benefit from these conclusions. They could also benefit from the valuation of importance of bus characteristics for transportation mode choice. The results indicate what travelers find most important about bus trips and what changes could attract potential customers. Second, besides these stakeholders, also the Dutch and regional governments that aim to promote public transportation use could benefit from the research. Insights in travel behavior and influence of transportation mode characteristics could help in policy making.

The theoretical relevance of the research concerns the additions that the research has on previous researches about transportation mode choice and pre-transport. The role of pre-transport and its characteristics of car journeys and multimodal railway journeys, and to what extent it influences transportation mode choice is an addition to previous researches that have been done. The fact that the research is not conducted from existing railway users only, but from a target group that has divers characteristics and use many types of transportation modes makes it interesting because this complete group of people has not been involved in many previous researches and therefore give new insights in the subject.

1.5 Research design

To achieve all research objectives and answer all the research questions, a design is developed to guide the research. Figure 4 shows a schematic representation of the research design. First a problem is identified by doing research in the field of human and public transportation. This problem identification is important to form relevant research questions and determine the aim of the research. After the research aim and questions are defined the most important terms are defined, explained and illustrated in the glossary. The most important terms that will be explained in the glossary are the type of journeys that are included in the research and the travel purposes of those journeys. Also, the research methods that will be used are explained in the research framework part of the glossary. At the same time a literature study is done about the problem that is identified earlier. In the literature study first the source of the problem was investigated by doing research on the history of the subjects and look at the trends of the recent past and for the future related to the subject. The supply and demand of Dutch transportation network are explained to show what the current situation is. The transportation mode choice part of the literature study is probably the most important part. It includes the characteristics of transportation modes that influence transportation mode choice. The transportation mode choice of travelers is the core of the research. After doing all this research in the available and published literature, an own research is put together. First the stated preference experiment is described. After that the attributes and attribute levels that are defined for the research will be explained. Then the questionnaire design and the type of data that is collected will be explained, and finally the questionnaire will be designed and tested. The data collection is conducted via an online questionnaire. The results of the stated preference experiment will be used for the data analysis. First a sample description is given to show how many and what type of respondents participated in the research. After that the current experience and travel behavior of the respondents is shown. Then the data is analyzed using a multinomial logit analysis that is validated afterwards. In the final conclusions all the results will be explained and discussed. After that some recommendations based on the results of the research are given for stakeholders. The discussion at the end gives the possibility to indicate points of improvement and what could be interesting for further research.

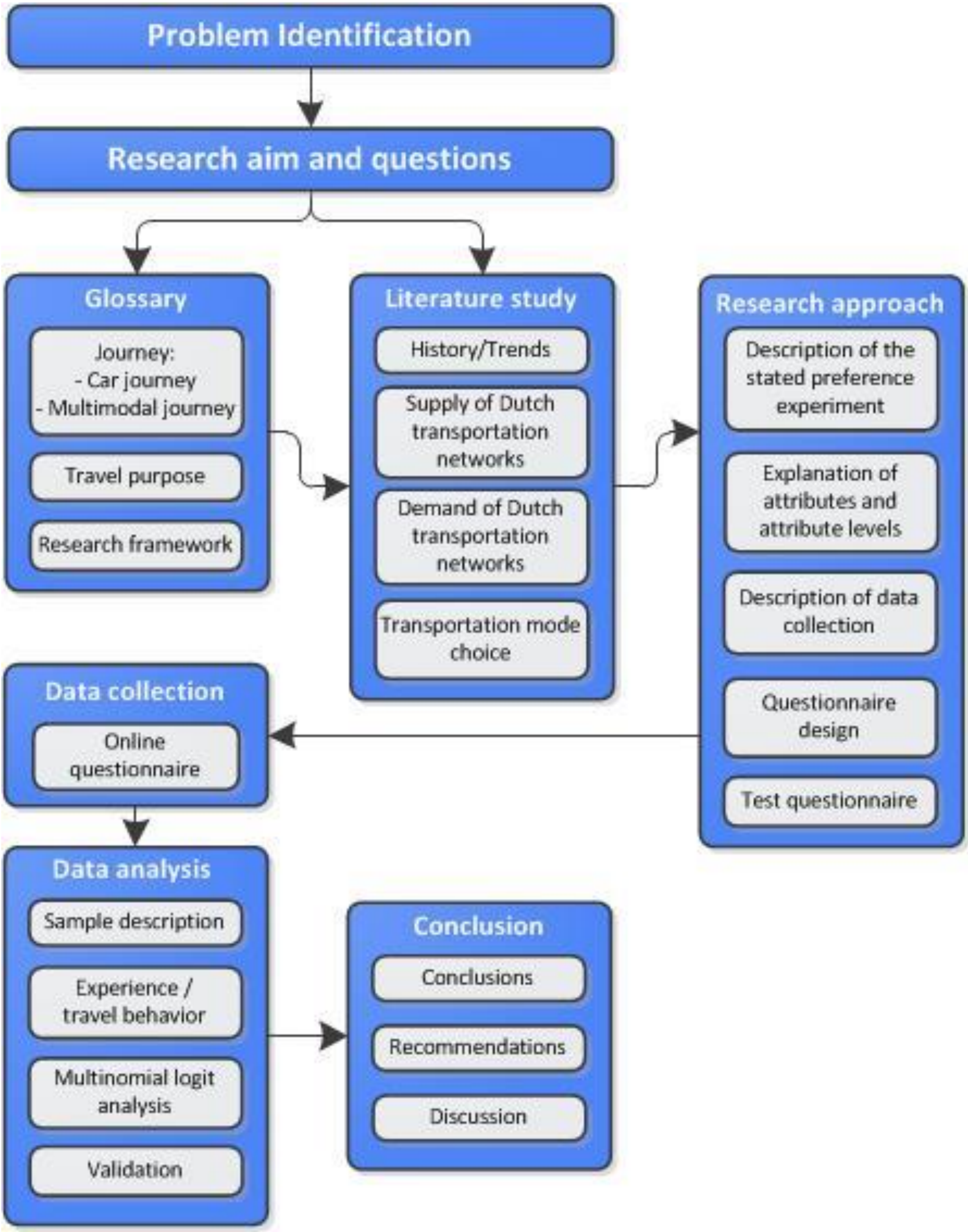


Figure 4. Research design.

2 Theoretical framework of transportation modes

2.1 Introduction

In this section of the thesis a glossary of relevant subjects and methods for the thesis is presented. This glossary presents the most important definitions, explanations and descriptions of specific methods that are used in the research and are related to the problem that is defined. First the different types of journeys that are applicable for the research are illustrated. The following two types of journeys are important for the research, the car journey and the multimodal railway journey. Pre-transport is for the research the most important part of a multimodal railway journey and is therefore explained separately. Shortly the difference between possible travel purposes are explained to emphasize the difference between the types of travel. Finally the research framework will be explained, this part consists of an explanation of the used research methods and the analytical framework that is used to achieve the goals that are set.

2.2 Journey

A journey is a continues travel from door-to-door that consists out of one or more transportation modes from the start-point to the end-point or activity. In the research two different journeys are considered. The first journey is the car journey and the second is the multimodal railway journey (Givoni & Rietveld(2), 2007).

2.2.1 Car journey

A car journey consist of a few different parts, also called trips, showed in Figure 5. The most important and time consuming part is the car trip. The trip from home to the parking place near the end destination is the car trip. The parking place near the end point is showed in the figure by a white P in a blue circle. The parking place is also an important part in the car journey because it can influence whether someone uses the car or not. A parking is not naturally exactly at the end destination, there could be some distance between these two. Also an important feature of the parking place is the security and the costs of parking the car, especially in urban areas and city centers.

The route that is chosen for the car trip is mostly the route that takes the least time. Sometimes monetary costs and congestion are also taken into account when the route is chosen. The advantage of the car that it has no fixed route and its flexibility gives the opportunity to take another route when desired. It is also possible and more convenient to use the car for multipurpose journeys where different travel purposes are combined (Ye, et al., 2007).

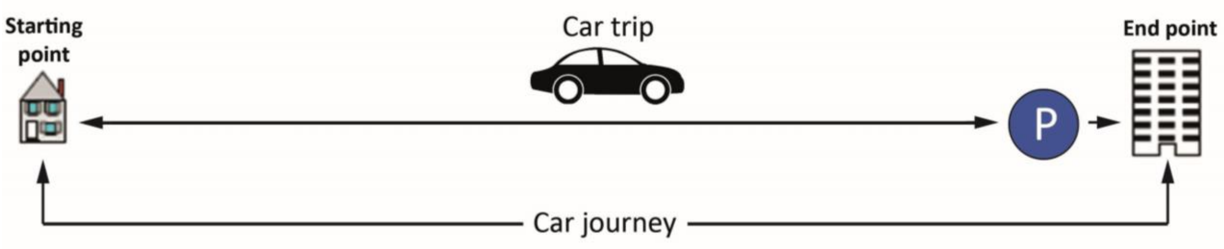


Figure 5. Car journey adapted from (MuConsult B.V., 2014).

2.2.2 Multimodal railway journey

A train trip is almost always part of a journey which is called a railway journey. It includes a trip to, the access mode, and later from, the egress mode, the railway station by different modes of transportation. So the railway journey is a multimodal trip with the train as main transportation mode. Each railway journey consists of three main elements (Givoni & Rietveld(2), 2007):

- The access trip/pre-transport
- The train trip
- The egress trip

The railway journey is visualized in Figure 6. The access trip is the trip from starting point to the Railway Station (RS), this trip is in the research called, the *pre-transport*. The train trip runs between the railway stations indicated in yellow in Figure 6. Within this train trip there are possible transfers at a railway stations. The final trip from the railway station to the end point is the egress trip.

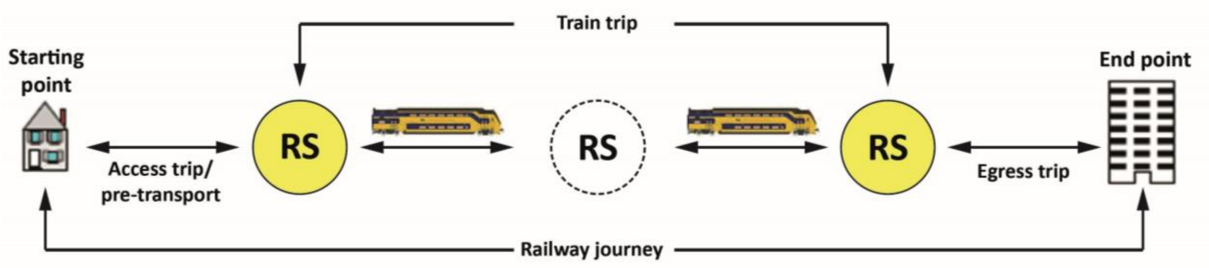


Figure 6. Multimodal railway journey ,adapted from (MuConsult B.V., 2014).

From the total number of journeys made in the Netherlands 97% is not multimodal, as can be seen in Figure 7. That means that only 3% of all journeys is multimodal, which resembles around 490 million travels on an annual basis. The total of multimodal trips covers about 13% of the total amount of kilometers that is traveled in the Netherlands. Especially public transport, with in particular the train, plays a big role in these multimodal trips. These travels are most common between areas of large cities. From the total multimodal trips, 61% uses the train as main transportation mode. Of all the multimodal journeys about one third is commuter traffic and a quarter is study related traffic, so these two daily movements together make up the largest part of the multimodal journeys (Ministerie van Infrastructuur en Milieu (1), 2014).

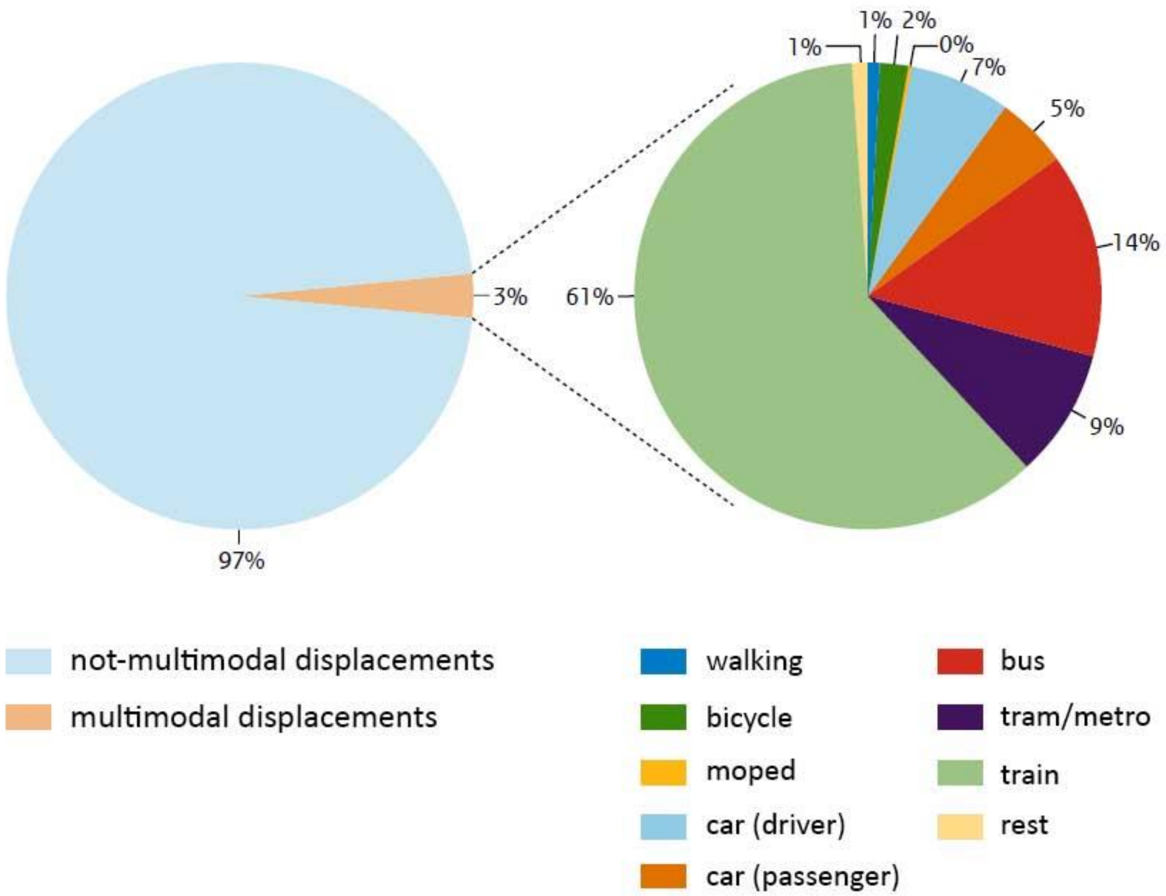


Figure 7. Number and subdivision of multimodal journeys in the Netherlands (Ministerie van Infrastructuur en Milieu (1), 2014).

2.2.3 Pre-transport

The pre-transport is the access trip that people have to make to get to the railway station. The quote that "the market potential of railway services depends to a considerable extent on the quality of the total chain from residence to place of activity and vice versa" (Rietveld, 2000, p. 74) is strengthened by a research of Givoni and Rietveld (2) (2007). In the research it is investigated to what extent the overall quality of a railway journey depends on the quality of the pre-transport. It is concluded that travelers place importance on the pre-transport, which indicates that some people avoid using the railway due to the discontent about the railway station and its accessibility. The results of the research also indicate that there is still substantial scope for improving the accessibility of railway stations and therefore the pre-transportation modes. This will contribute to higher satisfaction levels of pre-transport and therefore higher satisfaction of railway journeys.

In Figure 8 the subdivision of pre-transportation modes of multimodal railway journeys in the Netherlands is shown. In the period of 2011 to 2013 the bicycle was by far the most used form of pre-transport with 47 percent of all pre-transport trips. Followed by walking and public transport with both 16 percent. The car is used both as driver and as passenger, together making up 11 percent of the pre-transport, the rest of the trips are made with other types of pre-transportation (Ministerie van Infrastructuur en Milieu (1), 2014). The bicycle is considered to be the best pre-transportation mode in the Netherlands due to the fact that it allows travelers to avoid waiting time at public transport stops, it is cheap, environmentally friendly and it requires only little parking space that is available near all railway stations. In addition, the vast majority of the Dutch population live within a 10 kilometer range from the nearest railway station, and two third live within 5 kilometers (CBS, 2011; Keijer & Rietveld, 2000). The amount of people using the bicycle to get from home to the railway station could be higher, but because of the insufficient parking facilities for bicycles and the high risk of bicycle theft at the Dutch railway stations that is not the case (Rietveld, 2000).

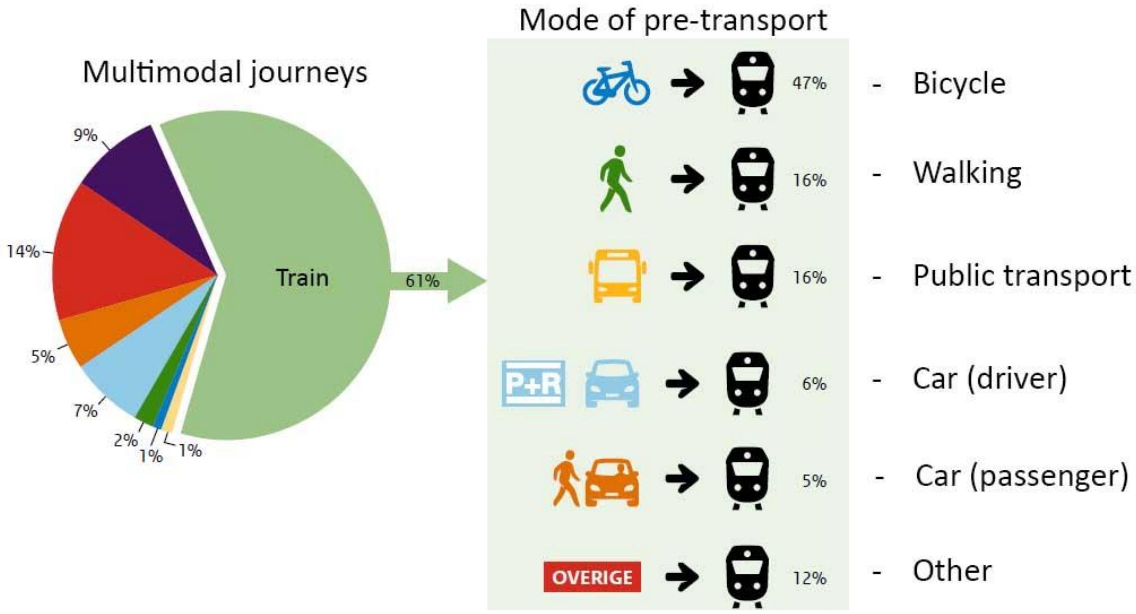


Figure 8. Subdivision of pre-transport in multimodal train journeys in the Netherlands (Ministerie van Infrastructuur en Milieu (1), 2014).

2.2.4 Train trip

A train trip is a travel by train between two railway stations. It is the main trip of a railway journey. Each trip has different characteristics. Transfers are more likely to occur in a long train trip than during a short trip. Also the effects of access and egress costs and time are relatively different. These monetary costs and time will be relatively lower for a long trip by train, than a short trip. The same applies to parking costs for a car or bicycle at the railway station (Mannaerts, et al., 2013). The time each trip takes are valuated differently by travelers. In vehicle time and waiting time are two characteristics of the train trip that are related to the time, the valuation of time will be further explained in Chapter 3.6.4. In a train trip there is always a chance of delay, but these chance is relatively low in the Netherlands compared to other countries (Mansveld, 2015). An important characteristic of the train is that normally passengers can sit and sometimes have a little table available to use. This creates possibilities for travelers. With the seat and possibly a table travelers can do activities in the train e.g. work, read, play games etc.. Experience learned us that many people make use of these possibilities and that the opportunity to use travel time productively is valuated really positive by travelers (Abrantes & Wardman, 2011). Besides all these characteristics also safety is important for travelers, especially female travelers. Fortunately the train and railway stations are relatively safe in the Netherlands, but when this is not the case, people will use the train less often, or not at all (Balcombe, et al., 2004).

2.3 Travel purpose

The journeys that are investigated in this research are medium to long journeys between large cities. The research aims at these type of journeys because in these medium to long distance journeys travelers are likely to make the tradeoff between car and train. When this tradeoff is made people will consider the entire car and railway journeys which include the pre-transport. Because the research aims at longer distance travel, some travel purposes are not applicable. Maintenance activities for example are not applicable in this situation, these activities consist of the purchase and consumption of convenience goods or personal services that are intended for the individual or household. These maintenance activities are usually close to the residents home which causes that the train is not an alternative transportation mode. The travel purposes that will be considered in the research are work, study, recreation and other. Two subsistence activities are introduced in the research, the travel purpose of work and study. These purposes are for households to supply their work, study and business services. These two are separated in the research and not merged because of the different characteristics of the groups of people who conduct these activities. The last travel purpose in the research is the group of people that travel for recreational purposes. These can vary from vacations to a day of shopping e.g. (Krizek, 2003).

All the journeys in the research are medium and longer distance journeys. According to Limtanakool et al. (2006) the shares of the commute journeys that is done by private car is 78 percent, the train is only used in 22 percent of these cases. Also generally, men depend much more on the car, and women rely to a greater extend on the train for these journeys. For journeys that are purely for business activities even 90.5 percent are undertaken by car. The characteristics of the people that make business trips mostly explains the high car use. For journeys with recreational purpose the share of railway travel is about 20 percent. The preference of the car seems to be a result of the flexibility of the car in comparison with public transport. A lot of attractive recreation destinations are poorly accessible by train and well accessible by car. Besides that, journeys with recreational purposes are more often undertaken with other people which makes traveling by car relatively more cheaper and more convenient with for example luggage and travel times (Limtanakool, et al., 2006).

2.4 Transportation mode choice

People all over the world have become very mobile over the last decades. Many inventions and innovations related to transportation have ensured that mobility became an important topic globally. All these inventions and innovations caused a wide range of possible transportation modes for every journey. Some transportation modes like walking are as old as mankind, but now also individual modes like bicycle and motorcycle have become possible. Also larger motor vehicles are possible ways to make a travel i.e. car and bus. Besides these vehicles that use the road network some modes of transportation like the train, metro and tram are common these days. The transportation modes discussed so far travel over land, but there are also modes that use the airspace to travel through (e.g. airplane or helicopter) or water to move over (e.g. boat). Many different transportation modes are present nowadays and each mode has its own characteristics and purposes.

Almost each day decisions have to be made to determine how a certain travel is made. For each travel that is made, more than one modes of transportation are possible. The decision that has to be made to determine which alternative will be used is called the transportation mode choice. Everyone in the current western world is confronted with transportation mode choices very often. A transportation mode choice depends on and is affected by all kinds of different factors that will be explained in Chapter 3.6. A set of alternative transportation modes is available for each journey that is made. Each alternative has its advantages and disadvantages that are dependent on the environment and the situation.

2.5 Research framework

2.5.1 Stated Preference

The stated preference (SP) approach is based on individuals' choices of hypothetical transportation mode alternatives (Wardman, et al., 2001 (1)). This approach is widely used and accepted in travel behavior research and practice to identify behavioral responses of travelers to choice situations which are not revealed in the market e.g. (Abrantes & Wardman, 2011; Hensher, 1994). SP surveys are stable preference estimates from stated choices that are the result of a research with hypothetical alternatives. These can be used to forecast impacts on transportation mode choices when alternatives are suggested (Fujii & Gärling, 2003). SP predefines the characteristics of alternatives in a choice set, it also seeks behavioral responses from travelers. These come in the form of either a choice selection or a preference ranking/rating. With SP an empirical model can be produced to predict travel choices, as well as derive the shadow prices and values of travel attributes (Hensher, et al., 1998).

A stated preference approach is considered to be a good method to perform a hypothetical study. The attribute values are controllable, therefore SP can be used to research hypothetical situations. So unlike revealed preference (RP), which is based on individuals' real choices, SP can give insight in situations that do not exist yet, it allows us to explore issues outside of the technological frontier. This information can be used to predict the consequences of changing and adjusting the current situation (Hensher, et al., 2005; Train, 2002).

An experimental design is the foundation for any stated preference experiment. To collect the correct data with the stated preference experiment it is important to use the experimental design as a guideline. Figure 9 shows an experimental design as presented by Henscher et al. (2005, pp. 100-103). The structure of this experimental design is followed in the research. First the problem is defined, this is the basis and necessary to continue with the research. After the problem is stated and refined the stimuli are identified. The stimuli in this experimental design are the alternatives, attributes and attribute levels. Identifying these are an important and iterative part of the design. When the research continues it may be the case that some of the identified stimuli are changed or left out of the research. After the stimuli are identified and refined it is considered what experimental design would be most suitable for the research. In this consideration the type of design, model specification and the reduction of the experiment size is done. The extent to which the experiment has to be reduced in size depends on the type of design and model that is used. Then the experimental design is generated and the attributes are allocated to design columns now the experiment begins to take shape. With this experimental design with allocated attributes the choice sets are generated. To create a useful random research these choice sets are randomized. When randomized they are ready to be used in the survey instrument and presented to the respondents. For the main part it is an iterative process that allows to refine the first four stages up until the fifth' stage. After the fifth' stage the experiment problem, alternatives, attributes, attribute levels and type of design are fixed and cannot be changed without redoing all the stages. When the choice sets are generated and randomized in the fifth and sixth stage the experiment is ready to construct a survey or questionnaire with. Following the experimental design structure is a good way to make sure that the results of the survey will be useful data that can be analyzed.

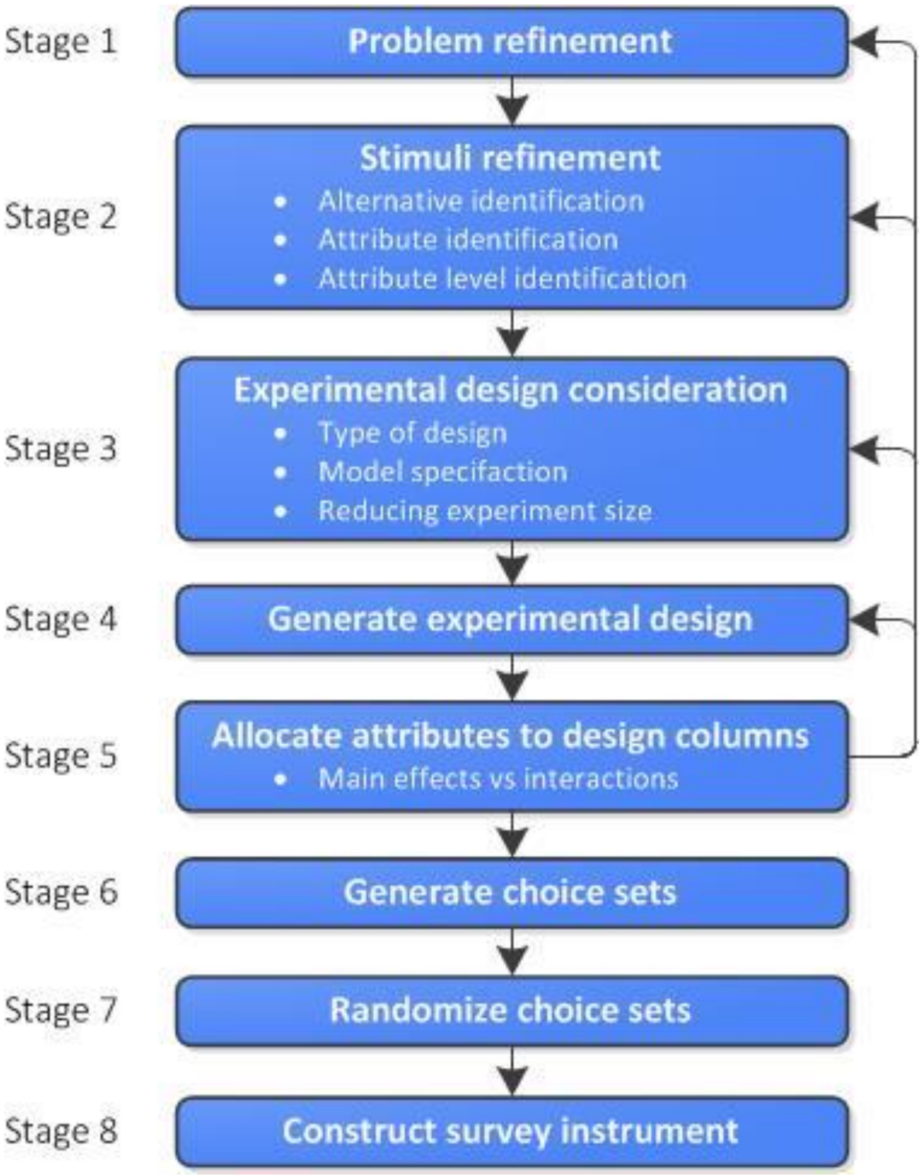


Figure 9. Experimental design process as presented by Henscher et al. (2005, p. 102).

2.5.2 Multinomial Logit Model

The data that is collected with a stated preference experiment can be analyzed with a discrete choice model. For the data analysis a Multinomial logit (MNL) model will be used to estimate the parameters of the stated preference experiment. A MNL model is a discrete choice model which can help to understand and predict choices between several alternatives. Train (2009) states that it is by far the easiest and most widely used discrete choice model in the world. The popularity of MNL is due to the fact that its formula for the choice probabilities take a closed form and therefore is readily interpretable. Three important characteristics of logit models that indicate the applicability are (Train, 2009):

- Logit models represent systematic taste variations that relate to observed characteristics that the decision maker determined on forehand. But it cannot represent random taste variations that cannot be linked to observed characteristics.
- The logit model implies proportional substitution of the alternatives, these are determined from the researcher's specification of representative utility. Therefore it can only capture forms of substitution to a certain flexibility, for more flexible forms other models are needed.
- If factors that are unobserved prove to be independent over time in repeated choice situations, logit can capture the dynamics of this repeated choice, including state-dependence.

In a multinomial logit model an individual (q), makes a decision from a mutually exclusive, exhaustive set of alternatives (A_i) for an alternative (i) that maximizes the utility of the individual (Train, 2002). U is the perceived utility of an alternative I by an individual q, the utility is built up of two components: a systematic component V_{iq} and a random component ε_{iq}.
The utility for an individual can be expressed as:

$$U_{iq} = V_{iq} + \varepsilon_{iq} \qquad (Equation\ 1)$$

Where: U_{iq} is the utility offered by alternative i for individual q;
V_{iq} is the representative component of utility determined by a function of the measured attributes;
E_{iq} is the random/error component of utility caused by unobserved influences.

The representative component of utility is determined by the following equation:

$$V_{iq} = \sum_n \beta_n X_{inq} \qquad (Equation\ 2)$$

Where: β_n is a parameter representing (generic) weight of attribute n;
X_{inq} is the score of alternative i on attribute n for individual q.

The score of alternatives depend on socioeconomic characteristics of the individuals as observed by the modeler. With this function the utility of a certain alternative for an individual is determined.

With MNL the probability that an alternative will be chosen can be determined by the following function:

$$P_{iq} = \frac{\exp(V_{iq})}{\sum_{i'} \exp(V_{i'q})}, \qquad i,i' \in A_q \qquad (Equation\ 3)$$

Where: P_{iq} is the probability that individual q will choose alternative i.

The MNL model can be estimated by using the maximum likelihood method (Train, 2009). If it is assumed that each choice of the decision makers is independent of choices of other decision makers, the probability of a person actually choosing the alternative that he was predicted to choose is calculated by the maximum likelihood method. The likelihood function can be evaluated for different values of β. The maximum likelihood method is expressed as:

$$L\ (\beta) = \pi_q \pi_i (P_{iq})^{y_{iq}} + C \qquad (Equation\ 4)$$

Where: P_{iq} is the probability that individual q will choose alternative i;
y_{iq} 1: alternative i was chosen by q;
0: otherwise;
C = 0 in case of only 1 observation per individual;
β is a vector containing the parameters of the model.

In many cases it is easier to instead of the likelihood function itself maximize the logarithm of the likelihood function.

$$LL\ (\beta) = \sum_q \sum_i y_{iq} ln\ (P_{iq}) \qquad (Equation\ 5)$$

Where: P_{iq} is the probability that individual q will choose alternative I;
y_{iq} 1: alternative i was chosen by q;
0: otherwise;
β is a vector containing the parameters of the model;
ln (.) is a natural logarithm.

Because of the complexity of the research, MNL models that include several trip characteristics are estimated. The goodness of fit of multinomial logit models are estimated to determine whether the model is good or not. The statistic that is used with discrete choice models to measure how well the models fit the data is called "the likelihood ratio index". The statistic measures how well the model performs compared with a model that has all parameters set to zero. The model with its estimated parameters is compared to a null-model. The comparison that will be made with this statistic is based on the log likelihood function that is defined in equation 5. It evaluates the function at both the estimated parameters with all parameters set to zero (Train, 2009). The likelihood ratio index is expressed as:

$$\rho^2 = 1.0 - [LL(\beta)/LL(0)] \qquad (Equation\ 6)$$

Where: LL(β) log-likelihood using estimated parameters;
LL(0) log-likelihood using null-model.

This statistic gives an index which varies between 0 (no fit) and 1 (perfect fit). Its meaning is clear in the limits of 0 and 1, but is does not have intuitive interpretation for intermediate values as in the case of R^2, these are interpreted really different. In the likelihood ratio index values around 0.4 are usually already considered excellent fits (Ortúzar & Willumsen, 2011).

Generally, when more parameters are added a model will perform better. To compare the performance of different subsets of variables, like the null model and the optimal model, the likelihood ratio test can be used (Ortúzar & Willumsen, 2011). To do this test, the log-likelihood at convergence of one model (0), in the research the null-model and the constants-model, is compared with the log-likelihood at convergence for the optimal model (β) with all the added parameters. The likelihood ratio test is distributed chi-squared and the degrees of freedom are equal to the number of restrictions implied by the null hypothesis. The likelihood ratio (LRS) test is defined as (Train, 2009):

$$LRS = -2[LL(0)/LL(\beta)] \qquad (\textit{Equation 7})$$

Where: LL(β) log-likelihood using estimated parameters;
LL(0) log-likelihood using the null-model.

If the value of the likelihood ratio test exceeds the critical value of chi-squared with the appropriate degrees of freedom, then the null hypothesis or constants only hypothesis is rejected (Train, 2002).

2.6 Conclusions

In the research two different types of journeys are relevant, the car journey and the multimodal railway journey. The most important difference is that a car journey starts more or less directly from the starting point of the journey and goes directly to the end point, in a multimodal railway journey the journey consists of several different parts. Two of those parts are important for the research, the access trip and the train trip. For the access trip a form of pre-transport is necessary. The forms of pre-transport that are included in the research are the bicycle, bus and car as a driver and as a passenger.

Travel purpose is the goal of the journey that is made. Many different travel purposes can be defined, but these can be summed up in: work, study and recreational. The travel purpose with its characteristics can affect a transportation mode choice. The transportation mode choice depends on more factors, many of them are influenced by the socioeconomic characteristics of the traveler. Besides socioeconomic influenced factors it is also influenced by habit, especially for commuter traveling. A stated preference approach is used to collect the data from respondents. Multinomial logit is used to analyze the collected data because it is a model that can help understand and predict choices between several alternatives.

3 Transportation in the Netherlands

3.1 Introduction

The Dutch transportation network is a highly developed network that makes traveling in the Netherlands convenient and well facilitated. Because of the high quality of the Dutch transportation network a lot of possible ways of making a travel are possible. The transportation mode choice depends on a many different factors that are discussed in the following sections of this chapter. Before all the influences on transportation mode choice are discussed, a brief history of the development of the transportation network in the Netherlands is given, and the trends of the latest years and for the future will be explained. The history and trends of the development of the transportation network give a good insight in the situation and make it easier to understand why people choose for transportation modes in specific situations.

The influences on transportation mode choices are comprehensively explained because these are the core of the research. To understand why people choose for a specific transportation mode, the context of the situation has to be clear. Besides socioeconomic factors also habit proved to play a significant role in the transportation mode choice. Not only social factors play a role in the decision making, also factors like demography are of influence. The current situation of the Dutch transportation network is involved in the literature review to give insights in the factors that could be of influence. Many researches are conducted with information of travel distances and time. It is important to know what influence these factors have on transportation in the Netherlands to conduct a good research. Hereby the distance to and the accessibility of the railway stations proved to be important. Also the organization and design of the environment of railway stations influence human travel behavior.

3.2 Transportation mode development in the Netherlands

3.2.1 History

Spatial planning in the Netherlands has always been regulated relatively much. When the industrialization began in the beginning of the twentieth century, the Netherlands did not allow urbanization of the countryside and chose a systematic approach for the urban expansion. This resulted in a clustered land-use pattern. The Housing Act (1901) made sure that municipalities and housing corporations were give subsidies to organize and structure the urban expansion well. In the seventies and eighties another policy was implemented to protect open areas, new urban developments were concentrated in growth centers located in proximity to existing large cities. In the late 1980s these Dutch planning policies changed course. Due to the fast population increase of the growth centers an exodus from the city centers of large cities began. Therefore in the new policy, the Fourth Physical Planning Memorandum, new neighborhoods were created at the edge of existing cities. This policy also introduced a policy for the location of firms. Firms were located in a way that car use was discouraged and the use of alternative transportation modes was stimulated. Firms should be close to main railway stations, if this was not possible they should be near regional transportation nodes. Goods-handling industries were located near the highway to improve their logistics. The objective of the policy that was approved by the parliament in 2006 was to concentrate services and other amenities in urban networks. Further the most important regional functions were concentrated around infrastructural and public transportation (PT) nodes. The most important main ports and urban areas in the Netherlands are connected by clustered connecting corridors for roads, rails and water infrastructure (Vos, 2015).

Spatial and socioeconomic structures of most metropolitan areas in the Netherlands have changed significantly in the last few decades. De-concentration of land use was caused by growing prosperity, profound economic changes and the increase of car ownership after the second world war (Alpkokin, 2012). The development toward motorization and suburbanization affected the way people travel greatly. Commuting patterns are shaped by changes in jobs, homes and residential location over time. The relocation of urban functions like stores and offices to suburban development nodes and city outskirts caused a decline in cycling, walking and the use of public transport. Therefore private car use increased for commuting and other travel purposes (Susilo & Maat, 2007; Vos, 2015). According to Vos (2015) the most important trend in terms of mobility in the Netherlands is the rapid increase in car use over the past decades. In the period 1980-2012 the total distance covered by cars has almost doubled. The local built environment has a great influence on the transportation mode choice. In suburban or rural areas the walking, cycling and public transportation use is significantly lower than in more urban areas, whilst car use is much higher (Ewing & Cervero, 2010; Mokhtarian & Cao, 2008).

Due to the increase of private car use and the negative consequences such as congestion, air pollution, and urban sprawl, from the 1990s onward spatial planners have tried to solve this problem by adapting the built environment. New concepts, like Transit Oriented Development (TOD), were introduced to reduce car use and travel distances. Neighborhoods with high densities and diversities are created, and the new designs are public transportation and non-motorized transportation modes oriented (Schwanen & Mokhtarian, 2005).

In the Dutch memorandum Mobility the aspect of mobility for all is not the main objective. The most important residential areas, employment areas, and ports are situated along a limited number of connecting corridors. These corridors with roads and railroads are being optimized, while additional housing is being provided in proximity of these corridors. So the existing infrastructure is being optimized to transport more people instead of being expanded. A limited but high quality PT service in urban networks will be created while PT services in small cities and the rural areas are limited. The high frequency and high capacity of the PT service in urban networks will have a high potential for travelers. It is also stimulated in the Netherlands to use the bicycle by offering better bicycle facilities in proximity of railway stations (Vos, 2015).

3.2.2 Trends

The trends of the past decades that made private car use increase tremendously have to be turned to limit the negative consequences for the environment. Transportation policies in Europe are differencing, this will make private car use less attractive for travelers. This will be combined with policies that make alternative transportation modes faster and more convenient and promote those (Buehler, 2011). Cycling is increasingly seen as alternative for

private car users for the shorter distances, which particularly in smaller cities has the potential to achieve less automobile kilometers e.g. (Alpkokin, 2012).
In 2012 the Memorandum Infrastructure and Space was approved by the Dutch government. This document in many ways break with the trends of previous spatial planning documents in its outlines for the physical character of the Netherlands in 2040. In this new policy spatial planning is being decentralized and the urban network concept is abandoned. The Dutch spatial planning policy is being decentralized and liberalized which makes the future function of areas less fixed (Vos, 2015). So the future mobility policies of the Netherlands aim at more sustainable transportation mode use, but with more freedom and flexibility in reaching that goal.

3.3 Dutch road network

The Dutch road network is one of the densest and most organized of the world, this is due to several factors, including transportation demand and population density (Eurostat, 2015). The Dutch road network consists out of three main types of roads. First, the *through roads* like highways and expressways are designed to process the through traffic as fast as possible. These roads are the most important connections for motorized traffic for long distance travel and between cities. The Netherlands, especially the Randstad, has one of the densest highway networks in the world. 'Rijkswaterstaat', the executive agency of the Dutch ministry of Infrastructure and Environment is responsible for the design, construction, management and maintenance of these main infrastructure facilities (Rijkswaterstaat(2), 2015). Second, the *distributor roads* are designed to distribute and gather traffic. The third type of roads are the *access roads* that are designed to provide direct access to lots. These three road types form the Dutch road network that is owned and managed by municipal authorities for more than 90 percent (Visser, 2010). The other 10 percent of the Dutch roads is owned by Rijkswaterstaat, provinces and water authorities.

The current road network has been developed according to the spatial and transportation planning philosophies of the last decades. Land use and infrastructure have been of influence on each other from the start of mobility. Infrastructure has partly been determined by the spatial structure, and on the other hand, the spatial structure is partly determined by the present infrastructure (Snelder, et al., 2005). Because compact cities changed to large metropolitan areas in the Netherlands, the city center is largely connected to the new outer districts via radial road structures. In this structure the hierarchy of the roads that is discussed previously is important to ensure safety and good accessibility everywhere (Dijker, 2010).

3.4 Dutch public transport

3.4.1 Dutch public transport network

The Netherlands has a dense and well-coordinated public transport network. Especially the Randstad has a very well organized network with good accessibility (European conference of ministers of transport, 2003). The Dutch public transport network consists out of several systems like the train, metro, tram and bus. These systems are used separately as well as combined with each other or other modes of transportation. The different public transport systems depend, in terms of performance, on the cohesion of the total network. The quality of the public transport network is determined by the total, all parties and systems are linked and work together. The chain is only as strong as its weakest link (Ministerie van Infrastructuur en Milieu (3), 2014).

Figure 10 show two possible ways of designing a public transport network. Lines of the public transport network in the Netherlands are bundled instead of a large amount of direct lines that connect areas crisscross. This is done for efficiency and cost reasons. Due to this approach the demand on the bundled lines is higher, therefore these lines can be designed and constructed more suitable. In Figure 10 this bundled line is shown in red. This network is hierarchical, lines with low demand can be held simple and lines with an higher demand will be designed suitable and optimal for that demand.

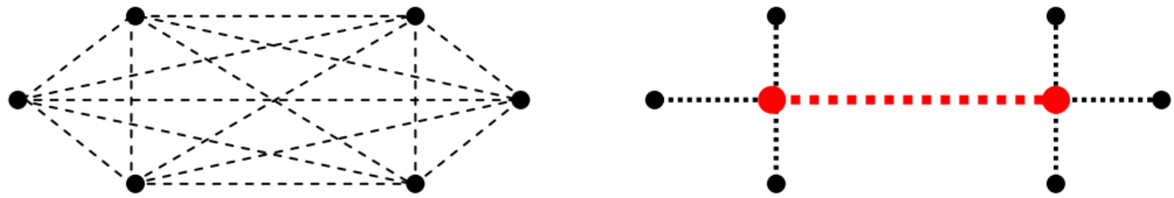


Figure 10. Network with crisscross relations (left) and an hierarchical network (right) (ECORYS, 2006).

Each public transport line has its own characteristics and needs. To make these lines used more efficient, different type of public transport are used in the Netherlands. Therefore the different types of public transport act on different type of trips. In Figure 11 the different types of public transport are shown that are used for certain distances of trips.

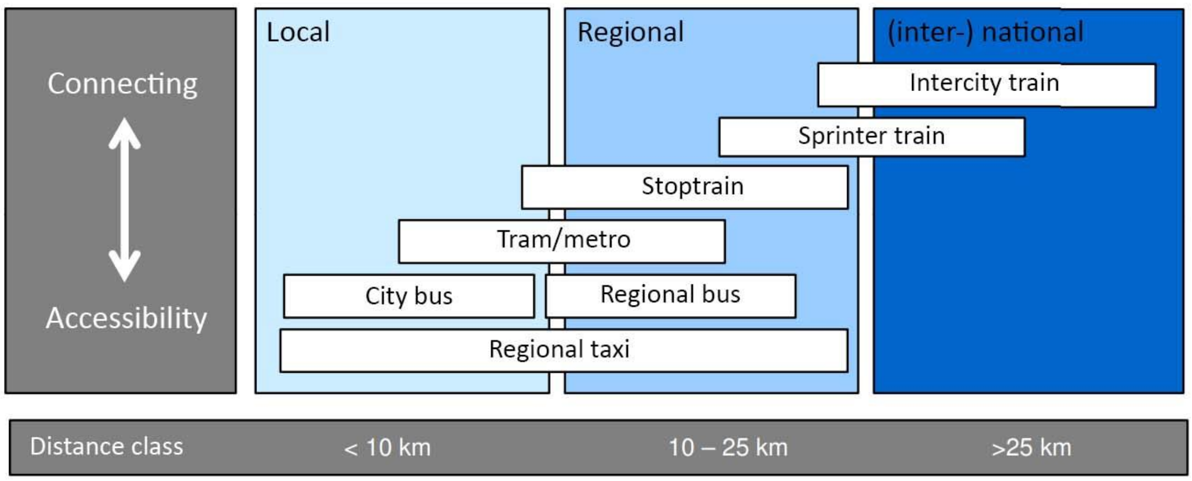


Figure 11. Types of public transport in the Netherlands classified by travel distance. Adapted from: (ECORYS, 2006).

Most public transport types have fixed routes and stops. The routes are links between the nodes. Different type of nodes are present in the public transport network. One type of node is the junction, a location where travelers can transfer between different links that may as well be of the same transportation mode as different mode. Other type of nodes are stops where no transfers are made, but where lots of people get in or of the public transport. This is often the case at facilities like hospitals or at industrial or commercial areas (ECORYS, 2006).

3.4.2 Dutch railway characteristics

In the Dutch public transport network the railway network is the backbone. Railways connect metropolitan and industrial areas, essential for the economy of the Netherlands (Ministerie van Infrastructuur en Milieu (3), 2014). The Dutch railway network, just like most public transportation network, consists out of nodes and links where the railway stations are the nodes and the railways are the links between these nodes. The Dutch railway network is considered to be a good network because of the good accessibility of, and short distances to railway stations. Also the environment of railway stations is developing. These close environments are increasingly providing facilities and comfort for travelers. Transit Oriented Development is one of the leading developments that aim to do this.

The Dutch railway network has a dual function, it is used both for transportation of travelers on short distances (i.e. within urban areas), as well as on long distances (i.e. between urban areas). In the Netherlands that causes the distinction between two different types of service that is offered. The first is a local transportation service for shorter distances with a ‘stoptrain’ or ‘sprinter’ trains that have many stops. For the longer distance an intercity service is used with ‘intercity’ trains that only stops at large railway stations. The Dutch railway network is an typical public transport network with fixed lines and differences in the capacities of these lines. The trains are facilitated and managed by the Dutch railway company the ‘Nederlandse Spoorwegen’ (NS). The NS used to be governmental, but is privatized to improve the railway system. The NS uses the Dutch railways that is managed by ProRail. The Dutch railway network is the busiest railway network of the European Union.

3.4.3 Accessibility of railway station

The accessibility of railway stations affect both the access and egress mode of the railway journey. Accessibility is one of the most important factors affecting transit use (Gutiérrez, et al., 2011). The “Integration Between Rail and Access-to-railway-stations Modes” (IBRAM) research from Givoni and Rietveld states that improving the quality of access facilities at railway stations is likely to increase passengers’ overall satisfaction of the railway journey, and therefore train use (Givoni & Rietveld(1), 2007). Wardman and Tyler (2000) found a relatively high elasticity of demand for inter-city rail travel with respect to distance from the station in their research about the accessibility of the railway network. This suggests that improving the access could increase rail use. Also, improvements to the accessibility of railway stations might be less expensive and more cost effective than improvements to the railway and actual train trip (Givoni & Rietveld(2), 2007).

The accessibility of a railway station can be an important factor in determining whether the train is chosen as a travel alternative (Rietveld, 2000). Therefore multiple papers are written about the accessibility of railway stations and in in particular about the access- and egress transportation mode choice of train users. In the vast majority of cases, the transportation mode used for the access to the railway station on the outward journey, will be the transportation mode used for egress on the return journey. A similar statement can be made for the egress mode of the trip. Therefore, the data presented in Table 1 only refers to the access outward journey (Givoni & Rietveld(2), 2007).

At the egress-end of the journey, the transportation mode choice is strongly influenced by the limited availability or the high expenses of the possible choices. Private access modes are usually only available at the access-end of the journey, whereas at the egress-end their availability is limited (Keijer & Rietveld, 2000). As shown in Table 1, at the egress-end of the journey, 81.8 percent of the people walk or use public transport. The pre-transport at the access-end of the journey is more scattered. The main difference is that the bicycle is often not available at the egress-end, therefore another transportation mode has to be chosen, this depends on the location of the final destination of the traveler.

Table 1. Transportation mode choice on the access trip and the egress trip (%) (Givoni & Rietveld(2), 2007)

	Access mode			Egress mode
		Distance to station		
		<3 km	>3km	
Bicycle	38.3	46.3	22.8	9.5
Bus/tram/metro	26.7	16.4	50.0	34.6
(Only) walking	20.1	27.0	4.6	47.2
Car (driver)	7.2	4.1	13.6	0.9
Car (passenger)	6.6	5.1	8.1	4.6
Taxi	0.2			0.9
Motorcycle	0.1			0.1
Train taxi	0.1			0.0
Other	0.7			2.2
Total	100			100

The access mode choice also depends on the travel purpose, frequency of using the railway, and passengers' age. Givoni and Rietveld (2) (2007) state that the travel purpose does not have very much influence. But business travelers seem to choose the car more often and leisure and business travelers use the bicycle less often compared to those traveling to school or commuting to work. In terms of the frequency of traveling by train, those who use the train more frequently use the bicycle more as a transportation mode, and the people that use the train less frequently, use the car significantly more. Finally, if the age rises, more travelers use the car and less people cycle to the railway station (Givoni & Rietveld(2), 2007).

The distance to railway station affects the accessibility of railway stations. The pre-transportation mode choice that is chosen to access a railway station is influenced by this distance between the start point and the railway station. Different (pre)-transportation modes have different characteristics. Some of these modes are more suitable for certain travel distances. In Figure 11 of the previous chapter it already was shown that for different distances, different modes of transportation are used. 91.6% of the Dutch population lives within a 10 kilometer range the nearest railway station and two third of the Dutch live within 5 kilometers (CBS, 2011; Keijer & Rietveld, 2000). So the coverage of the Dutch railway network is wide, this is confirmed by the fact that the mean distance of residents to the nearest railway station in the Netherlands is about 4.5 kilometer (Brons, et al., 2009). Figure 12 shows that the major part of the Netherlands is covered within 25 kilometers of railway stations, and the more densely populated areas are all closer. The distance between the residents and the nearest railway station has a great influence on the frequency of using the train. People that have a higher propensity to travel by train also choose to live closer to the railway station. There are some important differences related to the distance to the railway station. In general, for access trips passengers accept a longer travel time than for the egress trips. So it is important that the end destination is close to the railway station at the destination end (Givoni & Rietveld(2), 2007).

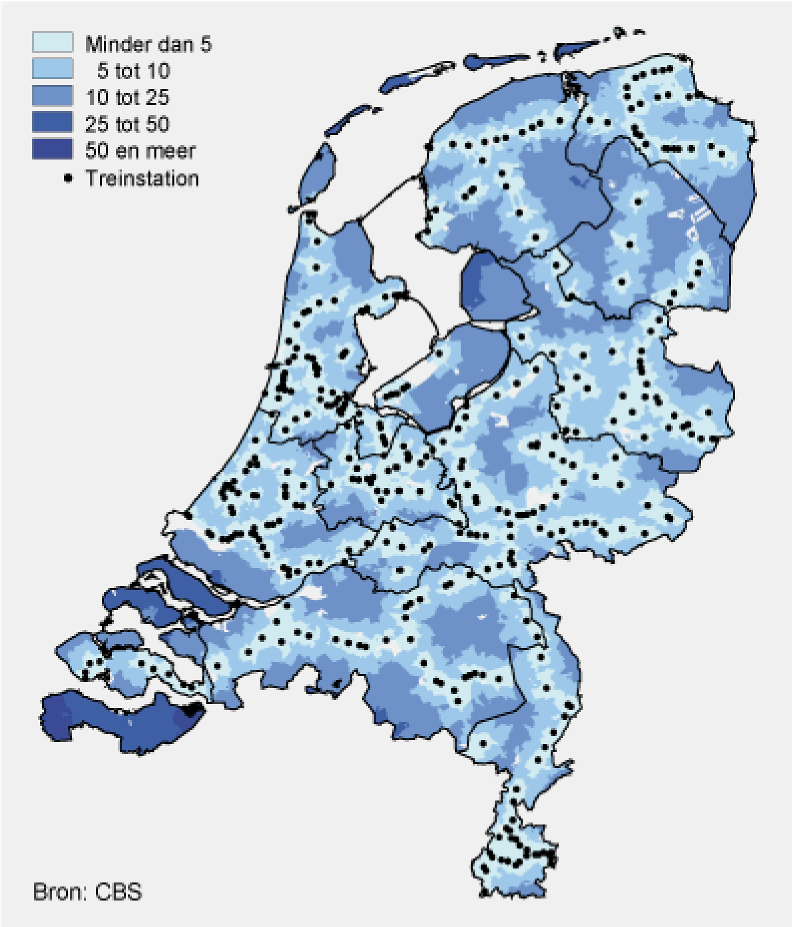


Figure 12. Distance to nearest railway station (CBS, 2011).

3.4.4 Transit oriented development (TOD)

New ways to improve accessibility and increase facilities on railway stations are developed. One of the most promising developments is Transit oriented development (TOD). Developments like TOD could improve the accessibility of railway stations and therefore influence pre-transportation. Parker et al. (2002) from the California department of transportation define TOD as "Transit-oriented Development (TOD) is moderate to higher-density development, located within an easy walk of a major transit stop, generally with a mix of residential, employment and shopping opportunities designed for pedestrians without excluding the auto. TOD can be new construction or redevelopment of one or more buildings whose design and orientation facilitate transit use." So TOD is a mixed-use residential or commercial area that is intended to maximize access to any form of public transportation (Holmes & Hemert, 2008). TOD focuses not only on what is being built, it is more about how and where. Sometimes that is more important for the value of economic development. People need to be able to get from their home to work, school, shopping, sports and other services affordable and efficiently. The physical aspect of TOD is referred to as the three dimensions, or '3 Ds', of sustainable development: Density, Diversity, and

Design (Cervero & Kockelman, 1997). Two dimensions are added later by Cervero and Murakami (2008). Distance to transit and Destination accessibility complete the '5 Ds' of the built environment. The '3 Ds' and '5 Ds' of TOD are shown in Figure 13.

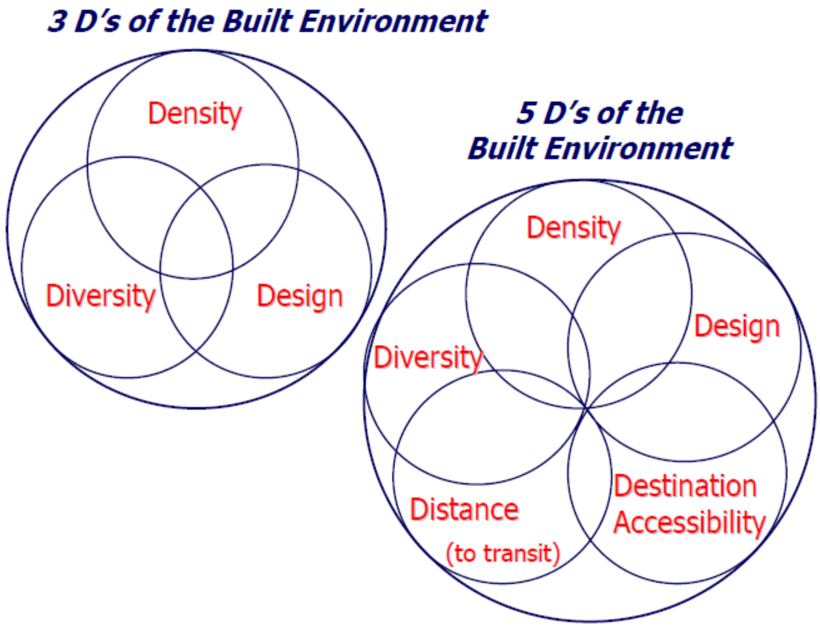


Figure 13. The '3 Ds' and '5 Ds' of Built Environment (Cervero & Murakami, 2008).

Ratner and Goetz (2013) state that TOD is more than simple developing near transit stations. Successful TOD has positive effects in urban areas, beautiful, vital and walkable neighborhoods are created. It provides shopping, housing and more transportation choices. It also generates lasting value for civilians and private and public stakeholders. And finally it provides good access to all kinds of facilities. The level of train use in TODs is relatively high compared to other 'normal' railway stations (Brons, et al., 2009).

3.5 Customer demands

3.5.1 The Dutch car users

A car journey consists out of some elements that all have their own characteristics, see Chapter 3.3. The car trip is the most important element of this journey. Dutch car users make use of the Dutch road network. Rijkswaterstaat is responsible for the main infrastructure facilities in the Netherlands and the Province and Municipalities manage the smaller other roads. Rijkswaterstaat did an investigation about the interest and demands of car users. In the research of Rijkswaterstaat (2015) the results show which facilities of the Dutch road network are most important and what are the demands of the users. The goal of almost every private car user is to get from one place to another. This car journey has to be as comfortable, safe, fast and cheap as possible. The most important facilities for the users are the safety on the road network, a good traffic flow and the quality of the roads. Also construction and maintenance of roads are considered to be important. An interesting facility which is becoming increasingly more important is the traffic information that is available before and especially during the trip. With the upcoming of smart phones and tablets that are connected to the internet almost everywhere this is a new facility and possibility that can be used to inform people with recent updates about traffic situations.

3.5.2 The Dutch train users

A railway journey also has several elements which have their own characteristics, but the railway journey consists out of more different elements. The journey is only as strong as its weakest element, so if one element is weak, it is important to know about it e.g. (Arntzen & Lindeman, 2013). Within the train trip not only the train ride has to be comfortable, safe and on schedule, the transfers, satisfactory on the railway stations and many other aspects of the journey are of importance as well.

Figure 14 shows the *pyramid of customer needs* of the Dutch railway travelers at railway stations. The base of the pyramid that is shown in red is formed by the basic needs for passengers, reliability and safety. *Safety* in this case particularly means social safety, which is a prerequisite for the functioning of a railway station and train as a public space. *Reliability* indicates the level of the passenger experience compared to what they expect. The majority of travelers choose as short a travel time for the journey as possible, so *speed* is the principal customer need. If the condition of a fast journey has been complied with, then the travelers want their experience to be *easy*. It creates a lot of disutility when travelers cannot find the information and requisites they need easily. These dissatisfiers, shown in the colors red and orange in Figure 14 have much impact on the utility of a railway journey. But there are also satisfiers in the pyramid of customer needs, these are indicated by a green color. A certain degree of physical *comfort* at the railway stations and in the train are expected by customers. *Experience*, at the top of the pyramid, has to be pleasant for the customers. The customer experience is influenced by visual aspects such as architecture, design and cleanliness as well as by less tangible environmental variables such as daylight, smell and noise e.g. (Hagen & Heiligers, 2011; Peek & Hagen, 2003).

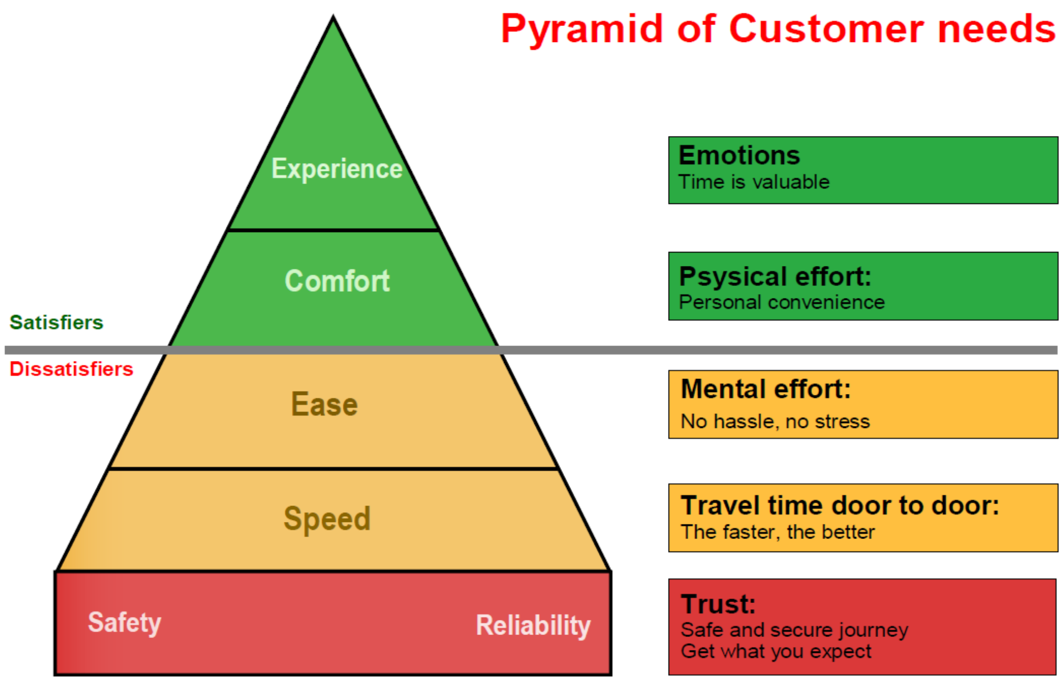


Figure 14. Pyramid of customer needs for railway stations (Hagen & Heiligers, 2011).

Not only the train trip, but also the access mode and egress mode respectively to and from the railway station are part of the railway journey. These are also determinative for the satisfaction of travelers. Resistance factors in a railway journey are travel time, monetary costs and effort. The lower these resistance factors, the higher the amount of transport will be. As the utility theory states, only if the benefits outweigh the costs, the trip will be made, in which costs are all the resistance factors that occur in the journey (Wee, et al., 2013).

3.5.3 Push and pull factors of public transport users

Push and pull factors are two different approaches to influence decision making. Push measurements discourage alternatives and therefore make the other alternatives more attractive, and pull measurements encourage alternatives which make those more preferable. In the context of transportation mode choice between private car use and public transport, the discouragement of car use is a push measurement and the encouragement and improvement of public transport is a pull measure to get people from using the car to using the train (Gärling, et al., 2002).

An investigation of perceived travel possibilities of car and train travelers on the main corridors to the city of Amsterdam, The Netherlands, and associations with traveler and trip characteristics was conducted by Exel and Rietveld (2009). From the, more than 19,000, car travelers about forty-two percent had public transport in their subjective transportation mode choice-set. The perceptions of these car travelers about public transport travel time exceeded objective values by forty-six percent. Forty-two percent considered using public transport as a transportation mode, but still used the car. It indicates that if a public transport mode would be a better alternative, possibly more travelers would choose it as transportation mode. Public transport services have the potential to attract private car users by the improvement of the quality of the service (Redman, et al., 2013). Not only improving public transport services attract potential users, making car use less attractive (e.g. by a system of road pricing) would be even more effective e.g. (Fiorio & Percoco, 2007).

In the research from Exel and Rietveld (2009) a survey was conducted from over 3500 public transport travelers with a car available, research was done about the main reasons for choosing public transport instead of car. Figure 15 shows these reasons for choosing public transport. Notable is that the two most important reasons, avoid traffic jams and parking problems are both push factors (the upper two in Figure 15). People want to avoid these things and therefore use the public transport. The other three reasons are pull factors (the bottom three in Figure 15), these are positive aspects of the public transport relatively to using the car. This indicates that push factors have more influence on the transportation mode choice than pull factors.

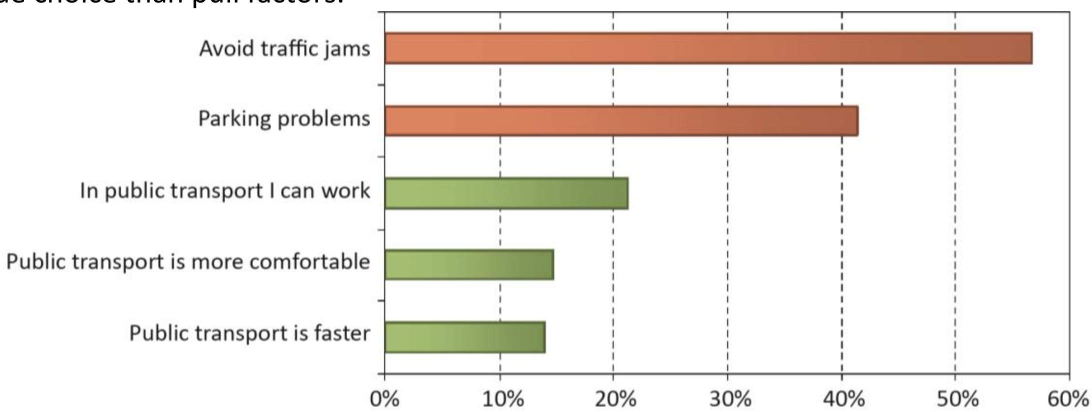


Figure 15. Push and Pull factors of choosing public transport instead of car. (Exel & Rietveld, 2009).

Making public transport a free service is a radical pull measurement for public transport that is applied in Flanders in Belgium. Goeverden et al. (2006) state a few consequences of making public transport free for users. First, all the costs that are attached to the cashing and administration of the payments for public transport will disappear. Therefore not only the safety of the driver or conductor is enhanced because no money is used, but also the passengers can get on and off faster which will result in less time loss by stepping on and off. Second, it will increase the attractiveness of a city that is reachable by public transport for tourists. And third, some car users will switch to using public transport. It turns out that whether the free public transport contributes positively to the formulated consequences or not depends strongly on the context.

SASI is a project with the objective to develop a comprehensive, consistent and transferable methodology to predict impacts of transport system improvements and transport infrastructure investments on development and social and economic activities. The main task of this project is to identify the way that transport infrastructure contributes to economic development in the region in different contexts. The authors of this project state as a guideline that wherever possible the preference should be given to pull factors rather than push factors (Fürst, et al., 1999).

3.5.4 Public transport service quality attributes

Redman et al. (2013) conducted a research to understand the aspects of public transport (PT) service quality that are most likely to attract car users. To define PT quality, a large number of attributes is proposed. These attributes are roughly categorized as either physical or perceived. The attributes that are assigned as physical are measured without involving the users of PT and therefore assumptions are made about the impact on the users of PT. The perceived attributes on the other hand are measured by observing the responses of PT users either directly or indirectly. Eight physical and four perceived PT service quality attributes are stated and defined in Table 2.

Table 2. Definitions of public transport (PT) service quality attributes (Redman, et al., 2013)

	Attribute	Definition
Physical	Reliability	How closely the actual service matches the route timetable
	Frequency	How often the service operates during a given period
	Speed	The time spent travelling between specified points
	Accessibility	The degree to which public transport is reasonably available to as many people as possible
	Price	The monetary cost of travel
	Information provision	How much information is provided about routes and interchanges
	Ease of transfers	How simple transport connections are, including time spent waiting
	Vehicle condition	The physical and mechanical condition of vehicles, including frequency of breakdowns
Perceived	Comfort	How comfortable the journey is regarding access to seat, noise levels, driver handling, air conditioning
	Safety	How safe from traffic accidents passengers feel during the journey as well as personal safety
	Convenience	How simple the PT service is to use and how well it adds to one's ease of mobility.
	Aesthetics	Appeal of vehicles, stations and waiting areas to users' senses

An improvement of the quality and efficiency of PT could change the daily transport habits of the people. Dell'Olio et al. (2011) used multinomial discrete choice models to estimate the relative bearing of desired service quality attributes. The data and information that was needed to do this research was conducted form a revealed preferences survey administered before the stated preferences survey later could be conducted. The results of the research are that especially the attribute 'waiting time' got the most weight in the utility function of transportation mode. This is because of the fact that the user sees the waiting time as lost time and the loss of time is irritating e.g. (Litman, 2008).

3.6 Transportation mode choice

To describe how people choose a transportation mode for their travel purposes, a theory of mode choice decisions is described by Schneider (2013). In his theory is suggested that there are five steps in the transportation mode choice decision process. The five steps of this theory are shown in Figure 16. The first part, awareness and availability, determine the possible transportation mode choices available for the travel. The following three elements, basic safety and security, convenience and cost, and enjoyment assess situational tradeoffs between the possible transportation modes. These three elements, in this theory known as the situational tradeoffs may be considered simultaneously in the choice sequence. The first four elements are all influenced by socioeconomic factors, this influence will be further explained in Chapter 3.6.1. A fifth element is of influence in the transportation mode choice, habit has the effect that people that choose a particular transportation mode regularly, are more likely to consider it as an option in the future. First, socioeconomic factors that influence the first four elements will be described. In the chapters following, the five elements of the theory will be described in more detail.

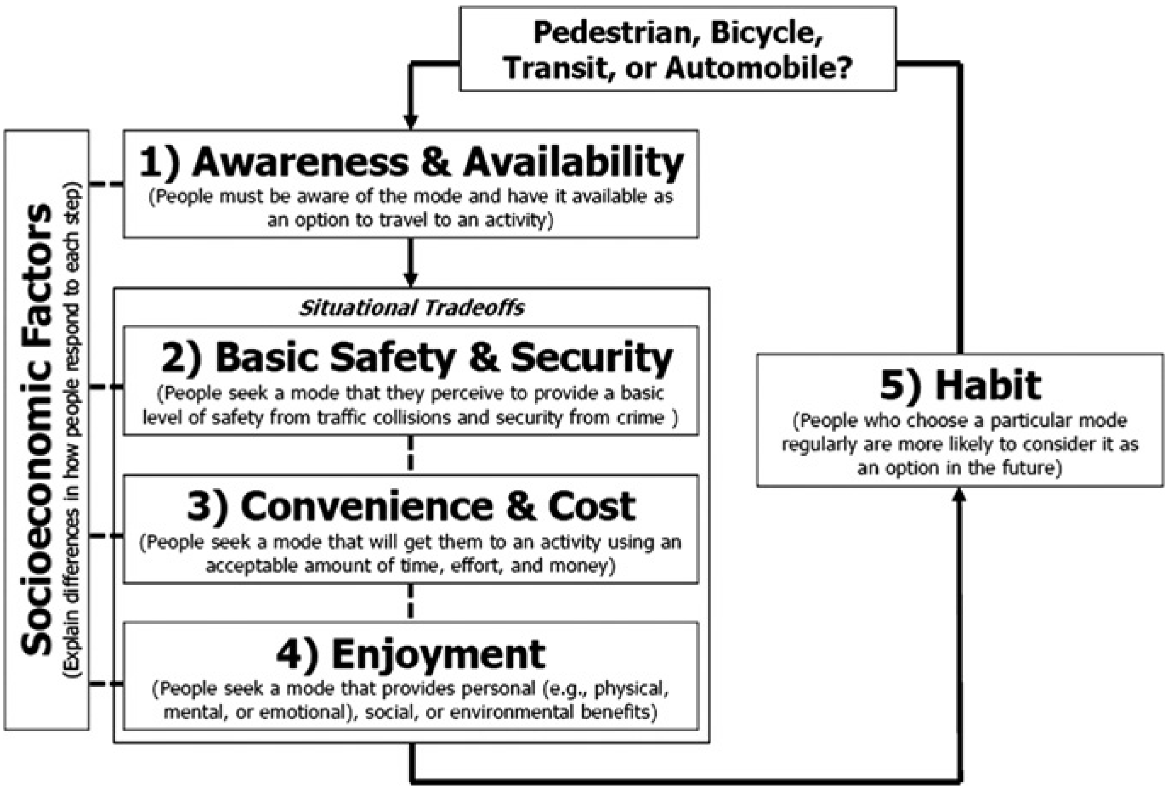


Figure 16. Theory of transportation mode choice decisions (Schneider, 2013) .

3.6.1 Socioeconomic factors

Transportation mode choice depends largely on socioeconomic characteristics (Ewing & Cervero, 2010). Eluru, et al (2012) state that there is a variety of characteristics of earlier research about investigating transportation mode choice decisions. Household and individual socio-demographics have a strong influence on transportation mode choice decisions for commuter traffic, which is a large share of the total traffic in the Netherlands. Specifically, income, lifestyle, perceived service level, willingness to pay, type of journey, travel time, gender, employment status and car ownership affect transportation mode choice e.g. (Bhat, 1997; Sardesai & Bhat, 2006; Beirao & Cabral, 2007; Brons, et al., 2009). All these elements often are influenced by, or a result of, residential location, neighborhood type and urban form. Therefore these spatial and urban factors play a prominent role in the determination of the favored transportation mode e.g. (Frank, et al., 2008; Pinjari, et al., 2007).

3.6.2 Awareness and availability

To understand the transportation mode choice of travelers the context of the situation is extremely relevant, so also the range of alternatives available to the traveler is key to the decision. The availability of alternative modes of transportation is essential to the probability of choosing those alternatives when a trip is made. Availability is important, if a transportation mode is not available it does not belong to the set of alternatives. Having a car available will increase the probability of choosing the car significantly over train and bus for travels on a range of some 1 to 2000 km (Johansson, et al., 2006). For short distance travels up to 10 km this applies to the bicycle as transportation mode choice. Whether people have a car or not really depends on the characteristics of the person, but in the Netherlands almost everyone owns a bicycle that can be used at all-time provided that the travel is made from home (Keijer & Rietveld, 2000).

Exel and Rietveld (2009) state that people that want to make a journey have a choice set of transportation mode alternatives, from these alternatives their transportation mode choice is made. This subjective choice set is different from the total set of possible alternatives, the objective choice set. So not all alternatives are taken into account when the transportation mode is chosen. The subjective choice set is the set of alternatives the person is aware of and considers acceptable and feasible as a transportation mode (Punj & Brookes, 2001). This is the set of alternatives that is actually considered in the choice making process. It is a part of the objective choice set which can vary from all possible alternatives to a single or even no alternative.

Rose and Marfurt (2007) conducted some surveys of individuals that participated at an event that tried to raise awareness of other transportation mode alternative. Over the timespan of five months they investigated whether the event influenced the transportation mode choice of the participants. The results were significant, the event that intended behavior change influenced the transportation mode choice of the participants. The promotion of alternative transportation modes and seeing other people change their behavior were the most important factors that influenced the transportation mode choice. Characteristics of participants played a role in the amount of influence the event had on the participants. Female participants were more influenced than male participants. And people who were familiar with the alternative transportation mode because they already used it at some point in time did not change their current behavior. These people already experienced the transportation mode and already made the decision not to use it.

3.6.3 Safety and security

Crime has always been a concerning factor for travelers, Carr and Spring (1993) state that the impact of fear of crime is significant. In Figure 17 the cycle of fear is shown, this Figure shows that the presence of fear among travelers is disturbing and therefore has to be avoided (Power & Barnes, 2011).

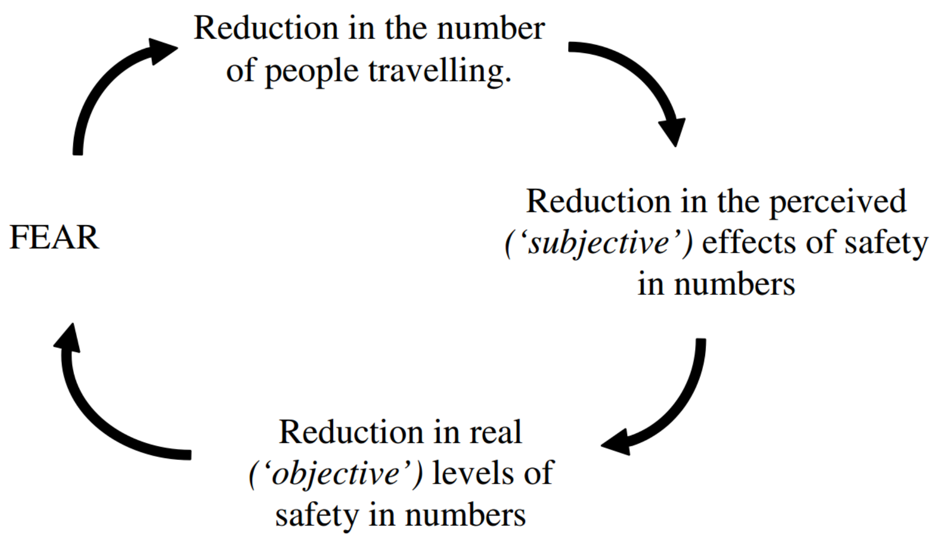


Figure 17. The cycle of fear (Carr & Spring, 1993).

Cozens et al. (2003) conducted a study about crimes against persons while traveling on transportation systems and crimes against persons whilst either exiting or entering the railway station. They state that mode of transportation can affect criminal opportunities by five means. First, each different transportation mode manages people in their own way. Private and public transportation modes can be differentiated in this case. Wherein public transport (PT) involves large numbers of strangers that are with each other for discrete periods of time. In PT offenders have great numbers of potential victims to select. Secondly, the transportation modes have different travel experiences. PT has fixed schedules, clustering people at specific times with predicable densities, while car is versatile and flexible. Thirdly, the different transportation modes cluster destinations are different. Private car users can travel between an infinite number of locations, while PT users travel between a limited amount of enter and exit points. Potential victims at a PT system cluster at predictable locations and facilitate the opportunity for selection by potential offenders. Fourthly, the travel paths of PT and private transportation modes are different. The travel paths of PT are defined and entrances to these paths are restricted. Therefore it is easier for potential offenders to plan a crime than when the travel route is not defined and harder to predict. Fifth and last, each transportation mode has different opportunity sets for potential offenders. Crimes in car travel are mostly conducted in car parks and residential parking areas. There are clustered targets that are unguarded most of the time. So those are the most suitable places for criminals and therefore the most likely places for potential crimes. PT facilitates inadvertently crime against persons where target density is crucial. Many people are moving on a small amount of space making it ideal for pick-pocketing and mugging. PT has another feature that makes crime more probable. People of different backgrounds are mixed including demographically high-crime-risk people (Cozens, et al., 2003).

From the research of Cozens et al. (2003) it was clear that people exhibited fears for their personal safety in relations to railway stations and their access routes. In general, females exhibited higher levels of fear than males in the same situation. Females are more concerned about their personal safety at the railway stations and males are especially concerned with their safety at car parks and for the security of the parked vehicle, particularly at night. Staffed railway stations were generally preferred because people felt that others could observe them and the other way around. The railway environment at night proved to be the most important personal safety fear. Better lighting and an open environment were the most frequently cited suggested improvement from the respondents in the research.

From the results of the research of Johansson et al. (2006) it turned out that safety was of insignificance importance in the transportation mode choice decision. This does not immediately mean that safety is considered unimportant in general, but it is an interesting result. The levels of the attributes could have been of influence on this result. The risk in general maybe is too small to discern the respondents. Bicyclist safety depends for the largest part on the safety of the route. The most important cycling facilities based on safety are that the route is away from traffic noise and pollution, and routes that are separated from other traffic. To make bicycle routes more safe and therefore more pleasurable to use, factors related to the built environment for cycling should be changed. Strong motivators to use a certain bicycle route are: separation from motor vehicle, ease of cycling, and pleasant route conditions. These motivators can be addressed in direct bicycle routes that are physically separated from other motorized traffic and has minimized gradients and cross sections (Winters, et al., 2011). Gender influences the frequency of bicycle usage. Women are less likely to use the bicycle as transportation mode than men. This is due to women being more concerned about safety while cycling, particularly from other vehicle traffic (Dill & Gliebe, 2008).

3.6.4 Convenience and costs

People seek a transportation mode for a journey using an acceptable amount of time, effort and money. Convenience and costs are in many researches the most important factors that influence the transportation mode choice. Modes that involve less cognitive effort to use are more desirable than modes that require the travelers to gather information. Having enough personal space and personal control over travel movement are also included in the convenience (Schneider, 2013). In the following parts of this chapter the most important and influencing convenience and cost factors are explained. The first factor that will be explained is travel time, followed by monetary costs, effects of unreliability and comfort.

Travel time

Each different mode of transportation has different travel time components from origin to destination, shown in Table 3. A single journey can include multiple modes of transportation.

Comparing total travel time of a journey between different transportation modes is not as simple as just add up all the different time components because people value time components differently (Wee, et al., 2013).

Table 3. Travel time components from origin to destination (Wee, et al., 2013)

Time-passenger transport			
Car	**Public transport**	**Bicycle**	**Walking**
Walking time to car park	Access mode	Time to get to bicycle storage location	Walking time
In vehicle travel time: • Free flow time • Congestion time	In vehicle travel time: • Travel time • Transfer time	Cycling time	
Time to find car park Walking time from car park to final destination	Egress mode	Time to store bicycle Time to get from bicycle storage facility to final destination	

As already mentioned speed is the principal customer need in a railway journey. Because the time perception within a railway journey is not constant, the sequence of elements are assessed differently. Hagen (2011) states that in a railway journey the 'in train time' is valued the highest, the 'access and egress time' are valued twice as low, and the transfer time three times as low (Wardman, 2004). Figure 18 visualizes the appreciation of time with 'time spent' on the horizontal axis and the 'value of time', the level of appreciation in the various elements, on the vertical axis. It is shown that the transfer element has the lowest appreciation and the access and egress elements are also appreciated low. So the trips to and from the train trip are not a useful way to spend time for travelers. A way to make the travelers experience less wasted time is by lowering the time spend to get to and from the railway station and for the transfers. But another way is to increase the value of the time by making the environment more pleasant which enhances the appreciation of the wait (Peek & Hagen, 2003; Peek, 2006).

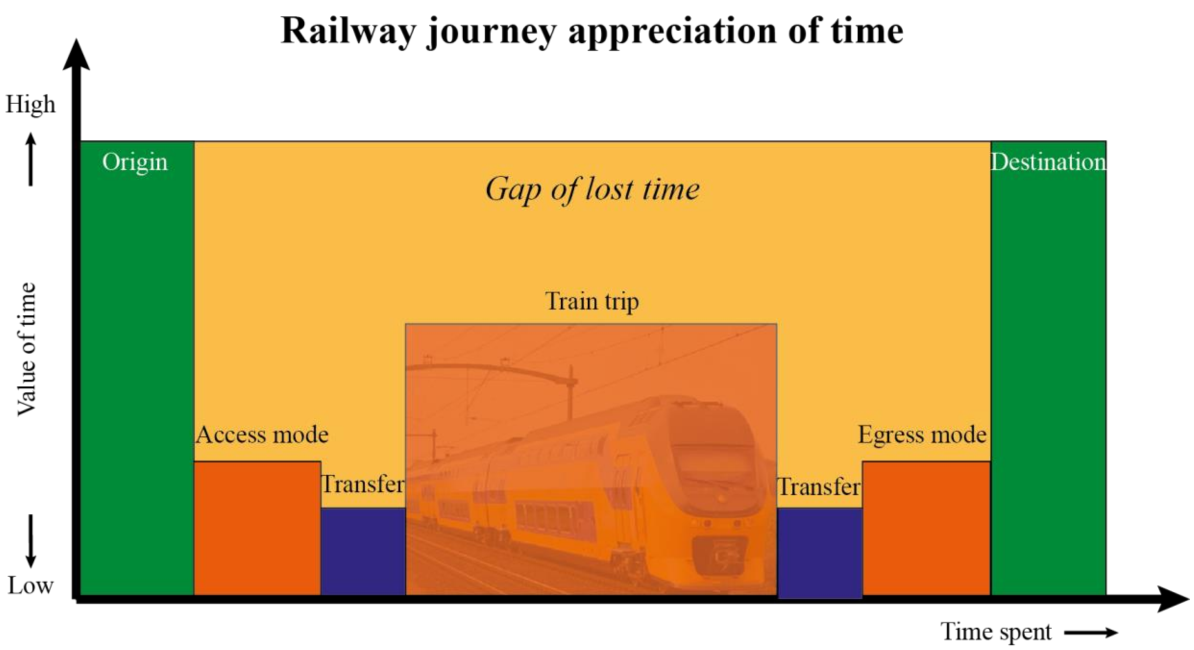


Figure 18. Railway journey appreciation time (Hagen, 2011).

Monetary costs

Monetary costs have significant influence on transportation mode choice decisions. Costs are always measured by travelers relative to the quality of the trip and the travel time. Whether and how much influence costs have on the transportation mode choice depends on the circumstances of the situation. Socioeconomic factors as well as characteristics of transportation modes affect the influence of costs on mode choices. The monetary costs that are incurred for a trip depend on the trip characteristics. Because of the significant differences between monetary costs for train and car these will be explained separately. Not only the direct costs of the main transportation modes need to be taken into account, but also the costs that occur alongside the use of these transportation modes.

The costs of a car trip can be divided into the costs that are caused by the usage of the car to make a trip, and the costs of ownership of the car. The ownership costs are comprised of maintenance, amortization, and taxes on ownership. These costs of ownership of the car are mostly not really considered when the car is used as transportation mode. Car ownership in the Netherlands is obvious in the Netherlands and owning one is not considered an extra expense in peoples transportation mode choice. The costs that are very much considered as an expense are the costs of the actual use. Especially fuel and parking costs have much influence on the transportation mode choice according to a research of Frank et al. (2008).

The costs of a railway journey also can be divided into two different parts, the actual costs of the train trip itself and the costs that is needed for the access and egress trip to and from the railway station. The costs of the train trip can be determined by the price of the ticket, these are very variable in the Netherlands due to discounts and different kinds of travel possibilities. According to Witte et al. monetary costs for traveling with public transport are very important, whether people can travel free with the public transport or not can make a huge difference in their transportation mode choice (Witte, et al., 2006). The costs of the access and egress trip depend on the transportation modes of these trips and the distance.

Effects of unreliability

According to Brons and Rietveld (2008) travel time reliability is one of the most important aspects of quality for railway travelers. If the travel time is more unreliable, the scheduling costs will be higher and the chance that the train is chosen as transportation mode is lower. Potential train users are scared in relation to reliability of the NS because of the many negative articles in newspapers and on the internet and stories of users of the Dutch railways. These people are not likely to start using the train in the near future because of that. Media and travelers are often very negative about the reliability in of the Dutch railways. But this is not completely right. The punctuality of the train trips in 2014 of the Dutch railways is 90.2 percent according to an investigation of ProRail and the Dutch ministry of infrastructure and environment (Mansveld, 2015). This means that of all train trips in the Netherlands only 10 percent has a delay of more than three minutes. With that given, the Dutch railways is one of the most reliable railways of Europe. Another situation is that commuters that use the train daily are confronted with decreasing reliability and therefore tend to choose a different transportation mode (Loon, et al., 2011).

Comfort

Johansson et al. (2006) conducted a research of a choice model, the survey data was used to construct and test the significance of five variables postulated to be important for transportation mode choice. The five tested variables are: environmental preferences, safety, comfort, convenience and flexibility. In the conclusions of their research is stated that comfort is very important for transportation mode choice. Comfort in this research is explained as follows; when the car is used as transportation mode, an active participation of the traveler in driving and navigation is required, which is not the case in public transport, also there are differences in the possibility to work and the space you have. So public transport has possibilities that are not available for car users. An important difference between public transport and car use is that public transport users do not have to drive the vehicle themselves as opposed to car users. Public transport travelers could carry out all kinds of tasks during their trips on public transport. Especially in the train these possibilities are endless. If traveling is seen as an activity, combining this traveling with another activity can be seen as multitasking. Multitasking in the car is limited to making phone calls and doing some thinking, while multitasking in the train can be al kinds of things, e.g. doing work on your laptop or watch a movie on a tablet or phone. The vast majority of the intercity trains in the Netherlands are equipped with free wifi (treinreiziger.nl, 2014), this internet connection enables multitasking in the train even more. In a research in Great Britain in 2007 already 30% of the train commuters used the time in the train to work or study, and this number has continued to grow ever since (Lyons, et al., 2007). Multitasking makes traveling by train far more valuable compared to other transportation modes because an increasing part of the in vehicle travel time becomes productive activity time e.g. (Kenyon & Lyons, 2007; Waerden, et al., 2009).

The complexity of a journey influences transportation mode choice also according to the research of Johansson et al. (2006). The car is flexible with route choices and changes in the route or plans. Therefore, individuals with a more complex journey that include organized car-sharing and household constraints such as picking up or dropping a child, and has possibly multiple stops, prefer the car as a mode of transportation (Scheiner, 2010; Ye, et al., 2007). Compared to alternative transportation modes car travel is generally perceived as more comfortable, flexible and better to support a busy lifestyle, it also is more private than public transport. The likelihood of choosing car over bus is increased by the presence of children in a household because of those advantages of the car (Johansson, et al., 2006).

Also at the railway stations comfort is important. The environment on railway stations influences the physical well-being of people. For many of the environmental stimuli there is a basic level at which most people feel comfortable. According to Hagen (2011) each railway journey has a comfort zone and an optimal point of arousal. The environmental stimuli are aspects as light, temperature, to little space or volume and tempo of music that is played. Too much of this environmental stimuli result in too high arousal, and to little is not comfortable either, this is visualized in the inverted U-curve in Figure 19. This optimal arousal theory is an optimal presentation of stimuli that leads to an optimally pleasant experience, the height of the line increases when the situation becomes more pleasurable. If there are too few or too many stimuli it will result in discomfort, a negative perception of the wait and a negative feeling. The physical uncomfortable situation not only influences the aspects of comfort more negatively, but it will also affect aspects that have nothing to do with comfort at all. People's reactions on each other and objects will become more negative which could result in disturbances (Apter, 2007). It is important for travelers to be in the comfort zone at railway stations. If they feel not comfortable traveling by train is will become far less appealing. The optimal arousal point and comfort zone are personal, so it has to be achieved that as many people as possible are in their comfort zone.

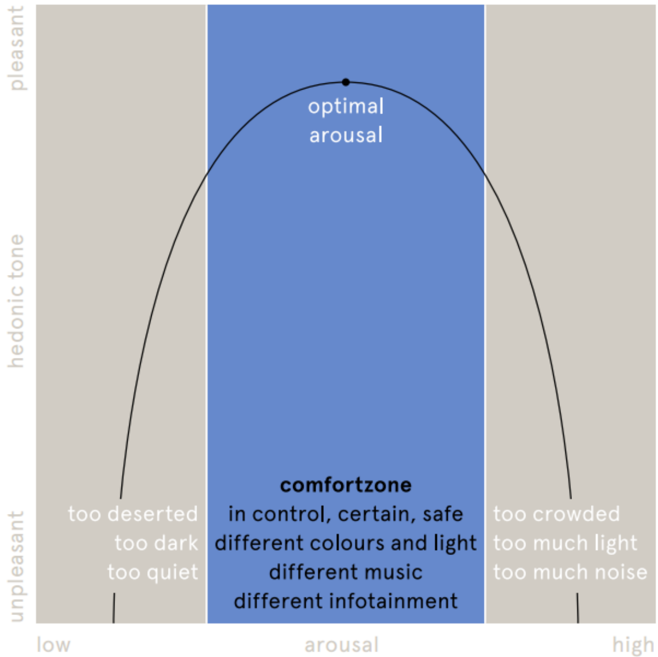


Figure 19. Railway journey appreciation time (Hagen, 2011).

3.6.5 Enjoyment

People tend to seek a transportation mode that provides personal, social or environmental benefits. This is captured in the term enjoyment. Personality traits and attitudes are important on transportation mode choice decisions. People's attitudes and personality traits can lead them to attribute variable importance to environmental considerations (Johansson, et al., 2006), therefore they consider using public transport instead of car. But public transport is considered to be a poor alternative for car use. Especially fervent car users do not like public transport. For them not only the instrumental function of the car outperformed that of the public transport. The car represents cultural and psychological values, they consider the car as a symbol of freedom and independence, a status symbol and driving is pleasurable. For these individuals car travel is appealing e.g. (Redman, et al., 2013; Steg, 2003).

3.6.6 Habit

Mobility in modern everyday life is deeply ingrained, so making transportation mode choices is an extremely repetitive type of behavior. Habitual behavior is formed by repetition of actions in a stable context in which the context is the environment where behavior takes place (Verplanken, et al., 2008). A study in the form of an online survey was conceived by Friedrichsmeier (2013) to research the influence of habit and the strength of habit on transportation mode choice. The results of this research indicate that the combination of behavior frequency and context stability is the main ingredient of habit and the strength of the habit is a product of these two (Wood, et al., 2005). If circumstances remain relatively stable, prior behavior makes a significant contribution to the decision making in the future, so habit is especially strong if the context is stable and the behavior frequency was high in the past. But if the context is changed and renewed, it can change behavior as a result of the cognitive regulated human behavior. So human social behavior is based on reason and can change, but habit do has influence on the transportation mode choice behavior e.g. (Bamberg, et al., 2003). So the strength of the habit is really well reflected by the frequency of past behavior. People with strong transportation mode habits are less likely to acquire information about alternative transportation mode options and conditions compared to people with weak habits (Verplanken, et al., 2008). Local land use and infrastructure, as well as personal characteristics have an effect on public transport user travel habits and which transportation mode they perceive as most desirable to use (Redman, et al., 2013).

3. 7 Conclusions

Due to tight spatial planning, Dutch infrastructure always has been regulated strongly. The consequences of these regulations over the past decades are that the infrastructure is very well structured and designed. Residents and industry are clustered in metropolitan areas. These dense built areas are connected with clustered connecting corridors that contains roads, rails and water infrastructure. These corridors make sure that cities are connected with high quality and high capacity roads and railroads. After the second world war the population grew tremendously, the economy changed and car ownership increased. These changes caused a de-concentration of land use in the Netherlands and therefore a decline in cycling, walking and the use of public transport. The increase of car use and decrease of alternative transportation modes has negative consequences for the environment. Governments are trying to limit that by designing policies that make alternative transportation modes more attractive and car use less.

The Dutch road network consist of three type of roads with each its own characteristics. The through roads are large roads that are designed to process through traffic as fast as possible. These roads mostly connect areas on a large distance from each other. Distributor roads are designed to distribute and gather the traffic coming from the through roads. The access roads are designed to provide direct access to lots. Together these type of roads make up the Dutch road network.

The Dutch public transport network is dense and well-coordinated. It has a hierarchical structure that consists out of different lines with own characteristics and capabilities. Besides these different lines, the public transport network also has different types of transportation modes that have its own characteristics. The most important public transport modes in the Netherlands are the train and bus.

The Dutch transportation network is now explained, which is useful for the research that will be conducted further on in the research. The characteristics of the Dutch transportation network will be included in the research and taken into account. The relevant transportation modes for the region of Eindhoven will be used in the research that is conducted in the region of Eindhoven. So the respondents will be able to identify to the situation and it is likely that they already have some experience with the transportation modes and journeys used in the research.

The demands of users of transportation modes depend on the type of transportation mode that is used. Both car users and public transport users find safety the most important. But in transportation mode choice this does not always have the most influence on the transportation mode choice. In most transportation mode choices, time and monetary costs have the largest influence. There is also a difference between push and pull factors that influence choices. Push factors discourage alternatives and therefore make a certain possibility more attractive, and pull factors encourage alternatives which make them more preferable. Push factors have proven to be more effective than pull factors, but push factors are not always desirable and cannot always be influenced.

Transportation mode choice depends on different factors. There are five steps in the transportation mode choice decision process. Besides habit there are four socioeconomic factors that influence the transportation mode choice. The first is that a person needs to be aware of the possibility of alternative transportation modes and whether those are available or not. Basic safety and security are always considered in the decision making, especially by women. The 'convenience and cost' of the journey is possibly the most important factor that influences the transportation mode choice. The final factor of influence is the amount of enjoyment people experience using a transportation mode. The socioeconomic factors like household and individual socio-demographics have a strong influence on the decision making. These factors often are influenced by, or a result of, residential location, neighborhood type and urban form. Therefore these spatial and urban factors play a prominent role in the decision of transportation mode choice (Frank, et al., 2008).

All the factors that influence transportation mode choice according to previous researches could influence transportation mode choices in the Netherlands. With the information about what could influence the transportation mode choice a research can be set up to investigate whether they actually have influence, and if they do how much. The factors that were discussed in Chapter 3.6 will be used to set up a research about the influence of transportation mode characteristics on transportation mode choice.

4 Model

4.1 Introduction

The stated preference experiment is based on a journey from the home of the respondents to one of the following large cities in the Netherlands: Utrecht, Amsterdam, Nijmegen, Arnhem, Heerlen, Maastricht, Rotterdam and Den Haag. All these cities are accessible by car, but also by train via the railway station of Eindhoven. A questionnaire will be designed to collect data of a specific target group. The content and structure of the questionnaire will be further explained in Chapter 4.2.5.

The research is designed for a specific target group that has to fit a certain profile. The experiment is about people that live in urban and suburban areas around the railway station of Eindhoven. The target group is residents from the following areas: Eindhoven (except the city center that is near the railway station), Veldhoven, Nuenen and Valkenswaard. All of those areas have a bus connection with the railway station of Eindhoven. The railway station is also reachable from these areas by car and bicycle. The focus of the research is to investigate what characteristics of pre-transport influence transportation mode choice and, if they do, to what extent. Therefore the research is designed specifically for this target group that has to make a choice between transportation and pre-transportation modes. The people that live in the previously described areas live at a distance from the railway station that makes the choices described in the experiment imaginable.

4.2 Research approach

4.2.1 Description of the Stated Preference experiment

Key to the experiment is the transportation mode choice. In the SP experiment the target group respondents will make a choice out of four different modes of transportation. Each alternative mode of transportation has attributes that characterize it.

The experiment consists of four transportation alternatives for making a travel, these are shown in Figure 20. The first alternative is the train as main transportation mode with the bus as mode of pre-transportation. Second is using the train with bicycle as mode of pre-transportation. The third alternative is the last one that has the train as main transportation mode, and has the car as a form of pre-transportation. The pre-transport of this alternative is divided into two different possibilities. The car is used to get from home to the railway station, at the railway station the car can be parked, or the traveler can be dropped off by someone. These are the two different forms of pre-transport with the car. Those are separated in the research because of the differences in characteristics of the two car trips. In the case of the drop-off no parking costs have to be paid, unlike when the car is parked at the railway station. The final alternative is to use the car for the journey instead of the train.

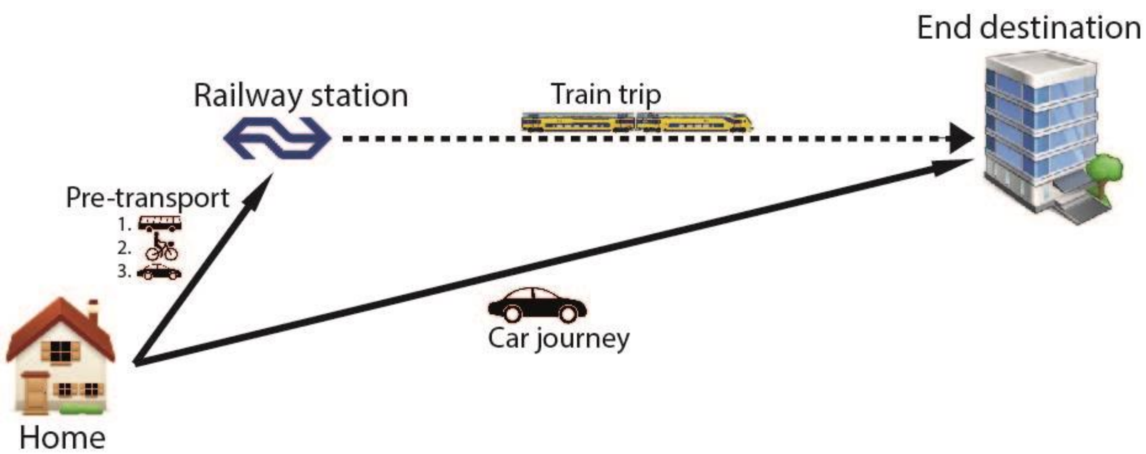


Figure 20. Different types of journeys that are included in the research.

For the SP experiment 81 profiles generated by fractional factorial design. The profiles are created by combining one of the three possible attribute levels for each attribute with each other. In each profile four alternative transportation mode options are presented from which the respondents has to choose one. With these profiles (Appendix A) the SP experiment can be conducted. Each respondent is presented with 9 random profiles in which they have to make a transportation mode choice. How the profiles are presented to the respondents will be explained in Chapter 4.2.5. Because of the amount of attributes and attribute levels that are included in the research, it is desirable that each of the 81 profiles is valuated about 40 times to make the research representable. Each respondent is presented with 9 profiles, so to desired minimal number of filled in questionnaires is (9*40)= 360.

4.2.2 Definition of attributes and attribute levels

A good stated preference experiment is one which has a comprehensive set of attributes and rich choice contexts. The attribute levels need to have enough variation to produce meaningful behavioral responses in the context (Hensher, 1994). A combined set of attributes describe what the different choices consists of. The attributes are chosen so that the respondents have to make tradeoffs between them. The attributes reflect possible motivations for the respondents in the given real choice situation. In the questionnaire it is made sure that the respondents understand the content of each attribute and the attribute levels in a clear and concise manner. All this is very important in order to assure the quality of the research (Kløjgaard, et al., 2012). Table 4 shows an overview of all attributes and corresponding attribute levels used in the choice experiment.

Table 4. Attributes, attribute levels and explanation of attribute levels included in the research

Attributes Train		
Attribute	*Attribute levels*	*Explanation to respondent*
In vehicle time (IVT)	45 minutes 50 minutes 55 minutes	The in vehicle time of the train is the time you spend in the train travelling from begin station to end station.
Waiting time (WT)	3 minutes 9 minutes 15 minutes	The waiting time is the time you have to wait on the railway platform till you can get on the train.
Costs of travel	10 euro 15 euro 20 euro	The costs of the travel with the train.

Chance of delay	5 percent 10 percent 15 percent	The chance that the train has a delay during the travel.
Safety	No additional measures Additional security cameras Additional security cameras and staff	What safety measures are present at the railway station.
Possibility to work	No additional facilities Personal work tables Special work cabins	The train can have facilities that improve the possibility to work in the train.
Attributes Car		
Attribute	*Attribute levels*	*Explanation to respondent*
In vehicle time (IVT)	50 minutes 60 minutes 70 minutes	The in vehicle time of the car is the time you spend in the car travelling from home to the end destination.
Parking search time (PST)	3 minutes 9 minutes 15 minutes	The time you need to find a parking spot.
Costs of travel	10 euro 14 euro 18 euro	The costs of the travel with the car.
Parking costs	2 euro per hour 4 euro per hour 6 euro per hour	The costs of the parking facility at the end destination per hour.
Chance of congestion	10 percent 20 percent 30 percent	The change that you suffer from congestion during the travel with the car.
Safety	No additional measures Additional security cameras Additional security cameras and staff	What safety measures are present at the parking facility where your car is parked.
Attributes Bus		
Attribute	*Attribute levels*	*Explanation to respondent*
Time to get to bus stop	1 minutes 4 minutes 7 minutes	The time you need to get from home to the bus stop.
In vehicle time (IVT)	15 minutes 20 minutes 25 minutes	The in vehicle time of the bus is the time you spend in the bus travelling from begin stop to end stop.
Time to get to railway platform	1 minute 3 minutes 5 minutes	The time you need to get from the bus to the railway platform.
Costs of travel	1 euro 2 euro 3 euro	The costs of the travel with the bus.
Chance of delay	0 percent 15 percent 30 percent	The chance that the bus has a delay during the travel.
Type of bus	Regular bus Express bus Shuttle bus	The regular bus stops regularly. The express bus has less stops and the shuttle bus travels directly to the railway station.
Safety measures	No additional measures Additional security cameras Additional security cameras and staff	What safety measures are present at the bus stops.
Safety level of the environment	Low Moderate High	The safety of the environment is the presence of enough light, flight routes and physical openness at the bus stops.
Attributes Bicycle		

Attribute	*Attribute levels*	*Explanation to respondent*
On vehicle time	20 minutes 25 minutes 30 minutes	The on vehicle time of the bicycle is the time you need to cycle from home to the railway station.
Time to get to railway platform	2 minutes 4 minutes 6 minutes	The time you need to get from the bicycle parking to the railway platform.
Costs of parking bicycle	0.50 euro per time 1.00 euro per time 1.50 euro per time	The costs of the parking facility at the railway station per time.
Chance of delay	0 percent 5 percent 10 percent	The change that you suffer from any form of delay during the travel with the bicycle.
Safety measures	Bad presence of cycling facilities Moderate presence of cycling facilities Good presence of cycling facilities	The safety measures for the bicycle is about the cycling facilities that are present on the cycling route. Good cycling facilities are separate cycle paths and priority intersections.
Safety level of the environment	Low Moderate High	The safety of the environment is the presence of enough light and physical openness on the bicycle paths.
Attributes Car/drop-off		
Attribute	*Attribute levels*	*Explanation to respondent*
In vehicle time (IVT)	10 minutes 15 minutes 20 minutes	The in vehicle time of the car is the time you spend in the car travelling from home to the railway station.
Time to get to railway platform	2 minutes 5 minutes 8 minutes	The time you need to get from the parking facility or drop-off place to the railway platform.
Costs of parking car	3.00 euro per day 3.50 euro per day 4.00 euro per day	The costs of the parking facility at the railway station per day.
Chance of delay	0 percent 10 percent 20 percent	The change that you suffer from any form of delay during the travel with the car.
Safety measures	No additional measures Additional security cameras Additional security cameras and staff	What safety measures are present at the parking facility or the place you are dropped off by car.
Safety level of the environment	Low Moderate High	The safety of the environment is the presence of enough light, flight routes and physical openness at the parking/drop-off facilities.

4.2.3 Included attributes

For each transportation mode attributes are determined separately due to the difference in characteristics of transportation modes. In total 32 attributes are formulated in the research. In this chapter all the attributes for each transportation mode will be explained in more detail. Many attributes are included in the research, because the goal of the research is to find out which characteristics of the pre-transport modes that is used, influence transportation mode choice. Therefore all attributes that have their own characteristics are used separately and are not combined into more general attributes. The goal is to gain detailed knowledge about the pre-transportation mode characteristics and their influence on transportation mode choice. Also attributes about the train trip and car trip are included to check whether the characteristics of the pre-transport are more or less of influence on the transportation mode choice. This is done to exclude the possibility that the transportation mode choice is based purely on characteristics of the train trip versus the characteristics of the car trip.

First all the attributes of the **train** as transportation mode will be explained. Six attributes are formulated for the train trip. Time is divided into two different attributes, the *in-vehicle time* (IVT), the time that is spend in the train during the train trip, and the *waiting time* (WT), the time it takes before you can enter the train . Time is divided into different attributes because WT has a different valuation than the IVT. This is due to the stress and frustration that is involved in waiting. Also less productive use can be made of WT and it involves more effort and less comfort than seated on a vehicle like during IVT (Abrantes & Wardman, 2011; Wardman, 2004). *Costs of travel* are the total monetary costs of the train trip from the railway station of Eindhoven to the railway station of the city that is the end destination. These costs are generally an important factor of transportation mode choice (Frank, et al., 2008). A train trip also has a *chance of delay* that is of influence when people consider using the train. The uncertainty of the travel time of a trip may be of influence on the transportation mode choice of the traveler (Brons & Rietveld, 2008). *Safety* is an attribute that is definitely something that is considered when the train is used as a form of transportation. Security and traveler safety measures could reduce crimes against persons and vandalism. People will travel less often or not at all with the train if they think it is not safe enough for them. So safety measures could be of great influence in a transportation mode choice e.g. (Balcombe, et al., 2004; Carr & Spring, 1993; Cozens, et al., 2003; Power & Barnes, 2011). *Possibility to work* during the train trip has become more important with the introduction of laptops, smartphones and Wi-Fi in the Dutch trains. The importance of comfort of vehicles that give the opportunity to use travel time productively has increased significantly over time (Abrantes & Wardman, 2011).

Second, the attributes of the **car** as transportation mode for the journey will be discussed. Six attributes are formulated for the car. Again, two different time related attributes are defined. The *in-vehicle time* (IVT), the time to get from home to the end destination in the car. At the end destination the car has to be parked somewhere, the time to find a parking spot at the end destination is the *parking search time (PST)*. These two attributes both indicate time, but are separated attributes because the valuation of time is different in both cases. Most car users value the time to find a parking space of much lower quality than the IVT (Abrantes & Wardman, 2011). The *costs of the travel* are an important factor in the decision making for each journey (Frank, et al., 2008). *Parking costs* are important as well, the difference with the travel costs is that parking costs are per hour. If the car has to parked somewhere an entire day this attribute will weigh higher than the visit is of short duration. The *chance of congestion* is an important attribute because time that is lost due to congestion is time that is considered of very low quality (Abrantes & Wardman, 2011). The stress in the car of driving associated with traffic congestion is often a problem and a motivating factor for using public transport (Beirao & Cabral, 2007). The attribute *safety* for the car refers to safety measures at parking lots. Especially certain population groups find it of significant importance that a the place where the car is parked is safe for them and their car e.g. (Cozens, et al., 2003; Lake & Townshend, 2012).

Now the attributes of the three forms of pre-transport will be discussed, beginning with the **bus**. The time it takes to get from home to the railway platform is divided into three attributes of time that each have their own valuation. The *time to get from home to the bus stop* is the first. This attributes involves the time to get from home to the bus stop and the wait time at the bus stop before the bus arrives. This access time is valuated at a very low quality and therefore separated from the other attributes that are about time (Abrantes & Wardman, 2011). The *in vehicle time* is the time that is spend in the bus during the bus trip from the bus stop to the railway station. The *time to get to the railway platform* is the time it takes to get from the bus to the railway platform. This is a short walking time that has a real different valuation from the other two attributes about time. This walking time is considered low quality, but with low uncertainty (Abrantes & Wardman, 2011). *Costs of travel* are the total monetary costs of the bus trip from the bus stop to the railway station. Monetary cost is generally an important factor of transportation mode choice (Frank, et al., 2008). When the bus is used as form of transportation, there is a *chance of delay.* According to Brons and Rietveld (2008), travel time reliability is one of the most important aspects of quality for public transport trips. The uncertainty of the travel time because of the chance of delay during a trip may be of influence on the transportation mode choice of the passenger. In the region of Eindhoven three different *types of public busses* drive to the railway station. Every bus has its own advantages and disadvantages. The type of bus could be of influence on whether a traveler wants to use the bus or not. *Safety measures* is an attribute that is definitely something that is considered when the bus is used as a form of transportation. Security and traveler safety could reduce crimes against persons and vandalism. People will travel less often or not at all by bus if they think it is not safe. So safety measures could be of great influence in a transportation mode choice e.g. (Balcombe, et al., 2004; Carr & Spring, 1993). Besides the safety measures also the *safety level of the environment* is added as an attribute. This attribute describes the characteristics of the environment that enhance safety on the bus and bus stops. These characteristics that enhance safety are lighting, the presence and visibility of flight routes and openness of the environment (Carr & Spring, 1993; Cozens, et al., 2003).

The **bicycle** as form of pre-transport has attributes that are deviating from the other forms of transport because it is a non-motorized vehicle with other characteristics. The first attribute is the *on vehicle time* of the bicycle. The time it takes to get from home to the railway station. In this attribute the time to get the bicycle is included in the trip time. At the railway station the bicycle has to be parked and the traveler has to get from the bicycle parking to the railway platform. Both things are included in the attribute *time to get to railway platform*. This parking and walking time has a different valuation from the on vehicle time and therefore is a different attribute (Frank, et al., 2008). The attribute *costs of parking the bicycle* is the costs per time the bicycle is parked. This amount is not very much, but it has to be included as an attribute to complete the whole and check whether it influences transportation mode choice. The *chance of delay* with the bicycle is the chance that the trip takes longer than planned. This can be due to a whole range of reasons, e.g. headwind, traffic lights or busy traffic. The *safety measures* for the bicycle are different from the other transportation modes. The safety measures for the bicycle are the measures that are taken to make the bicycle route safer and more accessible. For cyclists it is not safe to cycle between cars and cross intersections without traffic lights or other facilities for the bicycle. So the safety measures for the bicycle are about the presence of bicycle facilities like separate cycle paths and priority intersections. If these bicycle facilities are better, more people will use them e.g. (Dill & Carr, 2003; Dill & Gliebe, 2008; Schneider, 2013; Winters, et al., 2011). The *safety level of the environment* is about the environment cyclist have to cycle in. Cyclist rather not cycle through dark alleys and remote tunnels. This attribute describes the characteristics of the environment that have an influence on the safety. This includes the safety at the bicycle parking of the railway station, people don't want their bicycles to be stolen, this could withhold them from using the bicycle as a transportation mode (Cozens, et al., 2003; Rietveld, 2000).

The **car** as form of pre-transport requires some further explanation. The car could be used to get dropped off at the railway station by someone else. So the car does not have to be parked at the railway station. Or the traveler can be the driver of the car which makes it necessary to park the car at the railway station. The only difference between these two possibilities is the costs, parking costs money and the drop-off does not. The time to get from home to the railway platform is divided into two attributes of time with each their own valuation. The *in vehicle time* is the time that is spend in the car during the trip from home to the parking or kiss and ride at the railway station. The *time to get to the railway platform* is the time it takes to get from the car parking or the kiss and ride to the railway platform. This is a short walking time that has a real different valuation from the in-vehicle time. This walking time is considered to be of lower quality, but with low uncertainty (Abrantes & Wardman, 2011). The *chance of delay* due to congestion is an important attribute because time that is lost due to congestion is time that is considered of very low quality. The stress in the car of driving associated with traffic congestion is often a problem and a motivating factor for using public transport (Beirao & Cabral, 2007). The attribute *safety measures* refers to safety measures at the parking lot or the kiss and ride at the railway station. Especially certain population groups find it of significant importance that a the place where the car is parked or the traveler is dropped off is safe (Cozens, et al., 2003; Lake & Townshend, 2012). Besides the safety measures also the *safety level of the environment* is added as an attribute. This attribute describes the characteristics of the environment that enhance safety in the parking lots and at the kiss and ride location. These characteristics that enhance safety are lighting, the presence and visibility of flight routes and openness of the environment (Carr & Spring, 1993; Cozens, et al., 2003).

4.2.4 Included attribute levels

When determining the appropriate levels for each attribute it is important that the levels must be relevant and easy to comprehend. Besides that the levels must have a range that captures and ensures tradeoffs between attributes while still being reasonably realistic and acceptable to the respondents e.g. (Fowkes & Wardman, 1988; Hensher, 1994; Kløjgaard, et al., 2012). All attribute levels are based on a journey from home to one of the eight cities that are involved in the research. So the attribute levels are assumable values for that type of journeys. Each attribute has three attribute levels. Three levels are enough to cover the possibilities and to determine the influence of certain attributes in the experiment. Including more attribute levels would provide too little advantage and cause the experiment to become very complex unnecessary.

For each attribute that is related to '**time**', the levels were determined as follows. The value of the middle level is the value that is a probable and realistic mean for the indicated attribute trip. The highest level is a probable scenario in which the trip takes a little longer than usual. The lowest level is a probable scenario in which the trip takes a little less time than usual. So for each attribute that involves time, the middle value is the time that is probably takes, and there is a range to involve the fact that a trip can take a little bit more or a little less time than usual, depending on different factors. The lower and upper level capture and ensure tradeoffs between attributes by the respondents. The range is equal from the middle level to the upper and lower level, which is useful to investigate the relationships.

Several attributes are related to '**costs'**, the levels of these attributes are chosen similarly to the attribute levels for time related attributes. The middle value represents a probable and realistic mean for the costs for the attribute. A realistic range is set with a level of higher and a level of lower costs than the mean.

The attribute '**chance of delay'** has different level for each transportation mode. The punctuality of the train trips in 2014 of the Dutch railways is 90.2% according to an investigation of ProRail and the Dutch ministry of infrastructure and environment (Mansveld, 2015). This means that the *chance of delay for a train* trip in the Netherlands is about 10 percent. This is the middle level of the attribute chance of delay for the train. This attribute has a lower level of 5 % and upper level of 15 % to research how respondent will react on specific scenarios. A report from the Dutch national road network states that the past few years the reliability of travel time was about 90% average in the country. The journeys in the research are all relatively long trips to the center of a large city in the Netherlands, congestion in the Netherlands appears mostly around big cities. As a result the *chance of congestion for car users* is set on the three levels 10%, 20% and 30% (Lint, 2005; Ministerie van Infrastructuur en Milieu (2), 2014). The chance of delay for car users as a form of pre-transport is less high than the chance of delay for people who make much longer trips to other cities because the chance of congestion rises as a trip becomes longer. The levels for the *chance of delay for the pre-transport by car* is set to 0%, 10% and 20%. For the bus travel the chance could be lower but the range is higher because busses not only have to deal with congestion like cars do, but also with passengers getting off and on the bus. So an extra variable is included in the chance of delay of busses. Therefore the levels for the *chance of delay for pre-transport by bus* is set to 0%, 15% and 30%. The last form of pre-transport is the bicycle. When traveling by bicycle there are not many factors that cause a delay, because with the bicycle you are much more flexible in route choice and you are able go around congested areas. Therefore the levels for *chance of delay for pre-transport by bicycle* is set to 0%, 5% and 10%.

In the Eindhoven area three '**types of bus'** are used by the regional bus company. The regular bus is the most used bus, this type of bus stops regularly at bus stops to let passengers get in and out of the bus. The express bus drives the same route as the regular bus but with less stops. The shuttle bus is a bus that drives straight from the bus stop the passenger gets on the bus to the railway station. So the levels of bus type are regular bus, express bus and shuttle bus.

The attribute **'safety measures'** has the same three levels for the *train, car, bus and car/drop-off.* In these cases the attribute has three levels that indicate the amount of safety measures. The first level is that there are no additional safety measure, the second level indicate that additional security cameras are installed and the third level has security staff alongside the additional security cameras. For the *bicycle* the attribute has three different levels. The safety measures for the bicycle are an indicator for the amount of bicycle facilities on the bicycle route from home to the railway station. Three levels of facilities are stated; a bad presence of cycling facilities, a moderate presence of cycling facilities, a good presence of cycling facilities.

The **'safety level of the environment'** is the last attribute, all forms of pre-transport have this attribute. The attribute has the same levels for each form of pre-transport. The levels indicate the presence of facilities that give a safe feeling. There is a low level, a moderate level and a high level of presence.

4.2.5 Questionnaire design

Because the questionnaire is designed for a specific target group in the Netherlands, the questionnaire is completely in Dutch. The questionnaire consists of three different parts, each part has a particular purpose. The first part is about the current travel behavior of the respondent, the second part is the stated preference experiment and the third and final part are some personal questions. The total questionnaire can be found in Appendix B.

The first part is intended to find out what the current travel behavior of the respondents is. First the is asked whether and how often the respondents make a travel in the direction of one or more of the following cities:

- Utrecht
- Amsterdam
- Nijmegen
- Arnhem
- Heerlen
- Maastricht
- Rotterdam
- Den Haag

When the respondent never makes the travel in the direction of one of these cities he/she is not included in the research because he/she is not likely to understand the situation good enough to make a valuable contribution. For each travel behavior characteristic it is mentioned what reasoning lead to their inclusion in the questionnaire. The following respondent's travel behavior characteristics are included in the research:

1. **Current travel behavior**: How often do the respondents make the travel to one or more of the mentioned cities.

The levels of this attribute are:

- Never
- Sometimes
- Regular
- Often

2. **Purpose of the travel**: What is per city the purpose of the travel to the cities.
The levels of this attribute are:
    - Work
    - Study
    - Recreation
    - Other
3. **Transportation mode of the travel(s)**: What is/are per city the main transportation mode(s) that are used for the travel to one or more of the mentioned cities.
The levels of this attribute are:
    - Car
    - Train
    - Other
4. **Pre-transportation mode**: If the train is used as transportation mode in de previous question. What mode of pre-transport is used the most to get from home to the railway station.
The levels of this attribute are:
    - Bus
    - Quality public transport (Phileas)
    - Taxi
    - Car drop-off (getting dropped off at the railway station by car)
    - De car (park near railway station)
    - Bicycle
    - Variably

In the second part of the questionnaire the stated preference experiment is conducted. Before the questions about the transportation mode choice are asked there is a comprehensive explanation of the situation and of the used attributes and attribute levels. There also is an example question as a check for the respondents whether they understand everything or not. The respondent has to fill in this example question so they are required to read the table and explanations to provide a well-considered answer. At this point in the questionnaire it is still easy to go back to the page with the explanation of the attributes and attribute levels. This example question will not be part of the research results of the experiment, it serves only as a check for the respondents. It is useful for the respondents to check for themselves whether they understand the choice tasks they are presented with.

So after the explanation of the attributes and attribute levels the respondents will be presented with choice tasks in which they each time have to choose one of the four presented alternatives. Figure 21 shows an example of a choice task in the questionnaire. The left column of the table shows the attributes and the lines in the table with an azure blue background show the modes of (pre-)transportation of the alternatives. The texts that are not bold in the table show the levels of the attributes that apply to the alternatives shown in this choice task. At the bottom of the table there is a line with grey background, in this line the respondents have to fill in the alternative they prefer. Each alternative is represented by a column in the table. From the left to the right in the table the following alternatives are presented: The first alternative is using the train with bus as mode of pre-transport. Second is using the train with bicycle as mode of pre-transport. The third alternative is the last one with train as main transportation mode, this one has the car as a form of pre-transport. The last alternative is to use the car for the journey instead of the train. The first three columns share a column in the upper part of the table, this upper part shows the attribute levels for the train part of the journey. The three columns below show the attribute levels of the pre-transport of the alternatives.

Vervoermiddelkeuze en voortransport

Vink onderaan in de tabel de vervoersoptie aan die uw voorkeur heeft.

Kenmerken	Trein			Auto
Reistijd in het voertuig	55 minuten			60 minuten
Wachttijd/zoektijd naar parkeerplaats	15 minuten			3 minuten
Kosten trein-/autoreis	18 euro			10 euro
Kosten parkeren auto				4 euro per uur
Kans op vertraging	15 procent			20 procent
Veiligheid	Extra bewakingscamera's			Geen maatregelen
Mogelijkheid tot werken	Geen maatregelen			
	Voortransport			
	Bus	Fiets	Auto drop-off /parkeren	
Tijd om bij halte te komen	1 minuut			
Reistijd in/op het voertuig	25 minuten	25 minuten	20 minuten	
Tijd om op het perron te komen	5 minuten	4 minuten	2 minuten	
Rit-/stallingskosten	2 euro	1.50 euro per keer	3.50 euro per dag*	
Kans op vertraging	30 procent	10 procent	20 procent	
Bustype	Gewone bus			
Veiligheidsmaatregelen	Extra bewakingscamera's en beveiligingspersoneel	Gemiddelde aanwezigheid fietsvoorzieningen	Extra bewakingscamera's en beveiligingspersoneel	
Veiligheidsniveau omgeving	Gemiddeld	Laag	Hoog	
Uw voorkeur	○	○	○	○

* Dit tarief geldt enkel indien u uw auto in de buurt van het station parkeert.

Vorige | **Volgende**

Figure 21. Choice task in questionnaire.

All the attributes and attribute levels that characterize the choice task that is shown are ordered carefully to make the complex choice task as clear as possible for the respondents. The fact that Dutch people read from left to right and from the top to the bottom is taken into account in the design of the shown choice task. From the top, first the numerical attributes that are related to time are given, after that the monetary attributes, the chance on delay and finally the textual attributes are presented. Also the attributes related to time are logically ordered, the sequence is the same as it would be in an actual journey.

In the third and final part of the questionnaire some personal characteristics of the respondents' situation are asked. The personal questions are also used to check whether the respondents group is representable for the Netherlands and give insights in the personal characteristics of the respondents. The personal questions are asked at the end because the respondents are almost done with the questionnaire and the focus may be a little bit less than before. The personal questions are only facts and therefore easy to fill in for the respondents. In the begin of this part it is made clear that the answers will be processed anonymously and will not be traced back to a specific home or person. For each personal characteristic it is mentioned what hypotheses lead to their inclusion in the questionnaire.
The following respondent's personal characteristics are included in the research:

1. **Gender**: Male travelers will find other attributes more important than female travelers, e.g. safety and security is a major concern to female travelers while this is less of importance for male travelers (Cai & Combrink, 2007; Fleickert, et al., 2006).

The levels of this attribute are:

- Male
- Female

2. **Age**: Travelers with different ages will find other attributes more important. Older travelers are less willing to walk longer distances and do not want to face the difficulties of using the public transport (Schmöcker, et al., 2008).

The levels of this attribute are:

- Younger than 20 years
- 20-29 years
- 30-39 years
- 40-49 years
- 50-64 years
- 65 years and older

3. **Education**: Lower-educated people will probably think more in costs because in general they have less money to spend. While some better-educated people have no concern in costs and think more about their reputation. They consider the car as a symbol of freedom and independence, a status symbol (Steg, 2003).

The levels of this attribute are (Ministerie van Onderwijs, Cultuur en Wetenschap, 2014):

- Primary education
- Secondary education
- Secondary vocational education
- Higher professional education
- Scientific education (University)
- Other, namely:

4. **Free travel public transport**: Whether people can travel free with the public transport or not can make a huge difference in their transportation mode choice (Witte, et al., 2006). In the Netherlands some people can travel for free sometimes (during the week or during the weekend) and some people always can travel for free.

The levels of this attribute are:

- Always
- Sometimes
- Never

5. **Possibility to travel by car**: If people do not have any car available to travel with it could influence their decision of transportation mode. Car ownership does not cover it all because some people do not own a car and still have the possibility to travel by car.

The levels of this attribute are:

- Always
- Sometimes
- Never

6. **Possibility to travel by electric bicycle**: If people do not have an electric bicycle available to travel with it could influence their decision of transportation mode.

electric bicycle ownership does not cover it all because some people do not own a electric bicycle and still have the possibility to use one.

The levels of this attribute are:

- Always
- Sometimes
- Never

7. **Postal code of home**: The choice of pre-transportation mode depends on the environmental area of the home of the respondent and the distance from their home to the railway station (Brons, et al., 2009; Givoni & Rietveld(2), 2007; Keijer & Rietveld, 2000).

This attribute has no levels. The respondent should fill in the first four numbers of the postal code of their home address. These first four numbers indicate the region and the district the home is located in.

8. **Household composition**: The composition of a household could be of significant importance in a transportation mode choice. The car is flexible with route choices and changes in the route or plans. Therefore, individuals will be influenced when they have a more complex journey that include organized car-sharing and household constraints such as picking up or dropping a child could (Scheiner, 2010).

The levels of this attribute are:

- Single (including living with roommates)
- Living at home with parents
- Single with children living at home
- With partner without children living at home
- With partner and with children living at home

4.2.6 Data collection

The data for the SP experiment is not randomly collected. Because of the design of the research, the data will be collected from a specific target group. The target group of the experiment is specific, residents from the urban and suburban areas around the railway station of Eindhoven. Veldhoven, Nuenen, Valkenswaard and the city of Eindhoven except for the city center are areas around the railway station of Eindhoven that have a bus connection, car connection and bicycle connection with the railway station of Eindhoven and do not have another railway station nearby. The target group is chosen because of the following reasons. First, the selected people have to use a certain pre-transportation way to get to the railway station if they use the train as transportation mode. Therefore the pre-transport affects the transportation mode choice of these people. When a decision has to be made whether to use the train or car for a journey, the pre-transport will be taken into account. Second, there is no other large railway station present in any of the areas of the target group. So when the train is used as transportation mode, they are presumed to use a form of pre-transport to the railway station of Eindhoven. Third, the distance between the respondents and the railway station of Eindhoven is from about one to 17 kilometers. Within this range three forms of pre-transport are most likely to be used, the bus, bicycle or car. The postal code of the respondents will be asked in the questionnaire, so the transportation mode and possibly the pre-transportation mode choice can be linked to geographical characteristics of respondents.

The respondents for the questionnaire are selected from the market panel of PanelClix. PanelClix is an international organization that manages and built a panel for survey researches. On their website they state that the online panel is really large and diverse so that for every research they can use an appropriate and reliable group of respondents. For each survey PanelClix compiles a sample group that is determined on the basis of three demographical dimensions, gender, age and residence region. These demographical characteristics can be elaborated with more characteristics if necessary (PanelClix, 2015). For this research, the sample of respondents consists out of people with different demographic characteristics that live in the predetermined areas. The demographic characteristics of the respondents are asked in the questionnaire and are known because of the setup of the research. The minimal amount of filled in questionnaires that is aimed for is 360.

The selected target group could be a representation of people living in the region of other large cities that are like Eindhoven. So this study of Eindhoven will not only give insight in the preferences of the people of this target group, but also show the probable behavior of people in a similar situation.

4.3 Analysis

4.3.1 Respondents per area

The desired number of filled in questionnaires for the research was 360 as explained in Chapter 4.2.1. The total number of respondents is 415, which is sufficient to get reliable results. The diagram in Figure 22 shows the distribution of distances of residences from the railway station of respondents that filled in the questionnaires. It shows the amount of questionnaires that were filled in per distance category from the railway station. The table with the exact frequencies and percentages of filled in questionnaires per postal code is shown in Appendix C. Most houses of respondents lie at a distance from the railway station that makes it necessary for them to use a form of pre-transport to get to the railway station when they use the train. This is of interest for the research because it is important that respondents are able to identify with the situations that are presented in the Stated Preference experiment. Only a few respondents live closer than one kilometer from the railway station. It is less assumable that those respondents use a form of pre-transport to get to the railway station, and travelers that do not use pre-transport are less interesting for the research. Most respondents live between 1 and approximately 5 kilometers from the railway station, this is the most interesting group of respondents because each form of pre-transportation that is included in the research is suitable for a trip of that length.

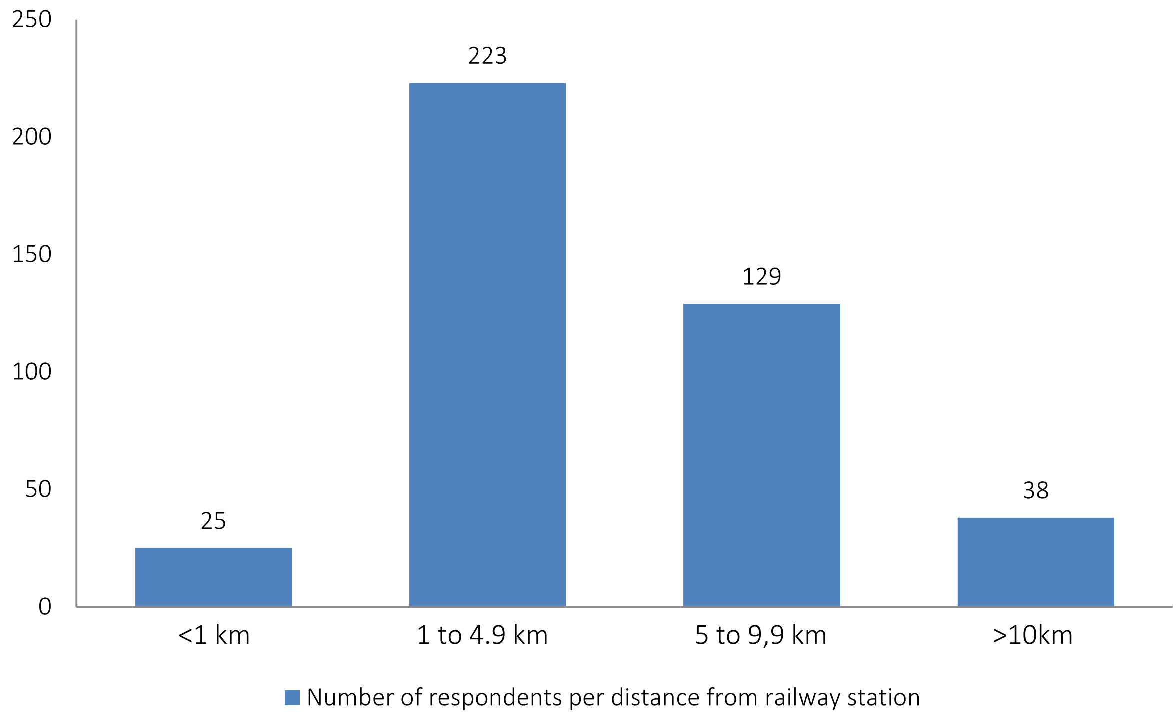


Figure 22. Distribution of filled in questionnaires by respondents.

4.3.2 Sample description

The questionnaire contained questions about the personal characteristics of the respondents. With the results of these personal information, the characteristics and the composition of the group of respondents is determined. In this chapter the results of the personal information of the respondents will be verified to show what people represent the research results. These results will be compared with the composition of the Dutch population to verify whether the respondents' group is a good representation for the rest of the Netherlands. Insights in the personal characteristics of the respondents show whether the results of the research also will be relevant to other areas.

The *gender* of the respondents and the total of the Netherlands are shown in Table 5. Man and women are distributed respectively 49.5 to 50.5 percent in the Netherlands, in the region of Eindhoven where the research is conducted there are slightly more men than women (CBS, 2014). The distribution of men and women in the research of the thesis is respectively 45.5 to 54.5 percent, which is a quite good representation of the national distribution. The comparison of the distribution in the research and the Netherlands is shown in Table 5. The complete output table of gender from SPSS is shown in Appendix D.

Table 5. Comparison of gender between research and national characteristics

Gender	Frequency	Research (%)	Netherlands (%)*
Male	189	45.5	49.5
Female	226	54.5	50.5
Total	415	100.0	100.0

* Source: (CBS, 2014)

Table 6 shows the distribution of *age* in the Netherlands in 2014 according to the Central Bureau of Statistics (2014). The distribution of the research deviates from that of the Netherlands. The main reasons for that, are the choice of the target group of the research and the users of panelclix that filled in the questionnaires. The most notable difference is the age group under twenty years old. This is due to the target group of the respondents. For the research, respondents under 18 years old are not interesting because they do not have the choice of using the car as transportation mode. So therefore the group of respondents under twenty years old is very small. The other age groups are relatively well distributed compared to the Netherlands. The complete output table of age categories from SPSS is shown in Appendix E.

Table 6. Comparison of age between research and national characteristics

Age category	Frequency	Research (%)	Netherlands (%)*
Younger than 20 years old	12	2.9	22.9
20 till 39 years old	126	30.4	24.5
40 till 64 years old	213	51.3	35.3
65 years and older	64	15.4	17.4
Total	415	100.0	100.0

* Source: (CBS, 2014)

The *level of education* of the respondents and the total of the Netherlands are shown in Table 7. The respondents' level of education is for the greatest part acceptable distributed. Compared to the total of the Netherlands there are less people with a very low education and also less people with a university education. But the respondents are not just people of one of the educational levels, therefore it represents the Netherlands quite well. In the region of Eindhoven the educational level is a little higher than in many other areas of the Netherlands, so the differences compared to the Netherlands were expected. The complete output table of educational levels from SPSS is shown in Appendix F.

Table 7. Comparison of level of education between research and national characteristics

Educational level	Frequency	Research (%)	Netherlands (%)*
Lower education and other	192	46.3	66.0
Higher professional education	173	41.7	21.0
University education	50	12.0	13.0
Total	415	100.0	100.0

* Source: (CBS, 2014)

The different *household types* of the respondents and of the Netherlands are shown in Table 8. The research represents the Dutch household types quite well. The national distribution is only slightly different from the deviation of households in the research. The respondents' households have a little less single households and more households with a partner. Within the partner household there are relatively more households without children and less households with children. The last group that was involved in the research was 'living at parents' home', this group is in the national distribution part of the one parent family type and the partnership with children type. It was a separate group in the research because this group has obvious different characteristics. The complete output table of household types from SPSS is shown in Appendix G.

Table 8. Comparison of household types between research and national characteristics

Household type	Frequency	Research (%)	Netherlands (%)*
Single household	114	27.5	36.0
One parent family	22	5.3	7.0
Partnership (of which:)	257	61.9	57.0
• without children	• 159	• 38.3	• 29.0
• with children	• 98	• 23.6	• 28.0
Living at parents' home	22	5.3	/
Total	415	100.0	100.0

* Source: (CBS, 2014)

The research reached the target group that was aimed for, people that live on a distance from the railway station that ensures a pre-transport trip when the train is used. The respondents that participated in the research are an acceptable representation of the Dutch population according to the sample description, this is useful information for parties that tend to use the research results for specific purposes.

4.3.3 Current behavior

The current travel behavior of the respondents is shown in this paragraph by means of the results of the questionnaire. The frequency of trips made to the different cities is shown, alongside the travel purpose and transportation mode used by the respondents.

Travel frequency and purpose per city

The travel frequency and the travel purpose per city are explained in this part. First, the frequency of travels to the cities, which is shown in Table 9, is explained. None of the cities have a high frequency of regular and often visits. But there is a clear deviation between cities that are never visited by many respondents and cities that are visited sometimes by many respondents. Utrecht and Amsterdam are visited most by the respondents, both cities have low rates of 'never' and the highest rates of 'sometimes' and 'regularly'. Amsterdam has the highest rate of the two that people visit only sometimes, but Utrecht is visited a little more frequently by respondents. Heerlen is the city that is visited least of all the cities in the research followed by Arnhem. The rest of the cities are in between of those extremes. The complete output table of travels to cities from SPSS is shown in Appendix H.

Table 9. Frequency of travels to cities by respondents

City	Never	Sometimes	Regularly	Often
Utrecht	97	249	57	12
Amsterdam	80	272	54	9
Nijmegen	222	150	37	6
Arnhem	281	115	16	3
Heerlen	311	88	12	4
Maastricht	148	226	37	4
Rotterdam	182	194	29	10
Den Haag	191	183	32	9

The difference in travel purposes to these cities is presented in Table 10. Amsterdam and Utrecht are both visited very often, however, there is a clear difference between these two cities regarding to the travel purposes. Amsterdam is visited with a really high frequency for recreational purposes, but relatively less for work or study. Utrecht has a lower frequency for the recreational purpose, but has a high visitation frequency for work and study, which explains the high visitation rate to that city. Notable is that some of the cities like Nijmegen, Arnhem and Heerlen have a relatively high travel purpose that is different from work, study or recreation. The complete output table of travel purposes from SPSS is shown in Appendix I.

Table 10. Frequency and percentage of travel purpose of respondents per cities

	Work		Study		Recreational		Other		Total	
City	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Utrecht	60	*16.5*	14	*3.9*	220	*60.6*	69	*19.0*	363	*100.0*
Amsterdam	35	*9.2*	5	*1.3*	277	*73.1*	62	*16.4*	379	*100.0*
Nijmegen	30	*11.8*	5	*1.9*	130	*51.0*	90	*35.3*	255	*100.0*
Arnhem	17	*8.2*	2	*1.0*	123	*59.4*	65	*31.4*	207	*100.0*
Heerlen	24	*12.5*	2	*1.0*	92	*47.9*	74	*38.6*	192	*100.0*
Maastricht	31	*9.8*	4	*1.3*	225	*71.2*	56	*17.7*	316	*100.0*
Rotterdam	29	*10.2*	3	*1.0*	185	*64.9*	68	*23.9*	285	*100.0*
Den Haag	26	*9.5*	3	*1.1*	178	*64.7*	68	*24.7*	275	*100.0*

Transportation mode per city

In the questionnaire respondents needed to indicate the transportation mode they used when traveling to the cities. Table 11 shows the frequencies and percentages of the transportation mode that was used to travel to each city. The percentages are relative for each city so the different transportation modes per city can be compared. Amsterdam and Utrecht are the two cities that have the highest rate of visit by train and compared to other cities low rate of visit by car. A possible explanation for that is the high parking costs and difficulty to find a parking place for the car in the city centers. The other cities are visited by car more than by train. The complete output table of transportation mode use from SPSS is shown in Appendix J.

Table 11. Frequency of transportation mode use by respondents to cities

	Car		Train		Other		Total	
City	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Utrecht	168	*43.9*	204	*53.2*	11	*2.9*	383	*100.0*
Amsterdam	144	*36.0*	246	*61.5*	10	*2.5*	400	*100.0*
Nijmegen	159	*65.2*	65	*26.6*	20	*8.2*	244	*100.0*
Arnhem	113	*59.5*	58	*30.5*	19	*10.0*	190	*100.0*
Heerlen	98	*56.3*	54	*31.0*	22	*12.7*	174	*100.0*
Maastricht	182	*56.5*	123	*38.2*	17	*5.3*	322	*100.0*
Rotterdam	140	*49.0*	129	*45.1*	17	*5.9*	286	*100.0*
Den Haag	139	*50.2*	124	*44.8*	14	*5.0*	277	*100.0*

The transportation mode choice seems to correlate with the 'omgevingsadressendichtheid' (oad), the Dutch benchmark for the level of urbanity of an area (RIVM, 2014). Cities with a high oad are visited more often by train and less often by car. That indicates that the characteristics of cities with a high oad probably affected the transportation mode choice. The characteristics that could have an influence on the transportation mode choice are likely: parking availability and costs, good public transport connections in the city, and place of destination. Appendix K shows the oad of the cities that were included in the research. Amsterdam has the highest oad and is also visited most often by train, and very little by car. It is the other way around for Nijmegen, Arnhem, Heerlen and Maastricht. Those cities have a relatively low oad and are visited far more often by car than by train.

Pre-transportation modes used

Respondents that chose the train as transportation mode in the previous question, were asked which pre-transportation mode was used mostly when traveling by train. As shown in Table 12, the bus is used by far the most by the respondents. Over 46 percent of the respondents uses the bus as pre-transportation mode. The bicycle is used by 22 percent of the respondents, which is also a large part of the respondents group. It also stands out that high quality public transport is not used very often, this could be due to absence of the accessibility to this type of pre-transportation or because it does not have advantages for the respondents compared to regular public transport. The complete output table of pre-transportation mode use from SPSS is shown in Appendix L.

Table 12. Frequency of pre-transportation mode use of respondents when traveling to cities by train

Pre-transportation mode	Frequency	Percentage
Bus	130	*46.1*
High quality public transport	5	*1.8*
Dropped off by car	26	*9.2*
Bicycle	62	*22.0*
Variable	35	*12.4*
Park car near station	24	*8.5*
Total	282	*100.0*

The spatial distribution of the pre-transportation modes, bus, bicycle and car are shown in respectively Figure 23, Figure 24 and Figure 25. In each figure the railway station is denoted by a yellow with black logo and only the areas with enough available data are taken into account. In each legend the percentage of respondents that use that specific type of pre-transportation are presented. The distribution of these three pre-transportation modes all have their own characteristics. The distribution of bicycle use in Figure 23 shows that especially on the short distances the bike is used, areas that are at a larger distance from the railway station show only very little bicycle use. It also stands out that in the area of Nuenen, the three light blue postal areas in the east, almost no bicycle is used. While in the Northern area of Eindhoven that is at least as far from the railway station the bicycle is used significantly more. This is possible due to connection problems and a difference in the presence of bicycle facilities in the areas. The complete output table of distribution of pre-transportation modes from SPSS is shown in Appendix M.

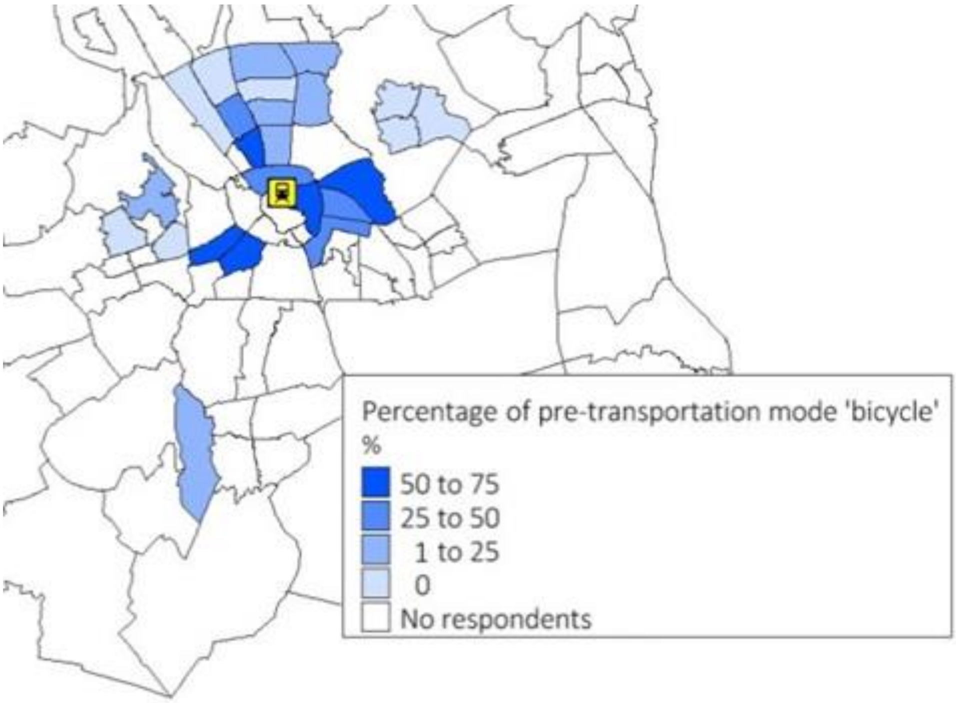


Figure 23. Distribution of bicycle use as pre-transportation mode of respondents.

In Figure 24, that shows the distribution of car use, the situation is opposite to the situation with the bicycle. The car is not used on short distance and more used from respondents that live further away from the railway station. In this figure the use of the car as drop off and parking at the station are combined to make the data more representable.

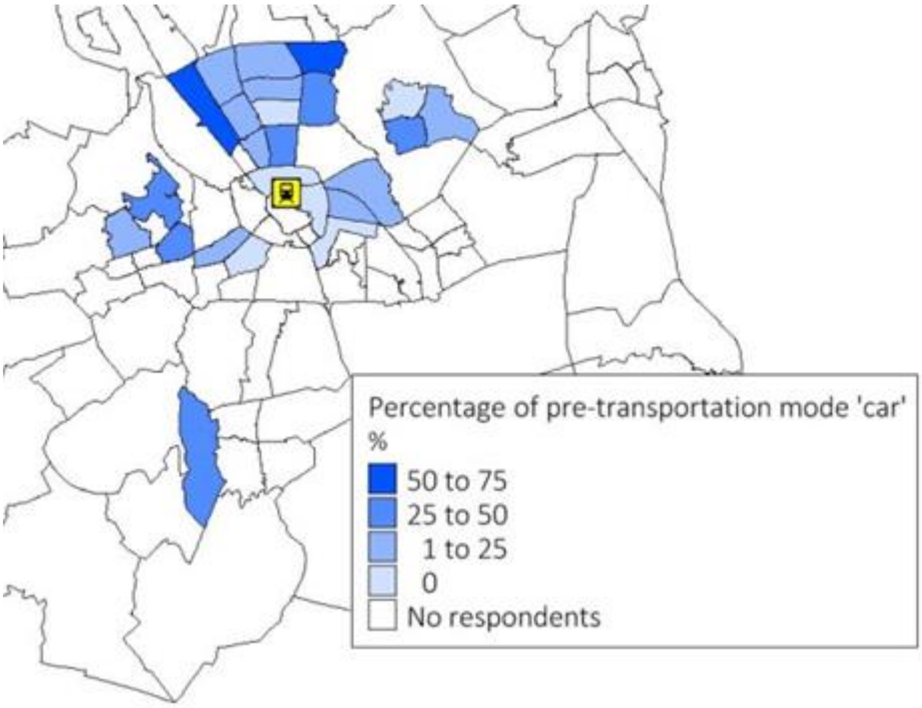


Figure 24. Distribution of car use as pre-transportation mode of respondents.

The distribution of bus use that is shown in Figure 25 shows that the use of bus is high and very well deviated over the different areas. Although some areas have a notable high use of bus, and some areas a really low use of bus. This could be due to the routes that busses follow and the presence or absence of bus stops in some of the areas.

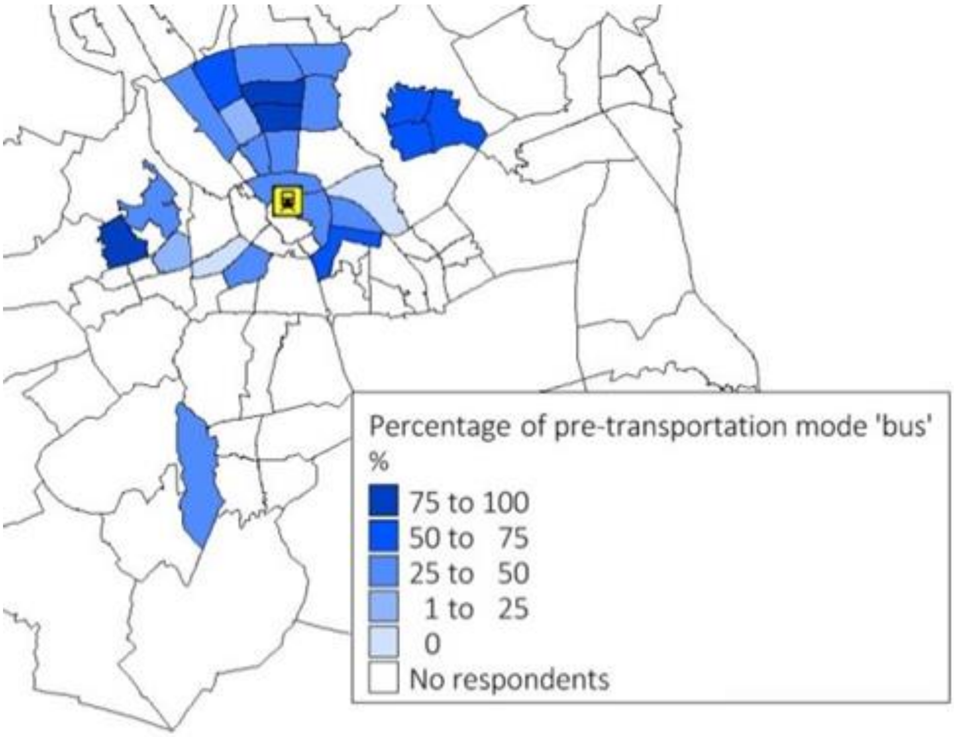


Figure 25. Distribution of bus use as pre-transportation mode of respondents.

4.3.4 Model analysis

In the model analysis, the model estimation is presented. In order to analyze to what extent journey characteristics influence the probability that a transportation mode is chosen, multinomial logit models were estimated. Nlogit was used to estimate the multinomial logit models. First the performance of the estimated model is tested to check whether and how useful the model results are. The model will be tested with the likelihood ratio statistics and with the likelihood ratio index. After the model is tested, the results will be analyzed and interpreted.

Likelihood ratio statistics

To test whether the approximations are accurate enough to use, the likelihood ratio statistic (LRS) that is described by equation 7 is used. With the likelihood ratio statistics, the performance of different subsets of variables are compared. With this test the null-model, constants only model and the optimal model will be compared to check whether the attributes and attribute levels affected the model or not. Table 13 shows the application of the likelihood ratio statistics. The log likelihood and degrees of freedom were obtained from the Nlogit output table shown in Appendix N. The chi-squared with the degrees of freedom and a chance on error of 0.05 are compared with the LRS to test the performance of the model. In the comparison of the optimal model and the constants only model the LRS is higher than the Chi-squared which means that the model optimal model perform significantly better than the constants only model. The same counts for the constants only model compared to the null model. The constants only model performs significantly better than the null model, which includes that the optimal also perform better than the null model.

Table 13. Comparison of the likelihood ratio statistics with the Chi-squared

	Null model	Constants only model	Optimal model
Log likelihood	-5177.80944	-5131.6066	-5054.44948
Degrees of freedom	3		64
Chi-squared	7.815		79.082
LRS	92.40568		154.31424

Likelihood ratio index

The likelihood ratio index is a statistic that is often used with discrete choice models to measure how well a models fits the data. It measures how well the model with estimated parameters performs compared with a model in which all parameters are zero, the null model). This comparison is made on the basis of the log likelihood function, which forms the likelihood ratio index function that is shown in equation 6. The likelihood ratio index is expressed as ρ^2. The ρ^2 for the model is calculated by Nlogit when the model was estimated. So the values of ρ^2 for the model are in the output of Nlogit in Appendix N. This output gives that ρ^2 = 0.024 and ρ^2_{adj} = 0.0091. Values between 0.2 and 0.4 are normally seen as excellent fits (Ortúzar & Willumsen, 2011). But the values of the estimated model are much lower, this indicates that the multinomial model is not a really good fit. But the cause of this low ρ^2 could be in many aspects of the model. Therefore more research should be done to determine what causes the low ρ^2.

Analysis and interpretation

The output table of the MNL model in Nlogit is shown in Appendix N. From this output table the total estimation table that is shown in Appendix O was calculated. The estimates (β) in the estimated tables show the preferences for the attribute levels. The strength of preference is indicated by a the β-estimate, a higher β-estimate indicates a stronger preference. The values of every third' attribute level of the attributes (cursive in table) were calculated by summing the estimates of the first two estimates multiplied by -1 so that all the estimates of an attribute together are 0.

Not all of the attributes included in the model gave significant attribute levels, indicating that not all attributes contributed to the transportation mode choice to a statistical significant extent. The fact that attributes showed little significance for some of the attribute levels indicates that those levels were not different from zero and thus preferred equally. Because some of the attributes did not show enough significance, they were left out of Table 14. Table 14 shows all attributes that have any respectable level of significance, which is 0.10 for this research. This means a confidence level of 90 percent is used.

The first thing that was noticed when looking at Table 14 is that none of the attributes of the train trip are included and thus none of these attributes have a significant contribution to the transportation mode choice. This could be due to the decision making process of the respondents. When using between the car and one of the three train alternatives the characteristics of the pre-transportation modes may have been more important for the decision than the characteristics of the train trip. So this indicates that the pre-transport has more influence on the transportation mode choice than the train trip itself. It could be possible that because of the focus of the research on pre-transport the respondents also focused more on the pre-transport than on the train trip.

Table 14. Significant results of multinomial logit model

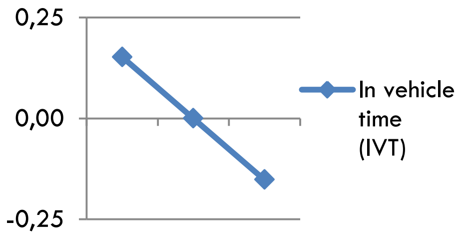
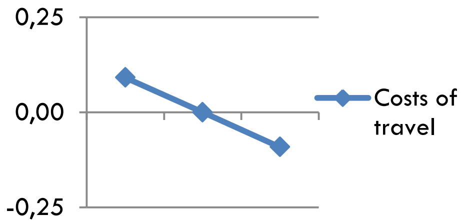
Transportation mode	Attributes	Attribute levels	β	Sign.
Car	In vehicle time (IVT)	50 minutes	0,15205	0,0046
		60 minutes	-0,08857	0,1083
		70 minutes	*-0,06348*	
	Costs of travel	10 euro	0,09140	0,0901
		14 euro	0,07656	0,1566
		18 euro	*-0,16796*	
	Parking costs	2 euro per hour	0,12914	0,0156
		4 euro per hour	0,00571	0,9167
		6 euro per hour	*-0,13485*	
Pre-transport Public transport	Time to get to bus stop	1 minutes	0,13531	0,0074
		4 minutes	0,01923	0,7027
		7 minutes	*-0,15454*	
	In vehicle time (IVT)	15 minutes	0,08758	0,0809
		20 minutes	0,05365	0,2912
		25 minutes	*-0,14123*	
	Costs of travel	1 euro	0,16690	0,0009
		2 euro	-0,10278	0,0460
		3 euro	*-0,06412*	
	Chance of delay	0 percent	0,18281	0,0003
		15 percent	-0,04436	0,3837
		30 percent	*-0,13845*	
	Type of bus	Regular bus	0,04151	0,4145
		Express bus	-0,08505	0,0970
		Shuttle bus	*0,04354*	
	Safety measures	No additional measures	-0,11817	0,0212
		Additional security cameras	0,09765	0,0511
		Additional security cameras and staff	*0,02052*	
	Safety level of the environment	Low	-0,09016	0,0769
		Moderate	0,05239	0,3033
		High	*0,03777*	
Pre-transport Bicycle	On vehicle time	20 minutes	0,14824	0,0052
		25 minutes	0,02722	0,6140
		30 minutes	*-0,17546*	
	Costs of parking bicycle	0.50 euro per time	0,12766	0,0163
		1.00 euro per time	-0,05090	0,3508
		1.50 euro per time	*-0,07676*	

Pre-transport Car	In vehicle time (IVT)	10 minutes	0,21124	0,0002
		15 minutes	-0,00732	0,9011
		20 minutes	*-0,20392*	
	Time to get to railway platform	2 minutes	0,15203	0,0085
		5 minutes	-0,05007	0,3987
		8 minutes	*-0,10196*	

Table 14 shows that most attributes that contribute to the transportation mode choice are travel time and monetary cost related. Only some attributes of public transport as mode of pre-transportation deviates from that. The outcome that most attributes related to travel time and monetary costs contribute to the transportation mode choice is in accordance with the expectations. From the literature review in Chapter 3.6.4 was concluded that transportation mode choice strongly depends on the time and money a journey or trip costs (Schneider, 2013). Besides the time and money related attributes, public transport as pre-transportation mode has more attributes that are of significant importance for the mode choice. First, chance of delay proves to be important, this attribute is related to time, but it has also to do with the uncertainty which travelers dislike. According to Brons and Rietveld (2008) travel time reliability is one of the most important aspects of quality for public transport trips. So if the travel time is uncertain due to a high chance of delay, it is less likely for travelers to choose that alternative. Second, the type of bus is of importance, people are less likely to choose the express bus. This could be due to the fact that people like to choose what they know, which is probable the regular bus. Third, the safety measures influence the transportation mode choice. No additional measures have a low probability, and additional measures like security cameras are more likely to be chosen. This indicates that travelers do appreciate when safety measures are taken on bus stops and in public transport. Last, the safety level of the environment of public transport stops and vehicles are of importance for transportation mode choice. So travelers find it of importance that enough lighting and open space that improves social security are present at public transport stops and vehicles. The fact that attributes related to safety measures contribute only to the public transport as pre-transportation mode indicates that travelers find the current safety situation of that mode less sufficient or more important than for other transportation modes.

All attributes, except for the type of bus and safety measures, have linear related attribute levels. Therefore, the probabilities that an attribute level is chosen are also linear related. The middle attribute level is set to zero and the attribute level that is significant, the first level is chosen as other point of reference. This way adjusted β's are calculated as probabilities. This is done because now only the significant attributes are included in the conclusions, and therefore the conclusions are more reliable. The impact of the attributes on the transportation mode choice was indicated by calculating the range between the highest and lowest estimated utility of the attribute. A visualization of the probability that an attribute level is chosen is shown in Table 15. The gradient of the graphs indicate the importance of the attribute.

Table 15. Adjusted results of multinomial logit model and visualization

<table>
<tr><th>Transportation mode</th><th>Graphs</th><th></th></tr>
<tr><td>Car</td><td>
</td><td>
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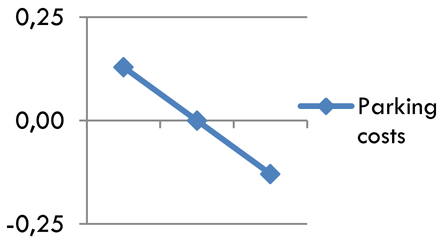
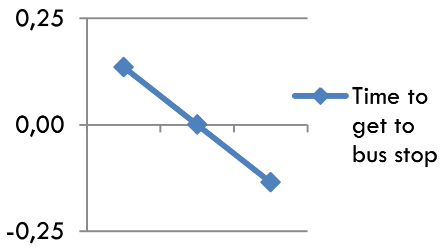
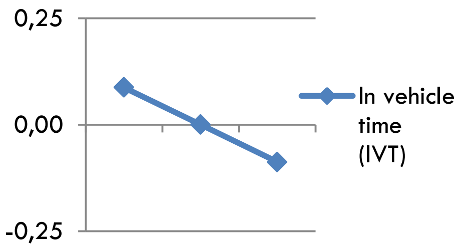
<tr><td></td><td>
</td><td></td></tr>
<tr><td>Pre-transport Public transport</td><td>
</td><td>
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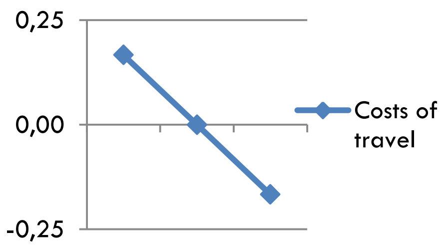
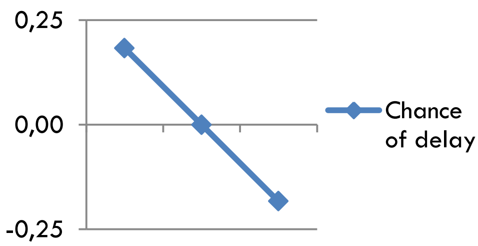
<tr><td></td><td>
</td><td>
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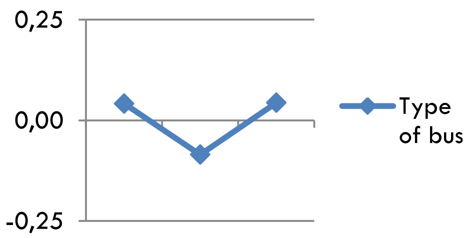
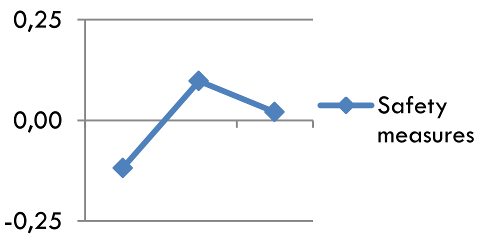
<tr><td></td><td>
</td><td>
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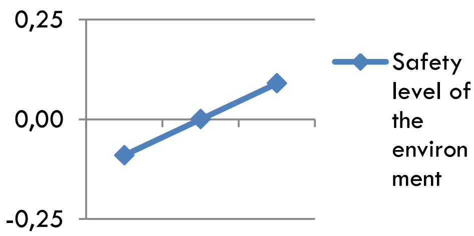
<tr><td></td><td>
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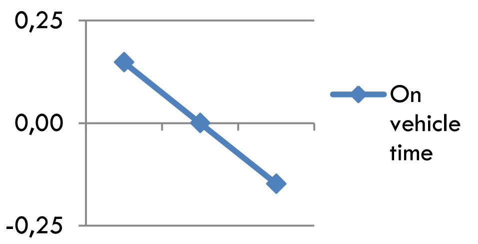
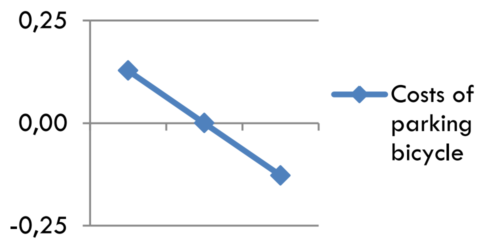
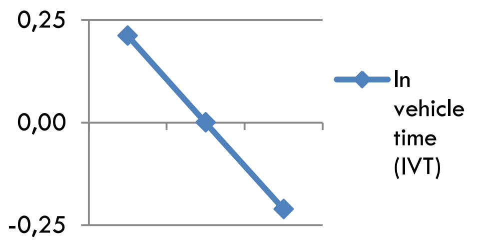
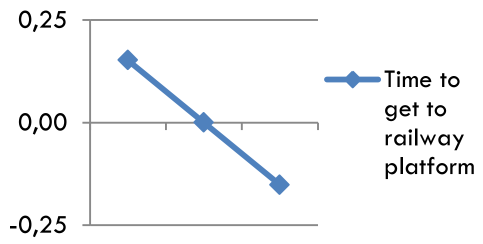
Pre-transport Bicycle		
Pre-transport Car		

Now that all attributes that influence transportation mode choice are discussed, the impact that the attributes have on the mode choice will be explained. The impact that attributes have indicate the weight of the contribution to the mode choice. Figure 26 shows the relative importance of each significant attribute of the research. The in vehicle time of the car as form of pre-transportation is the attribute with the highest impact of all. So it is likely that if the in vehicle time of this transportation mode is short, this mode will be chosen. Also the chance of delay and costs of travel for public transport as pre-transportation mode is of high influence. The in vehicle time for the car as well as the on vehicle time of the bicycle as mode of pre-transportation are two important characteristics in transportation mode choice. The type of bus proved to be a significant attribute in the research, but the influence on transportation mode choice seems to be really low. It is possible that respondents chose more for the regular bus because that was the most familiar choice.

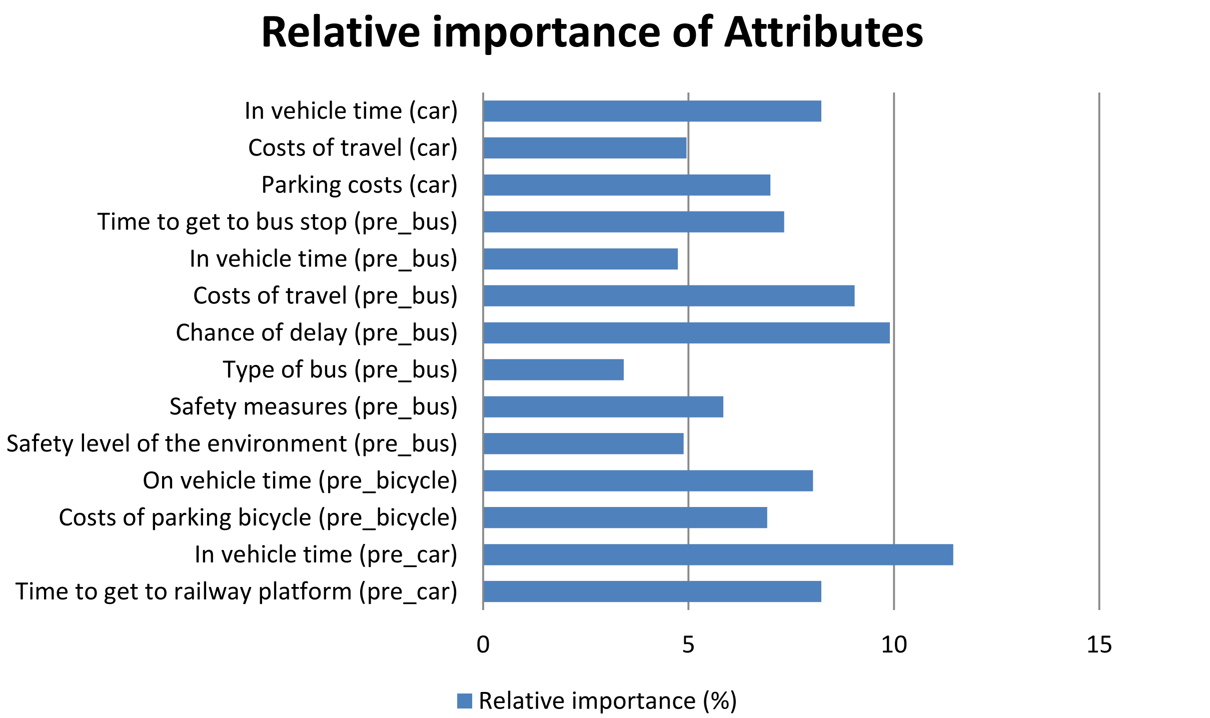


Figure 26. Relative importance of significant attributes include in the research.

4.3.5 Conclusions

The research in this thesis addresses a study of the influence of transportation mode characteristics on transportation mode choice. To collect data about the transportation mode choice, a research was set up and conducted in the region of Eindhoven. Respondents that are likely to use a form of pre-transportation when traveling with the train from the railway station of Eindhoven were approached to fill in a questionnaire including a stated preference experiment.

The results of the sample description of the research showed that the research reached the target group that was aimed for, people that live on a distance from the railway station that ensures a pre-transport trip when the train is used. This group of potential travelers proved to be a group with a wide variation and many different types of travel behavior. The distribution of characteristics of the respondent group that was aimed for proved to be present. The respondents that participated in the research are an acceptable representation of the Dutch population according to the sample description, this is useful information for parties that tend to use the research results for specific purposes. The current travel behavior of the respondents showed that journeys to cities often have different travel purposes. Each city has a different distribution of travel purposes. Also, the type of city seems to influence transportation mode choice. Cities with a high 'omgevingsadressendichtheid' tend to be visited more by public transport relative to the car. The pre-transportation mode of respondents shows a big difference with previous researches about the use of pre-transportation modes. Comparing the results with researches from Givoni and Rietveld (2) (2007) and the Ministerie van Infrastructuur en Milieu (1) (2014) that are based on data collected from Dutch Railways users, differences in pre-transportation mode use are present. In those researches the bicycle was used much more as pre-transportation mode and public transport less than in the research that was conducted for the thesis. The differences between the researches are probably due to the differences in respondents characteristics. The pre-transportation modes that is used most by respondents in this research about the railway station of Eindhoven is the bus, followed by the bicycle.

The optimal MNL model proved to be significantly better relative to the null-model according to the likelihood ratio statistics, but the ρ^2 was not really high which indicates that it is not a really good fit on all aspects. Noticeable about the results was that attributes related to time and costs were most important on the transportation mode choice, this was expected due to previous researches that revealed that time and monetary costs are important aspects in choosing a specific transportation mode. Striking was that none of the attributes of the train trip were of significant importance to transportation mode choice. This indicates that the decision between the car and train as transportation mode choice depends on the characteristics of the car trip and the pre-transportation trips. So the characteristics of the pre-transport are really important factors for the transportation mode choice of the train and thus of the railway journey. If it is tried to influence transportation mode choice, changing time and money related characteristics would have the most influence.

The research question that was formulated before the research is:

- *"What is the role of the characteristics of pre-transport in the travelers' decision making process of using the train as transportation mode or the car?"*

The characteristics of pre-transport proved to be of influence in the travelers' decision making process for the transportation mode choice. Some of the characteristics of the pre-transport even are more important than many of the characteristics of the main trip. So the characteristics of the pre-transport are important in transportation mode choice and the decision making process of using the train as transportation mode instead of the car. Characteristics related to time and monetary costs have the most influence.

5 Conclusions and recommendations

This chapter presents the conclusions from the literature study and the research that was conducted. It will elucidate on the relevance of the research. First the societal relevance will be discussed, after that the scientific relevance will be discussed, followed by the beneficiary relevance which include recommendations for stakeholders of the researched subject and recommendations for further research.

5.1 Societal relevance

The research that is conducted contributes to a better understanding of transportation mode choice in the context of choosing the train instead of the car. An important part of the research focusses on the relevance of pre-transport in the transportation mode choice, with in particular the specific characteristics of three pre-transportation modes. Because the rise of private car use proved to be a problem that is still expanding, understanding about why people choose to use the car instead of more environmental friendly alternatives like the train is important. This research provides insights in this choice and could help to change the trend of an increase of private car use in the Netherlands. Congestion during rush hour is a big problem in the Netherlands, especially in urbanized areas. A lot of costs and irritation is created by the congestion during rush hour. The increase of private car use in Netherlands, along with the prospect that the economy will get better again, could cause tremendous problems in the future. The economy that is recovering will cause an immediate increase of car and transportation traffic. This sudden increase alongside with the already growing use of the car will cause problems. The Netherlands has a very well structured public transport network with a lot of potential and therefore could benefit from the situation and help solving the problem as well. With the results of the research the public transport facilitators will be able to attract customers better because it is known what possibly withholds of attracts them from using the public transport as mode of transportation instead of the car. Pull measurements could be used to improve the satisfaction of a railway journey and therefore attract customers. Reduce the costs and chance of delay for bus users would improve the satisfaction for bus users immensely. Also improving safety measurements for the bus would have a positive influence. For bicycle users the time that is needed to get to the railway station and the costs of parking the bicycle at the railway station are seen as factors that are important to decide whether to use the bicycle together with the train or not. So if these measurements could be improved it will contribute to a higher rate of choosing this option. For the car that is used at pre-transportation mode it is especially important that the car drop-off or parking place near the railway station is close to the railway platform. So if these places could be closer to the railway platform it would be more pleasant for the travelers. For people that only use the car for the journey, the travel and parking costs are aspect that are considered in the decision making process. So if the car use has to be reduced it would help to increase the costs and therefore make car use less attractive for travelers.

The results and conclusions about the importance of the transportation mode characteristics give insights that can contribute to improve multimodal railway and car journeys. The research does not only prove which characteristics are of influence, but also how much the influence of the characteristics is. Therefore improvements can be made effectively.

5.2 Scientific relevance

Several researches about transportation mode choice and pre-transportation have been conducted over the last decades. All of those researches focused on several aspects of the journeys. The studies about pre-transportation especially focused on general characteristics like distance to the railway station and facilities at a railway station. Transportation mode choice studies focused especially on the influences of different factors on the decision making. This research focusses on the comparison between three types of multimodal railway journeys and a car journey. Each journey has specific characteristics that could influence the transportation mode choice. Many characteristics are included in the research to investigate whether they even influenced the transportation mode choice or not. So not only the general characteristics like distance, monetary costs and travel time are included, but the general characteristics are separated in smaller attributes that may have a different influence and less general characteristics are included as well. Because of this complex approach results that otherwise never would have been found became apparent. Notable results on this part are that costs of parking the bicycle when it is used as pre-transportation mode is of importance in transportation mode choice and that a regular bus is preferred over the use of an express bus.

Another important relevant difference between existing researches and the one that is conducted in the thesis is that the research is not conducted from existing railway users only, but from a target group that has divers characteristics and use many types of transportation modes. So the researched group of people is different from most existing researches. This gives new insights in the subject, because now a new potential group of train users is included in a research.

5.3 Beneficiary relevance

The main conclusions of the results is that monetary cost and time related characteristics of trips are the most important in transportation mode choice. So when changes in transportation mode choice have to be achieved, it is best to make a change in those characteristics. To make a transportation mode more attractive, characteristics that influence transportation mode choice could be made more appropriate for the customers. Also, considering that push measurements are often much more effective than pull measurements, maybe the characteristics of transportation modes that should be used less, could be influenced negatively to reach the goal.

For governmental parties the results and conclusions of the research are relevant information about transportation mode choice of people. It is shown which characteristics of transport influence transportation mode choice and to what extent. In policymaking the information can be used to form strategical policies and a tactical approach to address current problems. Governments have influence on many aspects and characteristics of transportation mode, direct as well as indirect. Increasing, e.g. excises and taxes, could be really useful ways of changing transportation mode choices of people and reducing private car use. Governments could also promote the positive aspects of public transportation and the benefits it has to use them with the help of literature that is reviewed and shown in this thesis.

The Dutch Railways (NS) and other public transport facilitators, i.e. bus companies, could also benefit from the research. The most important characteristics for transportation mode choice are revealed and shown. These stakeholders could respond to the available information about the base of the transportation mode choice. Especially for bus companies it is important that the safety measurements are improved and the chance of delay is as low as possible. These proved to be two relatively unknown factors that are really important for the transportation mode choice.

6 Discussion

This chapter discusses possible weaknesses and improvements in the research, it also presents potential subjects for further research. The research provided results that were not all significant. Because of the research goal, all the attributes that were included could not be reduced to less attributes. But the presentation of the choice tasks to the respondents may have been a little too complex for the respondents. The layout and structuring of the choice task was optimized before inserting it in the questionnaire, but it still was a complex task and this may could have been done a little different to get better results.

Furthermore, the attributes ‘type of bus’ and ‘In vehicle time’ of the bus were two separate attributes in the research. But the most important difference between the three bus types is the travel time of the type of bus. A regular bus has many stops, and a express bus and a shuttle bus less. The amount of stops influences the travel time of the bus. But in the research these two attributes were separate and independent, which is not logical for the respondent and sends a mixed message. So for next researches it should be taken into account more that some of the attributes are inextricably linked.

A multinomial logit (MNL) model was used to analyze the results of the stated preference experiment. The outcome of the MNL model had a low ρ^2, which indicates that the model is not that good. But because MNL is a relatively simple model that has some limitations that affect the results of the analysis. A Mixed Logit (ML) model is a statistical model for examining discrete choices that does not have some of the limitations of an MNL model. Three primary limitations that the MNL model has and the ML model does not have are; an ML model allows random taste variation, unrestricted substitution patterns, and correlation in unobserved factors over time (Train, 2009). Especially the random taste variation in the MNL model could have limited the analysis because every respondent in ML has a different β, which allows the slopes of utility to be random. So an improvement of the research would be to use a mixed logit model to do the analysis.

Even better than an ML model could be a Nested Logit (NL) model. The study that is conducted resembles a nested structure. Therefore this would be a good model to check whether the model indeed has a nested structure that influences the outcome of the model. The MNL could perform not optimal due to its IIA property because in the research the alternatives are not really independent. The three alternatives with pre-transport are more similar than the alternative of the car journey. So the model could be a NL model with the pre-transportation modes as a subset of alternatives.

In the results of the MNL model the train has not a single significant attribute level, which is a little strange. It could be that respondents do not find the attribute levels of the train trip of importance for their transportation mode choice, but it can also be due to other reasons. The way the choice tasks are structured could influence it. Because the train trip has three pre-transport trips that all three do have significant attribute levels, it is assumable that the decision for a railway journey is made by comparing the pre-transport characteristics instead of the characteristics of the train trip. It could be possible that respondents already choose for a train trip because of other reasons than comparing its characteristics with that of the car, for example habit could influence transportation mode choice in that particular way.

And after that the decision which journey is made, the pre-transport characteristics are compared and lead to the ultimate choice.

To expand the research and make the analysis more complete, it could be interesting to link the respondents characteristics (e.g. residence location, travel purpose, etc.) to the results of the analysis. This way the influence of these characteristics can be linked to transportation mode choice which would provide a more detailed image of the transportation mode choice for specific person characteristics.

For further research it would be interesting to investigate transportation mode choice of other areas. Cities with other types of pre-transportation like metro and trams could reveal totally different results. Also researches with different type and lengths of journeys than the one in this thesis could be conducted. Furthermore, besides widening researches it would also be interesting to investigate the relation between the specific socioeconomic factors of people and their transportation mode choice to reveal connections and reasons for their decisions.

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Appendices

Appendix A. Levels assigned to profiles per transportation mode

Attribute levels for transportation mode train

id	IVT_train	WT_train	DEL_train	SAF_train	PWR_train	COS_train
1	55 minuten	3 minuten	5 procent	Geen maatregelen	Speciale werkruimtes	10 euro
2	55 minuten	9 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	Speciale werkruimtes	10 euro
3	55 minuten	15 minuten	15 procent	Extra bewakingscamera's	Speciale werkruimtes	10 euro
4	50 minuten	3 minuten	10 procent	Extra bewakingscamera's	Persoonlijke werktafels	18 euro
5	50 minuten	9 minuten	15 procent	Geen maatregelen	Persoonlijke werktafels	18 euro
6	50 minuten	15 minuten	5 procent	Extra bewakingscamera's en beveiligingspersoneel	Persoonlijke werktafels	18 euro
7	45minuten	3 minuten	15 procent	Extra bewakingscamera's en beveiligingspersoneel	Geen maatregelen	14 euro
8	45minuten	9 minuten	5 procent	Extra bewakingscamera's	Geen maatregelen	14 euro
9	45minuten	15 minuten	10 procent	Geen maatregelen	Geen maatregelen	14 euro
10	55 minuten	3 minuten	5 procent	Geen maatregelen	Persoonlijke werktafels	14 euro
11	55 minuten	9 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	Persoonlijke werktafels	14 euro
12	55 minuten	15 minuten	15 procent	Extra bewakingscamera's	Persoonlijke werktafels	14 euro
13	50 minuten	3 minuten	10 procent	Extra bewakingscamera's	Geen maatregelen	10 euro
14	50 minuten	9 minuten	15 procent	Geen maatregelen	Geen maatregelen	10 euro
15	50 minuten	15 minuten	5 procent	Extra bewakingscamera's en beveiligingspersoneel	Geen maatregelen	10 euro
16	45minuten	3 minuten	15 procent	Extra bewakingscamera's en beveiligingspersoneel	Speciale werkruimtes	18 euro
17	45minuten	9 minuten	5 procent	Extra bewakingscamera's	Speciale werkruimtes	18 euro
18	45minuten	15 minuten	10 procent	Geen maatregelen	Speciale werkruimtes	18 euro
19	55 minuten	3 minuten	5 procent	Geen maatregelen	Geen maatregelen	18 euro
20	55 minuten	9 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	Geen maatregelen	18 euro
21	55 minuten	15 minuten	15 procent	Extra bewakingscamera's	Geen maatregelen	18 euro
22	50 minuten	3 minuten	10 procent	Extra bewakingscamera's	Speciale werkruimtes	14 euro
23	50 minuten	9 minuten	15 procent	Geen maatregelen	Speciale werkruimtes	14 euro
24	50 minuten	15 minuten	5 procent	Extra bewakingscamera's en beveiligingspersoneel	Speciale werkruimtes	14 euro
25	45minuten	3 minuten	15 procent	Extra bewakingscamera's en beveiligingspersoneel	Persoonlijke werktafels	10 euro
26	45minuten	9 minuten	5 procent	Extra bewakingscamera's	Persoonlijke werktafels	10 euro
27	45minuten	15 minuten	10 procent	Geen maatregelen	Persoonlijke werktafels	10 euro
28	55 minuten	3 minuten	5 procent	Geen maatregelen	Speciale werkruimtes	10 euro
29	55 minuten	9 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	Speciale werkruimtes	10 euro
30	55 minuten	15 minuten	15 procent	Extra bewakingscamera's	Speciale werkruimtes	10 euro
31	50 minuten	3 minuten	10 procent	Extra bewakingscamera's	Persoonlijke werktafels	18 euro
32	50 minuten	9 minuten	15 procent	Geen maatregelen	Persoonlijke werktafels	18 euro
33	50 minuten	15 minuten	5 procent	Extra bewakingscamera's en beveiligingspersoneel	Persoonlijke werktafels	18 euro
34	45minuten	3 minuten	15 procent	Extra bewakingscamera's en beveiligingspersoneel	Geen maatregelen	14 euro
35	45minuten	9 minuten	5 procent	Extra bewakingscamera's	Geen maatregelen	14 euro
36	45minuten	15 minuten	10 procent	Geen maatregelen	Geen maatregelen	14 euro

37	55 minuten	3 minuten	5 procent	Geen maatregelen	Persoonlijke werktafels	14 euro
38	55 minuten	9 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	Persoonlijke werktafels	14 euro
39	55 minuten	15 minuten	15 procent	Extra bewakingscamera's	Persoonlijke werktafels	14 euro
40	50 minuten	3 minuten	10 procent	Extra bewakingscamera's	Geen maatregelen	10 euro
41	50 minuten	9 minuten	15 procent	Geen maatregelen	Geen maatregelen	10 euro
42	50 minuten	15 minuten	5 procent	Extra bewakingscamera's en beveiligingspersoneel	Geen maatregelen	10 euro
43	45minuten	3 minuten	15 procent	Extra bewakingscamera's en beveiligingspersoneel	Speciale werkruimtes	18 euro
44	45minuten	9 minuten	5 procent	Extra bewakingscamera's	Speciale werkruimtes	18 euro
45	45minuten	15 minuten	10 procent	Geen maatregelen	Speciale werkruimtes	18 euro
46	55 minuten	3 minuten	5 procent	Geen maatregelen	Geen maatregelen	18 euro
47	55 minuten	9 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	Geen maatregelen	18 euro
48	55 minuten	15 minuten	15 procent	Extra bewakingscamera's	Geen maatregelen	18 euro
49	50 minuten	3 minuten	10 procent	Extra bewakingscamera's	Speciale werkruimtes	14 euro
50	50 minuten	9 minuten	15 procent	Geen maatregelen	Speciale werkruimtes	14 euro
51	50 minuten	15 minuten	5 procent	Extra bewakingscamera's en beveiligingspersoneel	Speciale werkruimtes	14 euro
52	45minuten	3 minuten	15 procent	Extra bewakingscamera's en beveiligingspersoneel	Persoonlijke werktafels	10 euro
53	45minuten	9 minuten	5 procent	Extra bewakingscamera's	Persoonlijke werktafels	10 euro
54	45minuten	15 minuten	10 procent	Geen maatregelen	Persoonlijke werktafels	10 euro
55	55 minuten	3 minuten	5 procent	Geen maatregelen	Speciale werkruimtes	10 euro
56	55 minuten	9 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	Speciale werkruimtes	10 euro
57	55 minuten	15 minuten	15 procent	Extra bewakingscamera's	Speciale werkruimtes	10 euro
58	50 minuten	3 minuten	10 procent	Extra bewakingscamera's	Persoonlijke werktafels	18 euro
59	50 minuten	9 minuten	15 procent	Geen maatregelen	Persoonlijke werktafels	18 euro
60	50 minuten	15 minuten	5 procent	Extra bewakingscamera's en beveiligingspersoneel	Persoonlijke werktafels	18 euro
61	45minuten	3 minuten	15 procent	Extra bewakingscamera's en beveiligingspersoneel	Geen maatregelen	14 euro
62	45minuten	9 minuten	5 procent	Extra bewakingscamera's	Geen maatregelen	14 euro
63	45minuten	15 minuten	10 procent	Geen maatregelen	Geen maatregelen	14 euro
64	55 minuten	3 minuten	5 procent	Geen maatregelen	Persoonlijke werktafels	14 euro
65	55 minuten	9 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	Persoonlijke werktafels	14 euro
66	55 minuten	15 minuten	15 procent	Extra bewakingscamera's	Persoonlijke werktafels	14 euro
67	50 minuten	3 minuten	10 procent	Extra bewakingscamera's	Geen maatregelen	10 euro
68	50 minuten	9 minuten	15 procent	Geen maatregelen	Geen maatregelen	10 euro
69	50 minuten	15 minuten	5 procent	Extra bewakingscamera's en beveiligingspersoneel	Geen maatregelen	10 euro
70	45minuten	3 minuten	15 procent	Extra bewakingscamera's en beveiligingspersoneel	Speciale werkruimtes	18 euro
71	45minuten	9 minuten	5 procent	Extra bewakingscamera's	Speciale werkruimtes	18 euro
72	45minuten	15 minuten	10 procent	Geen maatregelen	Speciale werkruimtes	18 euro
73	55 minuten	3 minuten	5 procent	Geen maatregelen	Geen maatregelen	18 euro
74	55 minuten	9 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	Geen maatregelen	18 euro
75	55 minuten	15 minuten	15 procent	Extra bewakingscamera's	Geen maatregelen	18 euro
76	50 minuten	3 minuten	10 procent	Extra bewakingscamera's	Speciale werkruimtes	14 euro

77	50 minuten	9 minuten	15 procent	Geen maatregelen	Speciale werkruimtes	14 euro
78	50 minuten	15 minuten	5 procent	Extra bewakingscamera's en beveiligingspersoneel	Speciale werkruimtes	14 euro
79	45minuten	3 minuten	15 procent	Extra bewakingscamera's en beveiligingspersoneel	Persoonlijke werktafels	10 euro
80	45minuten	9 minuten	5 procent	Extra bewakingscamera's	Persoonlijke werktafels	10 euro
81	45minuten	15 minuten	10 procent	Geen maatregelen	Persoonlijke werktafels	10 euro

Attribute levels for transportation mode car

id	IVT_car	PST_car	CON_car	SAF_car	COS_car	PCO_car
1	50 minuten	3 minuten	10 procent	Geen maatregelen	10 euro	2 euro per uur
2	60 minuten	15 minuten	20 procent	Extra bewakingscamera's en beveiligingspersoneel	20 euro	4 euro per uur
3	70 minuten	9 minuten	30 procent	Extra bewakingscamera's	15 euro	6 euro per uur
4	50 minuten	3 minuten	20 procent	Extra bewakingscamera's en beveiligingspersoneel	15 euro	6 euro per uur
5	60 minuten	15 minuten	30 procent	Extra bewakingscamera's	10 euro	2 euro per uur
6	70 minuten	9 minuten	10 procent	Geen maatregelen	20 euro	4 euro per uur
7	50 minuten	3 minuten	30 procent	Extra bewakingscamera's	20 euro	4 euro per uur
8	60 minuten	15 minuten	10 procent	Geen maatregelen	15 euro	6 euro per uur
9	70 minuten	9 minuten	20 procent	Extra bewakingscamera's en beveiligingspersoneel	10 euro	2 euro per uur
10	60 minuten	9 minuten	20 procent	Extra bewakingscamera's	15 euro	4 euro per uur
11	70 minuten	3 minuten	30 procent	Geen maatregelen	10 euro	6 euro per uur
12	50 minuten	15 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	20 euro	2 euro per uur
13	60 minuten	9 minuten	30 procent	Geen maatregelen	20 euro	2 euro per uur
14	70 minuten	3 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	15 euro	4 euro per uur
15	50 minuten	15 minuten	20 procent	Extra bewakingscamera's	10 euro	6 euro per uur
16	60 minuten	9 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	10 euro	6 euro per uur
17	70 minuten	3 minuten	20 procent	Extra bewakingscamera's	20 euro	2 euro per uur
18	50 minuten	15 minuten	30 procent	Geen maatregelen	15 euro	4 euro per uur
19	70 minuten	15 minuten	30 procent	Extra bewakingscamera's en beveiligingspersoneel	20 euro	6 euro per uur
20	50 minuten	9 minuten	10 procent	Extra bewakingscamera's	15 euro	2 euro per uur
21	60 minuten	3 minuten	20 procent	Geen maatregelen	10 euro	4 euro per uur
22	70 minuten	15 minuten	10 procent	Extra bewakingscamera's	10 euro	4 euro per uur
23	50 minuten	9 minuten	20 procent	Geen maatregelen	20 euro	6 euro per uur
24	60 minuten	3 minuten	30 procent	Extra bewakingscamera's en beveiligingspersoneel	15 euro	2 euro per uur
25	70 minuten	15 minuten	20 procent	Geen maatregelen	15 euro	2 euro per uur
26	50 minuten	9 minuten	30 procent	Extra bewakingscamera's en beveiligingspersoneel	10 euro	4 euro per uur
27	60 minuten	3 minuten	10 procent	Extra bewakingscamera's	20 euro	6 euro per uur
28	50 minuten	3 minuten	10 procent	Geen maatregelen	10 euro	2 euro per uur
29	60 minuten	15 minuten	20 procent	Extra bewakingscamera's en beveiligingspersoneel	20 euro	4 euro per uur
30	70 minuten	9 minuten	30 procent	Extra bewakingscamera's	15 euro	6 euro per uur
31	50 minuten	3 minuten	20 procent	Extra bewakingscamera's en beveiligingspersoneel	15 euro	6 euro per uur
32	60 minuten	15 minuten	30 procent	Extra bewakingscamera's	10 euro	2 euro per uur

33	70 minuten	9 minuten	10 procent	Geen maatregelen	20 euro	4 euro per uur
34	50 minuten	3 minuten	30 procent	Extra bewakingscamera's	20 euro	4 euro per uur
35	60 minuten	15 minuten	10 procent	Geen maatregelen	15 euro	6 euro per uur
36	70 minuten	9 minuten	20 procent	Extra bewakingscamera's en beveiligingspersoneel	10 euro	2 euro per uur
37	60 minuten	9 minuten	20 procent	Extra bewakingscamera's	15 euro	4 euro per uur
38	70 minuten	3 minuten	30 procent	Geen maatregelen	10 euro	6 euro per uur
39	50 minuten	15 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	20 euro	2 euro per uur
40	60 minuten	9 minuten	30 procent	Geen maatregelen	20 euro	2 euro per uur
41	70 minuten	3 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	15 euro	4 euro per uur
42	50 minuten	15 minuten	20 procent	Extra bewakingscamera's	10 euro	6 euro per uur
43	60 minuten	9 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	10 euro	6 euro per uur
44	70 minuten	3 minuten	20 procent	Extra bewakingscamera's	20 euro	2 euro per uur
45	50 minuten	15 minuten	30 procent	Geen maatregelen	15 euro	4 euro per uur
46	70 minuten	15 minuten	30 procent	Extra bewakingscamera's en beveiligingspersoneel	20 euro	6 euro per uur
47	50 minuten	9 minuten	10 procent	Extra bewakingscamera's	15 euro	2 euro per uur
48	60 minuten	3 minuten	20 procent	Geen maatregelen	10 euro	4 euro per uur
49	70 minuten	15 minuten	10 procent	Extra bewakingscamera's	10 euro	4 euro per uur
50	50 minuten	9 minuten	20 procent	Geen maatregelen	20 euro	6 euro per uur
51	60 minuten	3 minuten	30 procent	Extra bewakingscamera's en beveiligingspersoneel	15 euro	2 euro per uur
52	70 minuten	15 minuten	20 procent	Geen maatregelen	15 euro	2 euro per uur
53	50 minuten	9 minuten	30 procent	Extra bewakingscamera's en beveiligingspersoneel	10 euro	4 euro per uur
54	60 minuten	3 minuten	10 procent	Extra bewakingscamera's	20 euro	6 euro per uur
55	50 minuten	3 minuten	10 procent	Geen maatregelen	10 euro	2 euro per uur
56	60 minuten	15 minuten	20 procent	Extra bewakingscamera's en beveiligingspersoneel	20 euro	4 euro per uur
57	70 minuten	9 minuten	30 procent	Extra bewakingscamera's	15 euro	6 euro per uur
58	50 minuten	3 minuten	20 procent	Extra bewakingscamera's en beveiligingspersoneel	15 euro	6 euro per uur
59	60 minuten	15 minuten	30 procent	Extra bewakingscamera's	10 euro	2 euro per uur
60	70 minuten	9 minuten	10 procent	Geen maatregelen	20 euro	4 euro per uur
61	50 minuten	3 minuten	30 procent	Extra bewakingscamera's	20 euro	4 euro per uur
62	60 minuten	15 minuten	10 procent	Geen maatregelen	15 euro	6 euro per uur
63	70 minuten	9 minuten	20 procent	Extra bewakingscamera's en beveiligingspersoneel	10 euro	2 euro per uur
64	60 minuten	9 minuten	20 procent	Extra bewakingscamera's	15 euro	4 euro per uur
65	70 minuten	3 minuten	30 procent	Geen maatregelen	10 euro	6 euro per uur
66	50 minuten	15 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	20 euro	2 euro per uur
67	60 minuten	9 minuten	30 procent	Geen maatregelen	20 euro	2 euro per uur
68	70 minuten	3 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	15 euro	4 euro per uur
69	50 minuten	15 minuten	20 procent	Extra bewakingscamera's	10 euro	6 euro per uur
70	60 minuten	9 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	10 euro	6 euro per uur
71	70 minuten	3 minuten	20 procent	Extra bewakingscamera's	20 euro	2 euro per uur
72	50 minuten	15 minuten	30 procent	Geen maatregelen	15 euro	4 euro per uur

73	70 minuten	15 minuten	30 procent	Extra bewakingscamera's en beveiligingspersoneel	20 euro	6 euro per uur
74	50 minuten	9 minuten	10 procent	Extra bewakingscamera's	15 euro	2 euro per uur
75	60 minuten	3 minuten	20 procent	Geen maatregelen	10 euro	4 euro per uur
76	70 minuten	15 minuten	10 procent	Extra bewakingscamera's	10 euro	4 euro per uur
77	50 minuten	9 minuten	20 procent	Geen maatregelen	20 euro	6 euro per uur
78	60 minuten	3 minuten	30 procent	Extra bewakingscamera's en beveiligingspersoneel	15 euro	2 euro per uur
79	70 minuten	15 minuten	20 procent	Geen maatregelen	15 euro	2 euro per uur
80	50 minuten	9 minuten	30 procent	Extra bewakingscamera's en beveiligingspersoneel	10 euro	4 euro per uur
81	60 minuten	3 minuten	10 procent	Extra bewakingscamera's	20 euro	6 euro per uur

Attribute levels for pre-transportation mode bus

id	COS_pt	PRE_pt	IVT_pt	POS_pt	TYP_pt	DEL_pt	SAF_pt	SOC_pt
1	1 euro	1 minuut	25 minuten	1 minuut	Gewone bus	30 procent	Geen maatregelen	Hoog
2	1 euro	4 minuten	20 minuten	5 minuten	Gewone bus	30 procent	Extra bewakingscamera's	Laag
3	1 euro	7 minuten	15 minuten	3 minuten	Gewone bus	30 procent	Extra bewakingscamera's en beveiligingspersoneel	Gemiddeld
4	2 euro	1 minuut	20 minuten	3 minuten	Snelbus	0 procent	Geen maatregelen	Hoog
5	2 euro	4 minuten	15 minuten	1 minuut	Snelbus	0 procent	Extra bewakingscamera's	Laag
6	2 euro	7 minuten	25 minuten	5 minuten	Snelbus	0 procent	Extra bewakingscamera's en beveiligingspersoneel	Gemiddeld
7	3 euro	1 minuut	15 minuten	5 minuten	Shuttle bus	15 procent	Geen maatregelen	Hoog
8	3 euro	4 minuten	25 minuten	3 minuten	Shuttle bus	15 procent	Extra bewakingscamera's	Laag
9	3 euro	7 minuten	20 minuten	1 minuut	Shuttle bus	15 procent	Extra bewakingscamera's en beveiligingspersoneel	Gemiddeld
10	1 euro	1 minuut	25 minuten	1 minuut	Snelbus	15 procent	Extra bewakingscamera's	Gemiddeld
11	1 euro	4 minuten	20 minuten	5 minuten	Snelbus	15 procent	Extra bewakingscamera's en beveiligingspersoneel	Hoog
12	1 euro	7 minuten	15 minuten	3 minuten	Snelbus	15 procent	Geen maatregelen	Laag
13	2 euro	1 minuut	20 minuten	3 minuten	Shuttle bus	30 procent	Extra bewakingscamera's	Gemiddeld
14	2 euro	4 minuten	15 minuten	1 minuut	Shuttle bus	30 procent	Extra bewakingscamera's en beveiligingspersoneel	Hoog
15	2 euro	7 minuten	25 minuten	5 minuten	Shuttle bus	30 procent	Geen maatregelen	Laag
16	3 euro	1 minuut	15 minuten	5 minuten	Gewone bus	0 procent	Extra bewakingscamera's	Gemiddeld
17	3 euro	4 minuten	25 minuten	3 minuten	Gewone bus	0 procent	Extra bewakingscamera's en beveiligingspersoneel	Hoog
18	3 euro	7 minuten	20 minuten	1 minuut	Gewone bus	0 procent	Geen maatregelen	Laag
19	1 euro	1 minuut	25 minuten	1 minuut	Shuttle bus	0 procent	Extra bewakingscamera's en beveiligingspersoneel	Laag
20	1 euro	4 minuten	20 minuten	5 minuten	Shuttle bus	0 procent	Geen maatregelen	Gemiddeld
21	1 euro	7 minuten	15 minuten	3 minuten	Shuttle bus	0 procent	Extra bewakingscamera's	Hoog
22	2 euro	1 minuut	20 minuten	3 minuten	Gewone bus	15 procent	Extra bewakingscamera's en beveiligingspersoneel	Laag
23	2 euro	4 minuten	15 minuten	1 minuut	Gewone bus	15 procent	Geen maatregelen	Gemiddeld
24	2 euro	7 minuten	25 minuten	5 minuten	Gewone bus	15 procent	Extra bewakingscamera's	Hoog
25	3 euro	1 minuut	15 minuten	5 minuten	Snelbus	30 procent	Extra bewakingscamera's en beveiligingspersoneel	Laag
26	3 euro	4 minuten	25 minuten	3 minuten	Snelbus	30 procent	Geen maatregelen	Gemiddeld
27	3 euro	7 minuten	20 minuten	1 minuut	Snelbus	30 procent	Extra bewakingscamera's	Hoog
28	2 euro	4 minuten	20 minuten	3 minuten	Snelbus	15 procent	Extra bewakingscamera's	Gemiddeld

29	2 euro	7 minuten	15 minuten	1 minuut	Snelbus	15 procent	Extra bewakingscamera's en beveiligingspersoneel	Hoog
30	2 euro	1 minuut	25 minuten	5 minuten	Snelbus	15 procent	Geen maatregelen	Laag
31	3 euro	4 minuten	15 minuten	5 minuten	Shuttle bus	30 procent	Extra bewakingscamera's	Gemiddeld
32	3 euro	7 minuten	25 minuten	3 minuten	Shuttle bus	30 procent	Extra bewakingscamera's en beveiligingspersoneel	Hoog
33	3 euro	1 minuut	20 minuten	1 minuut	Shuttle bus	30 procent	Geen maatregelen	Laag
34	1 euro	4 minuten	25 minuten	1 minuut	Gewone bus	0 procent	Extra bewakingscamera's	Gemiddeld
35	1 euro	7 minuten	20 minuten	5 minuten	Gewone bus	0 procent	Extra bewakingscamera's en beveiligingspersoneel	Hoog
36	1 euro	1 minuut	15 minuten	3 minuten	Gewone bus	0 procent	Geen maatregelen	Laag
37	2 euro	4 minuten	20 minuten	3 minuten	Shuttle bus	0 procent	Extra bewakingscamera's en beveiligingspersoneel	Laag
38	2 euro	7 minuten	15 minuten	1 minuut	Shuttle bus	0 procent	Geen maatregelen	Gemiddeld
39	2 euro	1 minuut	25 minuten	5 minuten	Shuttle bus	0 procent	Extra bewakingscamera's	Hoog
40	3 euro	4 minuten	15 minuten	5 minuten	Gewone bus	15 procent	Extra bewakingscamera's en beveiligingspersoneel	Laag
41	3 euro	7 minuten	25 minuten	3 minuten	Gewone bus	15 procent	Geen maatregelen	Gemiddeld
42	3 euro	1 minuut	20 minuten	1 minuut	Gewone bus	15 procent	Extra bewakingscamera's	Hoog
43	1 euro	4 minuten	25 minuten	1 minuut	Snelbus	30 procent	Extra bewakingscamera's en beveiligingspersoneel	Laag
44	1 euro	7 minuten	20 minuten	5 minuten	Snelbus	30 procent	Geen maatregelen	Gemiddeld
45	1 euro	1 minuut	15 minuten	3 minuten	Snelbus	30 procent	Extra bewakingscamera's	Hoog
46	2 euro	4 minuten	20 minuten	3 minuten	Gewone bus	30 procent	Geen maatregelen	Hoog
47	2 euro	7 minuten	15 minuten	1 minuut	Gewone bus	30 procent	Extra bewakingscamera's	Laag
48	2 euro	1 minuut	25 minuten	5 minuten	Gewone bus	30 procent	Extra bewakingscamera's en beveiligingspersoneel	Gemiddeld
49	3 euro	4 minuten	15 minuten	5 minuten	Snelbus	0 procent	Geen maatregelen	Hoog
50	3 euro	7 minuten	25 minuten	3 minuten	Snelbus	0 procent	Extra bewakingscamera's	Laag
51	3 euro	1 minuut	20 minuten	1 minuut	Snelbus	0 procent	Extra bewakingscamera's en beveiligingspersoneel	Gemiddeld
52	1 euro	4 minuten	25 minuten	1 minuut	Shuttle bus	15 procent	Geen maatregelen	Hoog
53	1 euro	7 minuten	20 minuten	5 minuten	Shuttle bus	15 procent	Extra bewakingscamera's	Laag
54	1 euro	1 minuut	15 minuten	3 minuten	Shuttle bus	15 procent	Extra bewakingscamera's en beveiligingspersoneel	Gemiddeld
55	3 euro	7 minuten	15 minuten	5 minuten	Shuttle bus	0 procent	Extra bewakingscamera's en beveiligingspersoneel	Laag
56	3 euro	1 minuut	25 minuten	3 minuten	Shuttle bus	0 procent	Geen maatregelen	Gemiddeld
57	3 euro	4 minuten	20 minuten	1 minuut	Shuttle bus	0 procent	Extra bewakingscamera's	Hoog
58	1 euro	7 minuten	25 minuten	1 minuut	Gewone bus	15 procent	Extra bewakingscamera's en beveiligingspersoneel	Laag
59	1 euro	1 minuut	20 minuten	5 minuten	Gewone bus	15 procent	Geen maatregelen	Gemiddeld
60	1 euro	4 minuten	15 minuten	3 minuten	Gewone bus	15 procent	Extra bewakingscamera's	Hoog
61	2 euro	7 minuten	20 minuten	3 minuten	Snelbus	30 procent	Extra bewakingscamera's en beveiligingspersoneel	Laag
62	2 euro	1 minuut	15 minuten	1 minuut	Snelbus	30 procent	Geen maatregelen	Gemiddeld
63	2 euro	4 minuten	25 minuten	5 minuten	Snelbus	30 procent	Extra bewakingscamera's	Hoog
64	3 euro	7 minuten	15 minuten	5 minuten	Gewone bus	30 procent	Geen maatregelen	Hoog
65	3 euro	1 minuut	25 minuten	3 minuten	Gewone bus	30 procent	Extra bewakingscamera's	Laag
66	3 euro	4 minuten	20 minuten	1 minuut	Gewone bus	30 procent	Extra bewakingscamera's en beveiligingspersoneel	Gemiddeld
67	1 euro	7 minuten	25 minuten	1 minuut	Snelbus	0 procent	Geen maatregelen	Hoog
68	1 euro	1 minuut	20 minuten	5 minuten	Snelbus	0 procent	Extra bewakingscamera's	Laag

69	1 euro	4 minuten	15 minuten	3 minuten	Snelbus	0 procent	Extra bewakingscamera's en beveiligingspersoneel	Gemiddeld
70	2 euro	7 minuten	20 minuten	3 minuten	Shuttle bus	15 procent	Geen maatregelen	Hoog
71	2 euro	1 minuut	15 minuten	1 minuut	Shuttle bus	15 procent	Extra bewakingscamera's	Laag
72	2 euro	4 minuten	25 minuten	5 minuten	Shuttle bus	15 procent	Extra bewakingscamera's en beveiligingspersoneel	Gemiddeld
73	3 euro	7 minuten	15 minuten	5 minuten	Snelbus	15 procent	Extra bewakingscamera's	Gemiddeld
74	3 euro	1 minuut	25 minuten	3 minuten	Snelbus	15 procent	Extra bewakingscamera's en beveiligingspersoneel	Hoog
75	3 euro	4 minuten	20 minuten	1 minuut	Snelbus	15 procent	Geen maatregelen	Laag
76	1 euro	7 minuten	25 minuten	1 minuut	Shuttle bus	30 procent	Extra bewakingscamera's	Gemiddeld
77	1 euro	1 minuut	20 minuten	5 minuten	Shuttle bus	30 procent	Extra bewakingscamera's en beveiligingspersoneel	Hoog
78	1 euro	4 minuten	15 minuten	3 minuten	Shuttle bus	30 procent	Geen maatregelen	Laag
79	2 euro	7 minuten	20 minuten	3 minuten	Gewone bus	0 procent	Extra bewakingscamera's	Gemiddeld
80	2 euro	1 minuut	15 minuten	1 minuut	Gewone bus	0 procent	Extra bewakingscamera's en beveiligingspersoneel	Hoog
81	2 euro	4 minuten	25 minuten	5 minuten	Gewone bus	0 procent	Geen maatregelen	Laag

Attribute levels for pre-transportation mode bicycle

id	COS_bike	IVT_bike	POS_bike	DEL_bike	SAF_bike	SOC_bike
1	0,50 euro per keer	20 minuten	2 minuten	0 procent	Beperkte aanwezigheid fietsvoorzieningen	Hoog
2	1,00 euro per keer	30 minuten	6 minuten	5 procent	Beperkte aanwezigheid fietsvoorzieningen	Laag
3	1,50 euro per keer	25 minuten	4 minuten	10 procent	Beperkte aanwezigheid fietsvoorzieningen	Gemiddeld
4	1,00 euro per keer	30 minuten	4 minuten	10 procent	Ruime aanwezigheid fietsvoorzieningen	Hoog
5	1,50 euro per keer	25 minuten	2 minuten	0 procent	Ruime aanwezigheid fietsvoorzieningen	Laag
6	0,50 euro per keer	20 minuten	6 minuten	5 procent	Ruime aanwezigheid fietsvoorzieningen	Gemiddeld
7	1,50 euro per keer	25 minuten	6 minuten	5 procent	Gemiddelde aanwezigheid fietsvoorzieningen	Hoog
8	0,50 euro per keer	20 minuten	4 minuten	10 procent	Gemiddelde aanwezigheid fietsvoorzieningen	Laag
9	1,00 euro per keer	30 minuten	2 minuten	0 procent	Gemiddelde aanwezigheid fietsvoorzieningen	Gemiddeld
10	1,00 euro per keer	25 minuten	4 minuten	5 procent	Beperkte aanwezigheid fietsvoorzieningen	Hoog
11	1,50 euro per keer	20 minuten	2 minuten	10 procent	Beperkte aanwezigheid fietsvoorzieningen	Laag
12	0,50 euro per keer	30 minuten	6 minuten	0 procent	Beperkte aanwezigheid fietsvoorzieningen	Gemiddeld
13	1,50 euro per keer	20 minuten	6 minuten	0 procent	Ruime aanwezigheid fietsvoorzieningen	Hoog
14	0,50 euro per keer	30 minuten	4 minuten	5 procent	Ruime aanwezigheid fietsvoorzieningen	Laag
15	1,00 euro per keer	25 minuten	2 minuten	10 procent	Ruime aanwezigheid fietsvoorzieningen	Gemiddeld
16	0,50 euro per keer	30 minuten	2 minuten	10 procent	Gemiddelde aanwezigheid fietsvoorzieningen	Hoog
17	1,00 euro per keer	25 minuten	6 minuten	0 procent	Gemiddelde aanwezigheid fietsvoorzieningen	Laag
18	1,50 euro per keer	20 minuten	4 minuten	5 procent	Gemiddelde aanwezigheid fietsvoorzieningen	Gemiddeld
19	1,50 euro per keer	30 minuten	6 minuten	10 procent	Beperkte aanwezigheid fietsvoorzieningen	Hoog
20	0,50 euro per keer	25 minuten	4 minuten	0 procent	Beperkte aanwezigheid fietsvoorzieningen	Laag
21	1,00 euro per keer	20 minuten	2 minuten	5 procent	Beperkte aanwezigheid fietsvoorzieningen	Gemiddeld
22	0,50 euro per keer	25 minuten	2 minuten	5 procent	Ruime aanwezigheid fietsvoorzieningen	Hoog
23	1,00 euro per keer	20 minuten	6 minuten	10 procent	Ruime aanwezigheid fietsvoorzieningen	Laag
24	1,50 euro per keer	30 minuten	4 minuten	0 procent	Ruime aanwezigheid fietsvoorzieningen	Gemiddeld
25	1,00 euro per keer	20 minuten	4 minuten	0 procent	Gemiddelde aanwezigheid	Hoog

					fietsvoorzieningen	
26	1,50 euro per keer	30 minuten	2 minuten	5 procent	Gemiddelde aanwezigheid fietsvoorzieningen	Laag
27	0,50 euro per keer	25 minuten	6 minuten	10 procent	Gemiddelde aanwezigheid fietsvoorzieningen	Gemiddeld
28	1,00 euro per keer	25 minuten	4 minuten	5 procent	Gemiddelde aanwezigheid fietsvoorzieningen	Gemiddeld
29	1,50 euro per keer	20 minuten	2 minuten	10 procent	Gemiddelde aanwezigheid fietsvoorzieningen	Hoog
30	0,50 euro per keer	30 minuten	6 minuten	0 procent	Gemiddelde aanwezigheid fietsvoorzieningen	Laag
31	1,50 euro per keer	20 minuten	6 minuten	0 procent	Beperkte aanwezigheid fietsvoorzieningen	Gemiddeld
32	0,50 euro per keer	30 minuten	4 minuten	5 procent	Beperkte aanwezigheid fietsvoorzieningen	Hoog
33	1,00 euro per keer	25 minuten	2 minuten	10 procent	Beperkte aanwezigheid fietsvoorzieningen	Laag
34	0,50 euro per keer	30 minuten	2 minuten	10 procent	Ruime aanwezigheid fietsvoorzieningen	Gemiddeld
35	1,00 euro per keer	25 minuten	6 minuten	0 procent	Ruime aanwezigheid fietsvoorzieningen	Hoog
36	1,50 euro per keer	20 minuten	4 minuten	5 procent	Ruime aanwezigheid fietsvoorzieningen	Laag
37	1,50 euro per keer	30 minuten	6 minuten	10 procent	Gemiddelde aanwezigheid fietsvoorzieningen	Gemiddeld
38	0,50 euro per keer	25 minuten	4 minuten	0 procent	Gemiddelde aanwezigheid fietsvoorzieningen	Hoog
39	1,00 euro per keer	20 minuten	2 minuten	5 procent	Gemiddelde aanwezigheid fietsvoorzieningen	Laag
40	0,50 euro per keer	25 minuten	2 minuten	5 procent	Beperkte aanwezigheid fietsvoorzieningen	Gemiddeld
41	1,00 euro per keer	20 minuten	6 minuten	10 procent	Beperkte aanwezigheid fietsvoorzieningen	Hoog
42	1,50 euro per keer	30 minuten	4 minuten	0 procent	Beperkte aanwezigheid fietsvoorzieningen	Laag
43	1,00 euro per keer	20 minuten	4 minuten	0 procent	Ruime aanwezigheid fietsvoorzieningen	Gemiddeld
44	1,50 euro per keer	30 minuten	2 minuten	5 procent	Ruime aanwezigheid fietsvoorzieningen	Hoog
45	0,50 euro per keer	25 minuten	6 minuten	10 procent	Ruime aanwezigheid fietsvoorzieningen	Laag
46	0,50 euro per keer	20 minuten	2 minuten	0 procent	Gemiddelde aanwezigheid fietsvoorzieningen	Gemiddeld
47	1,00 euro per keer	30 minuten	6 minuten	5 procent	Gemiddelde aanwezigheid fietsvoorzieningen	Hoog
48	1,50 euro per keer	25 minuten	4 minuten	10 procent	Gemiddelde aanwezigheid fietsvoorzieningen	Laag
49	1,00 euro per keer	30 minuten	4 minuten	10 procent	Beperkte aanwezigheid fietsvoorzieningen	Gemiddeld
50	1,50 euro per keer	25 minuten	2 minuten	0 procent	Beperkte aanwezigheid fietsvoorzieningen	Hoog
51	0,50 euro per keer	20 minuten	6 minuten	5 procent	Beperkte aanwezigheid fietsvoorzieningen	Laag
52	1,50 euro per keer	25 minuten	6 minuten	5 procent	Ruime aanwezigheid fietsvoorzieningen	Gemiddeld
53	0,50 euro per keer	20 minuten	4 minuten	10 procent	Ruime aanwezigheid fietsvoorzieningen	Hoog
54	1,00 euro per keer	30 minuten	2 minuten	0 procent	Ruime aanwezigheid fietsvoorzieningen	Laag
55	1,50 euro per keer	30 minuten	6 minuten	10 procent	Ruime aanwezigheid fietsvoorzieningen	Laag
56	0,50 euro per keer	25 minuten	4 minuten	0 procent	Ruime aanwezigheid fietsvoorzieningen	Gemiddeld
57	1,00 euro per keer	20 minuten	2 minuten	5 procent	Ruime aanwezigheid fietsvoorzieningen	Hoog
58	0,50 euro per keer	25 minuten	2 minuten	5 procent	Gemiddelde aanwezigheid fietsvoorzieningen	Laag
59	1,00 euro per keer	20 minuten	6 minuten	10 procent	Gemiddelde aanwezigheid fietsvoorzieningen	Gemiddeld
60	1,50 euro per keer	30 minuten	4 minuten	0 procent	Gemiddelde aanwezigheid fietsvoorzieningen	Hoog
61	1,00 euro per keer	20 minuten	4 minuten	0 procent	Beperkte aanwezigheid fietsvoorzieningen	Laag
62	1,50 euro per keer	30 minuten	2 minuten	5 procent	Beperkte aanwezigheid fietsvoorzieningen	Gemiddeld
63	0,50 euro per keer	25 minuten	6 minuten	10 procent	Beperkte aanwezigheid fietsvoorzieningen	Hoog
64	0,50 euro per keer	20 minuten	2 minuten	0 procent	Ruime aanwezigheid fietsvoorzieningen	Laag

65	1,00 euro per keer	30 minuten	6 minuten	5 procent	Ruime aanwezigheid fietsvoorzieningen	Gemiddeld
66	1,50 euro per keer	25 minuten	4 minuten	10 procent	Ruime aanwezigheid fietsvoorzieningen	Hoog
67	1,00 euro per keer	30 minuten	4 minuten	10 procent	Gemiddelde aanwezigheid fietsvoorzieningen	Laag
68	1,50 euro per keer	25 minuten	2 minuten	0 procent	Gemiddelde aanwezigheid fietsvoorzieningen	Gemiddeld
69	0,50 euro per keer	20 minuten	6 minuten	5 procent	Gemiddelde aanwezigheid fietsvoorzieningen	Hoog
70	1,50 euro per keer	25 minuten	6 minuten	5 procent	Beperkte aanwezigheid fietsvoorzieningen	Laag
71	0,50 euro per keer	20 minuten	4 minuten	10 procent	Beperkte aanwezigheid fietsvoorzieningen	Gemiddeld
72	1,00 euro per keer	30 minuten	2 minuten	0 procent	Beperkte aanwezigheid fietsvoorzieningen	Hoog
73	1,00 euro per keer	25 minuten	4 minuten	5 procent	Ruime aanwezigheid fietsvoorzieningen	Laag
74	1,50 euro per keer	20 minuten	2 minuten	10 procent	Ruime aanwezigheid fietsvoorzieningen	Gemiddeld
75	0,50 euro per keer	30 minuten	6 minuten	0 procent	Ruime aanwezigheid fietsvoorzieningen	Hoog
76	1,50 euro per keer	20 minuten	6 minuten	0 procent	Gemiddelde aanwezigheid fietsvoorzieningen	Laag
77	0,50 euro per keer	30 minuten	4 minuten	5 procent	Gemiddelde aanwezigheid fietsvoorzieningen	Gemiddeld
78	1,00 euro per keer	25 minuten	2 minuten	10 procent	Gemiddelde aanwezigheid fietsvoorzieningen	Hoog
79	0,50 euro per keer	30 minuten	2 minuten	10 procent	Beperkte aanwezigheid fietsvoorzieningen	Laag
80	1,00 euro per keer	25 minuten	6 minuten	0 procent	Beperkte aanwezigheid fietsvoorzieningen	Gemiddeld
81	1,50 euro per keer	20 minuten	4 minuten	5 procent	Beperkte aanwezigheid fietsvoorzieningen	Hoog

Attribute levels for pre-transportation mode car

id	IVT_drop	POS_drop	DEL_drop	SAF_drop	SOC_drop	COS_drop
1	10 minuten	2 minuten	0 procent	Geen maatregelen	Hoog	3,00 euro per dag*
2	20 minuten	5 minuten	0 procent	Geen maatregelen	Laag	3,50 euro per dag*
3	15 minuten	8 minuten	0 procent	Geen maatregelen	Gemiddeld	4,00 euro per dag*
4	20 minuten	8 minuten	20 procent	Extra bewakingscamera's	Hoog	3,00 euro per dag*
5	15 minuten	2 minuten	20 procent	Extra bewakingscamera's	Laag	3,50 euro per dag*
6	10 minuten	5 minuten	20 procent	Extra bewakingscamera's	Gemiddeld	4,00 euro per dag*
7	15 minuten	5 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	Hoog	3,00 euro per dag*
8	10 minuten	8 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	Laag	3,50 euro per dag*
9	20 minuten	2 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	Gemiddeld	4,00 euro per dag*
10	10 minuten	2 minuten	20 procent	Extra bewakingscamera's en beveiligingspersoneel	Laag	4,00 euro per dag*
11	20 minuten	5 minuten	20 procent	Extra bewakingscamera's en beveiligingspersoneel	Gemiddeld	3,00 euro per dag*
12	15 minuten	8 minuten	20 procent	Extra bewakingscamera's en beveiligingspersoneel	Hoog	3,50 euro per dag*
13	20 minuten	8 minuten	10 procent	Geen maatregelen	Laag	4,00 euro per dag*
14	15 minuten	2 minuten	10 procent	Geen maatregelen	Gemiddeld	3,00 euro per dag*
15	10 minuten	5 minuten	10 procent	Geen maatregelen	Hoog	3,50 euro per dag*
16	15 minuten	5 minuten	0 procent	Extra bewakingscamera's	Laag	4,00 euro per dag*
17	10 minuten	8 minuten	0 procent	Extra bewakingscamera's	Gemiddeld	3,00 euro per dag*
18	20 minuten	2 minuten	0 procent	Extra bewakingscamera's	Hoog	3,50 euro per dag*
19	10 minuten	2 minuten	10 procent	Extra bewakingscamera's	Gemiddeld	3,50 euro per dag*
20	20 minuten	5 minuten	10 procent	Extra bewakingscamera's	Hoog	4,00 euro per dag*

21	15 minuten	8 minuten	10 procent	Extra bewakingscamera's	Laag	3,00 euro per dag*
22	20 minuten	8 minuten	0 procent	Extra bewakingscamera's en beveiligingspersoneel	Gemiddeld	3,50 euro per dag*
23	15 minuten	2 minuten	0 procent	Extra bewakingscamera's en beveiligingspersoneel	Hoog	4,00 euro per dag*
24	10 minuten	5 minuten	0 procent	Extra bewakingscamera's en beveiligingspersoneel	Laag	3,00 euro per dag*
25	15 minuten	5 minuten	20 procent	Geen maatregelen	Gemiddeld	3,50 euro per dag*
26	10 minuten	8 minuten	20 procent	Geen maatregelen	Hoog	4,00 euro per dag*
27	20 minuten	2 minuten	20 procent	Geen maatregelen	Laag	3,00 euro per dag*
28	15 minuten	5 minuten	10 procent	Extra bewakingscamera's	Gemiddeld	3,50 euro per dag*
29	10 minuten	8 minuten	10 procent	Extra bewakingscamera's	Hoog	4,00 euro per dag*
30	20 minuten	2 minuten	10 procent	Extra bewakingscamera's	Laag	3,00 euro per dag*
31	10 minuten	2 minuten	0 procent	Extra bewakingscamera's en beveiligingspersoneel	Gemiddeld	3,50 euro per dag*
32	20 minuten	5 minuten	0 procent	Extra bewakingscamera's en beveiligingspersoneel	Hoog	4,00 euro per dag*
33	15 minuten	8 minuten	0 procent	Extra bewakingscamera's en beveiligingspersoneel	Laag	3,00 euro per dag*
34	20 minuten	8 minuten	20 procent	Geen maatregelen	Gemiddeld	3,50 euro per dag*
35	15 minuten	2 minuten	20 procent	Geen maatregelen	Hoog	4,00 euro per dag*
36	10 minuten	5 minuten	20 procent	Geen maatregelen	Laag	3,00 euro per dag*
37	15 minuten	5 minuten	0 procent	Geen maatregelen	Hoog	3,00 euro per dag*
38	10 minuten	8 minuten	0 procent	Geen maatregelen	Laag	3,50 euro per dag*
39	20 minuten	2 minuten	0 procent	Geen maatregelen	Gemiddeld	4,00 euro per dag*
40	10 minuten	2 minuten	20 procent	Extra bewakingscamera's	Hoog	3,00 euro per dag*
41	20 minuten	5 minuten	20 procent	Extra bewakingscamera's	Laag	3,50 euro per dag*
42	15 minuten	8 minuten	20 procent	Extra bewakingscamera's	Gemiddeld	4,00 euro per dag*
43	20 minuten	8 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	Hoog	3,00 euro per dag*
44	15 minuten	2 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	Laag	3,50 euro per dag*
45	10 minuten	5 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	Gemiddeld	4,00 euro per dag*
46	15 minuten	5 minuten	20 procent	Extra bewakingscamera's en beveiligingspersoneel	Laag	4,00 euro per dag*
47	10 minuten	8 minuten	20 procent	Extra bewakingscamera's en beveiligingspersoneel	Gemiddeld	3,00 euro per dag*
48	20 minuten	2 minuten	20 procent	Extra bewakingscamera's en beveiligingspersoneel	Hoog	3,50 euro per dag*
49	10 minuten	2 minuten	10 procent	Geen maatregelen	Laag	4,00 euro per dag*
50	20 minuten	5 minuten	10 procent	Geen maatregelen	Gemiddeld	3,00 euro per dag*
51	15 minuten	8 minuten	10 procent	Geen maatregelen	Hoog	3,50 euro per dag*
52	20 minuten	8 minuten	0 procent	Extra bewakingscamera's	Laag	4,00 euro per dag*
53	15 minuten	2 minuten	0 procent	Extra bewakingscamera's	Gemiddeld	3,00 euro per dag*
54	10 minuten	5 minuten	0 procent	Extra bewakingscamera's	Hoog	3,50 euro per dag*
55	20 minuten	8 minuten	20 procent	Extra bewakingscamera's en beveiligingspersoneel	Laag	4,00 euro per dag*
56	15 minuten	2 minuten	20 procent	Extra bewakingscamera's en beveiligingspersoneel	Gemiddeld	3,00 euro per dag*
57	10 minuten	5 minuten	20 procent	Extra bewakingscamera's en beveiligingspersoneel	Hoog	3,50 euro per dag*
58	15 minuten	5 minuten	10 procent	Geen maatregelen	Laag	4,00 euro per dag*
59	10 minuten	8 minuten	10 procent	Geen maatregelen	Gemiddeld	3,00 euro per dag*

60	20 minuten	2 minuten	10 procent	Geen maatregelen	Hoog	3,50 euro per dag*
61	10 minuten	2 minuten	0 procent	Extra bewakingscamera's	Laag	4,00 euro per dag*
62	20 minuten	5 minuten	0 procent	Extra bewakingscamera's	Gemiddeld	3,00 euro per dag*
63	15 minuten	8 minuten	0 procent	Extra bewakingscamera's	Hoog	3,50 euro per dag*
64	20 minuten	8 minuten	10 procent	Extra bewakingscamera's	Gemiddeld	3,50 euro per dag*
65	15 minuten	2 minuten	10 procent	Extra bewakingscamera's	Hoog	4,00 euro per dag*
66	10 minuten	5 minuten	10 procent	Extra bewakingscamera's	Laag	3,00 euro per dag*
67	15 minuten	5 minuten	0 procent	Extra bewakingscamera's en beveiligingspersoneel	Gemiddeld	3,50 euro per dag*
68	10 minuten	8 minuten	0 procent	Extra bewakingscamera's en beveiligingspersoneel	Hoog	4,00 euro per dag*
69	20 minuten	2 minuten	0 procent	Extra bewakingscamera's en beveiligingspersoneel	Laag	3,00 euro per dag*
70	10 minuten	2 minuten	20 procent	Geen maatregelen	Gemiddeld	3,50 euro per dag*
71	20 minuten	5 minuten	20 procent	Geen maatregelen	Hoog	4,00 euro per dag*
72	15 minuten	8 minuten	20 procent	Geen maatregelen	Laag	3,00 euro per dag*
73	20 minuten	8 minuten	0 procent	Geen maatregelen	Hoog	3,00 euro per dag*
74	15 minuten	2 minuten	0 procent	Geen maatregelen	Laag	3,50 euro per dag*
75	10 minuten	5 minuten	0 procent	Geen maatregelen	Gemiddeld	4,00 euro per dag*
76	15 minuten	5 minuten	20 procent	Extra bewakingscamera's	Hoog	3,00 euro per dag*
77	10 minuten	8 minuten	20 procent	Extra bewakingscamera's	Laag	3,50 euro per dag*
78	20 minuten	2 minuten	20 procent	Extra bewakingscamera's	Gemiddeld	4,00 euro per dag*
79	10 minuten	2 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	Hoog	3,00 euro per dag*
80	20 minuten	5 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	Laag	3,50 euro per dag*
81	15 minuten	8 minuten	10 procent	Extra bewakingscamera's en beveiligingspersoneel	Gemiddeld	4,00 euro per dag*

Appendix B. Questionnaire with nine random choice tasks

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Vervoermiddelkeuze en voortransport

Welkom!

Geachte heer/mevrouw,

Mijn naam is Koen Sanders. Ik studeer Construction, Management & Engineering aan de Technische Universiteit Eindhoven. Graag nodig ik u uit deel te nemen aan mijn onderzoek.

Als het goed is woont U in de buurt van Eindhoven. Voor het reizen van uw woonlocatie naar één van de grote steden in Nederland zijn verschillende alternatieve reisopties (waaronder trein en auto) beschikbaar. Dit onderzoek gaat over uw vervoermiddelkeuze wanneer u een verplaatsing maakt van uw woonlocatie naar de grote steden in Nederland. Het doel van dit onderzoek is om inzicht te krijgen in de invloed van het voortransport op de vervoermiddelkeuze van reizigers. Onder voortransport wordt in dit onderzoek verstaan: de verplaatsing van uw woonadres naar het dichtst bij gelegen hoofdtreinstation.

Door deelname helpt u mij met mijn afstudeerproject. Daarvoor wil ik u alvast hartelijk danken!

De enquête duurt ongeveer 15 minuten. De gegevens worden volledig anoniem verwerkt.

Met vriendelijke groet,

Koen Sanders

Start

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Vervoermiddelkeuze en voortransport

Deel A: Huidige verplaatsingsgedrag

Maakt u wel eens een reis naar de onderstaande steden?

Geef hieronder uw antwoorden (iedere stad één antwoord).

Stad	Nooit	Soms	Regelmatig	Vaak
Utrecht	●	○	○	○
Amsterdam	○	●	○	○
Nijmegen	○	○	●	○
Arnhem	○	●	○	○
Heerlen	○	●	○	○
Maastricht	○	●	○	○
Rotterdam	○	●	○	○
Den Haag	○	●	○	○

Vorige **Volgende**

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Vervoermiddelkeuze en voortransport

Deel A: Huidige verplaatsingsgedrag

Geef per stad aan met welk(e) doel(en) u dan deze verplaatsing maakt:

Geef hieronder uw antwoorden (meerdere antwoorden per stad mogelijk)*

Stad	Werk	Studie	Recreatie	Anders
Utrecht	☐	☐	☐	☐
Amsterdam	☐	☐	☐	☐
Nijmegen	☐	☐	☐	☐
Arnhem	☐	☐	☐	☐
Heerlen	☐	☐	☐	☐
Maastricht	☐	☐	☐	☐
Rotterdam	☐	☐	☐	☐
Den Haag	☐	☐	☐	☐

* Als u een stad nooit bezoekt, hoeft u geen doel aan te vinken voor deze stad.

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Vervoermiddelkeuze en voortransport

Deel A: Huidige verplaatsingsgedrag

Welk(e) vervoermiddel(en) gebruikt u voor de verplaatsing naar deze steden?

Geef hieronder uw antwoorden (meerdere antwoorden per stad mogelijk)

Stad	Auto	Trein	Anders
Utrecht	☐	☐	☐
Amsterdam	☐	☐	☐
Nijmegen	☐	☐	☐
Arnhem	☐	☐	☐
Heerlen	☐	☐	☐
Maastricht	☐	☐	☐
Rotterdam	☐	☐	☐
Den Haag	☐	☐	☐

* Als u een stad nooit bezoekt, hoeft u geen vervoermiddel aan te vinken voor deze stad.

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Vervoermiddelkeuze en voortransport

Deel A: Huidige verplaatsingsgedrag

Wanneer u de trein gebruikt als vervoermiddel, welk (voor)transportmiddel gebruikt u dan meestal om van huis naar het station te komen?

- Bus
- Hoogwaardig openbaar vervoer (Phileas)
- Taxi
- Met de auto weggebracht worden
- De auto (parkeren nabij het station)
- Fiets
- Wisselend

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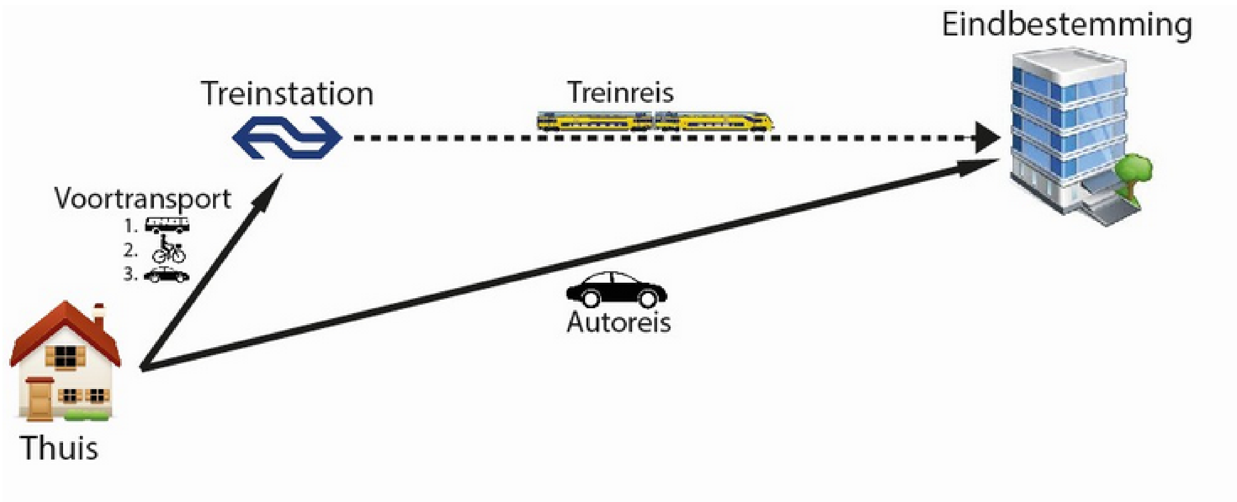
Vervoermiddelkeuze en voortransport

Deel B: Vervoermiddelkeuze

In dit deel van de enquête wordt ingegaan op de keuze die u zou maken wat betreft het vervoermiddel dat u gebruikt om op een bestemming te komen. **Eerst leggen we een paar dingen uit.**

Er zijn verschillende manieren om op een bestemming te komen. In deze enquête wordt uitgegaan van de volgende mogelijkheden (zie ook figuur).
- De trein met als voortransport de bus
- De trein met als voortransport de fiets
- De trein met als voortransport de auto, dit kan zijn dat u wordt afgezet bij het station, of dat u uw auto parkeert nabij het station (P&R Fuutlaan)
- De auto



In dit deel worden verschillende keuzesituaties aan u voorgelegd. U wordt telkens gevraagd een keuze te maken uit de verschillende vervoersopties. Ieder alternatief wordt gekenmerkt door een aantal variabelen. Deze worden op de volgende pagina toegelicht.

Vorige Volgende

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Vervoermiddelkeuze en voortransport

Deel B: Uitleg keuzesituaties

Hieronder worden de kenmerken toegelicht zodat u weet wat onder deze kenmerken verstaan wordt.

Rit-/stallingskosten
Het kenmerk rit-/stallingskosten geeft een tweedeling weer. Voor het voortransport met de bus zijn het de ritkosten die worden weergegeven en voor het voortransport met de fiets en de auto zijn het de mogelijke stallingskosten die worden weergegeven. Indien u met de auto naar het station komt en deze daar achterlaat moet u rekening houden met parkeerkosten.

Veiligheidsmaatregelen
Het kenmerk veiligheidsmaatregelen in het geval van de trein en het openbaar vervoer heeft betrekking op de veiligheid op de stations en in de voertuigen. De veiligheidsmaatregelen van de auto en drop-off hebben betrekking op de plek waar auto's worden geparkeerd of u wordt afgezet.

(Fiets)veiligheidsmaatregelen
Het kenmerk veiligheidsmaatregelen van de fiets heeft te maken met de veiligheid die u heeft tijdens het fietsen. De fietsveiligheid hangt af van het aantal fietsvoorzieningen dat aanwezig is op de route die u fietst. Wanneer het aantal fietsvoorzieningen beperkt is, dan is een klein gedeelte van de fietsroute vrijliggend fietspad en heeft u op een klein aantal kruisingen voorrang. Wanneer het aantal fietsvoorzieningen ruim is, dan is een groot gedeelte van de fietsroute vrijliggend fietspad en heeft u op een groot aantal kruisingen voorrang. Daar tussenin zit de gemiddelde aanwezigheid van fietsvoorzieningen.

Mogelijkheid tot werken
Er zijn bepaalde maatregelen die het werken in de trein kunnen bevorderen. Een tafel is vaak handig om uw boeken of laptop op de zetten. Daarnaast zou een speciale werkruimte die ingericht is om te werken nog meer voordelen kunnen opleveren.

Type bus
Er zijn in dit onderzoek drie bustypes die u voorgelegd kunnen worden. De gewone bus, deze stopt regelmatig bij haltes. De snelbus, deze slaat veel haltes over en stopt alleen maar op een aantal grotere haltes. En de shuttlebus brengt u rechtstreeks van uw halte naar het station.

Veiligheidsniveau omgeving
Het veiligheidsniveau van de omgeving is de veiligheid die u ondervindt door de aanwezigheid van veiligheidskenmerken in de omgeving. Deze veiligheidskenmerken zijn onder andere de aanwezigheid van verlichting, vluchtwegen en een ruimtelijke openheid. Bij een hoog veiligheidsniveau zijn deze zaken volop aanwezig, bij een laag veiligheidsniveau zijn deze gebrekkig of niet aanwezig.

Ieder kenmerk heeft 3 niveaus waarvan er in iedere keuzesituatie één van toepassing is. Deze zullen op de volgende pagina aan u worden voorgelegd.

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Vervoermiddelkeuze en voortransport

Deel B: Uitleg keuzesituaties

Ieder kenmerk heeft 3 niveaus waarvan er in iedere keuzesituatie één van toepassing is.

De **tijden**, **kosten** en **kansen** worden respectievelijk weergegeven in minuten, euro's en procenten.

Het kenmerk **Veiligheidsmaatregelen** heeft de volgende drie niveaus:
- Geen maatregelen
- Extra bewakingscamera's
- Extra bewakingscamera's en beveiligingspersoneel

Het kenmerk **(Fiets)veiligheidsmaatregelen** heeft de volgende drie niveaus:
- Beperkte aanwezigheid fietsvoorzieningen
- Gemiddelde aanwezigheid fietsvoorzieningen
- Ruime aanwezigheid fietsvoorzieningen

Het kenmerk **Mogelijkheid tot werken** heeft de volgende drie niveaus:
- Geen maatregelen
- Persoonlijke werktafels
- Speciale werkruimtes

Het kenmerk **Type bus** bestaat uit de volgende niveaus:
- Gewone bus
- Snelbus (minder haltes)
- Shuttlebus (rechtstreeks)

Het kenmerk **Veiligheidsniveau omgeving** kent de volgende veiligheidsniveaus:
- Laag
- Middelmatig
- Hoog

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Vervoermiddelkeuze en voortransport

Deel B: Uitleg keuzesituaties

In de onderstaande tabel worden vier verschillende vervoersopties gegeven. De kenmerken per vervoersoptie kunt u in de tabel van boven naar beneden aflezen. De vervoersopties waaruit u kunt kiezen worden van links naar rechts getoond.
U kunt de kenmerken van verschillende vervoersopties vergelijken. In het voorbeeld ziet u staan dat de reistijd in het voertuig bij de trein 50 minuten is en bij de auto 60 minuten. Bij de trein komt er nog 3 minuten wachttijd bij en bij de auto 9 minuten voor het zoeken naar een parkeerplaats op de eindbestemming. Bij het vervoer met de trein heeft u ook nog voortransport nodig om op het station te komen. U kunt daarvoor de bus, de fiets of de auto gebruiken. Ieder voortransport heeft weer zijn eigen kenmerken. Wanneer u in het voorbeeld kijkt naar het voortransport met de fiets, dan ziet u dat het 25 minuten zal duren om met de fiets op het station te komen. Daarna heeft u 4 minuten nodig om uw fiets te stallen en naar het perron te lopen.

Tot nu toe is er enkel gekeken naar de tijden van elke vervoersoptie. Naast tijd zijn er nog andere kenmerken die uw keuze kunnen beïnvloeden. Bekijk en vergelijk deze kenmerken goed zodat u een onderbouwde keuze kunt maken. Onder aan de tabel kunt u de keuzeoptie die uw voorkeur heeft aanvinken.

Voorbeeldtabel

Kenmerken	Trein			Auto
Reistijd in het voertuig	50 minuten			60 minuten
Wachttijd/zoektijd naar parkeerplaats	3 minuten			9 minuten
Kosten trein-/autoreis	14 euro			15 euro
Kosten parkeren auto				4 euro per uur
Kans op vertraging	10 procent			20 procent
Veiligheid	Geen maatregelen			Extra bewakingscamera's en beveiligingspersoneel
Mogelijkheid tot werken	Speciale werkruimtes			
	Voortransport			
	Bus	Fiets	Auto drop-off/parkeren	
Tijd om bij halte te komen	4 minuten			
Reistijd in/op het voertuig	20 minuten	25 minuten	15 minuten	
Tijd om op het perron te komen	3 minuten	4 minuten	5 minuten	
Rit-/stallingskosten	1 euro	1,50 euro per keer	3,00 euro per dag*	
Kans op vertraging	15 procent	5 procent	10 procent	
Bustype	Snelbus			
Veiligheidsmaatregelen	Geen maatregelen	Ruime aanwezigheid fietsvoorzieningen	Extra bewakingscamera's	
Veiligheidsniveau omgeving	Hoog	Gemiddeld	Laag	
Uw voorkeur	◉	○	○	○

* Dit tarief geldt enkel indien u uw auto in de buurt van het station parkeert.

Nu volgen 9 tabellen waarin u gevraagd wordt uw voorkeur aan te vinken. Succes!

Vorige | Volgende

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Vervoermiddelkeuze en voortransport

Vink onderaan in de tabel de vervoersoptie aan die uw voorkeur heeft.

Kenmerken	Trein			Auto
Reistijd in het voertuig	55 minuten			60 minuten
Wachttijd/zoektijd naar parkeerplaats	15 minuten			3 minuten
Kosten trein-/autoreis	18 euro			10 euro
Kosten parkeren auto				4 euro per uur
Kans op vertraging	15 procent			20 procent
Veiligheid	Extra bewakingscamera's			Geen maatregelen
Mogelijkheid tot werken	Geen maatregelen			
	Voortransport			
	Bus	Fiets	Auto drop-off /parkeren	
Tijd om bij halte te komen	1 minuut			
Reistijd in/op het voertuig	25 minuten	25 minuten	20 minuten	
Tijd om op het perron te komen	5 minuten	4 minuten	2 minuten	
Rit-/stallingskosten	2 euro	1.50 euro per keer	3.50 euro per dag*	
Kans op vertraging	30 procent	10 procent	20 procent	
Bustype	Gewone bus			
Veiligheidsmaatregelen	Extra bewakingscamera's en beveiligingspersoneel	Gemiddelde aanwezigheid fietsvoorzieningen	Extra bewakingscamera's en beveiligingspersoneel	
Veiligheidsniveau omgeving	Gemiddeld	Laag	Hoog	
Uw voorkeur	○	○	○	○

* Dit tarief geldt enkel indien u uw auto in de buurt van het station parkeert.

Vorige Volgende

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Vervoermiddelkeuze en voortransport

Vink onderaan in de tabel de vervoersoptie aan die uw voorkeur heeft.

Kenmerken	Trein			Auto
Reistijd in het voertuig	55 minuten			50 minuten
Wachttijd/zoektijd naar parkeerplaats	9 minuten			9 minuten
Kosten trein-/autoreis	18 euro			15 euro
Kosten parkeren auto				2 euro per uur
Kans op vertraging	10 procent			10 procent
Veiligheid	Extra bewakingscamera's en beveiligingspersoneel			Extra bewakingscamera's
Mogelijkheid tot werken	Geen maatregelen			
	Voortransport			
	Bus	Fiets	Auto drop-off /parkeren	
Tijd om bij halte te komen	7 minuten			
Reistijd in/op het voertuig	15 minuten	30 minuten	10 minuten	
Tijd om op het perron te komen	1 minuut	6 minuten	8 minuten	
Rit-/stallingskosten	2 euro	1.00 euro per keer	3.00 euro per dag*	
Kans op vertraging	30 procent	5 procent	20 procent	
Bustype	Gewone bus			
Veiligheidsmaatregelen	Extra bewakingscamera's	Gemiddelde aanwezigheid fietsvoorzieningen	Extra bewakingscamera's en beveiligingspersoneel	
Veiligheidsniveau omgeving	Laag	Hoog	Gemiddeld	
Uw voorkeur	○	○	○	○

* Dit tarief geldt enkel indien u uw auto in de buurt van het station parkeert.

Vorige | Volgende

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Vervoermiddelkeuze en voortransport

Vink onderaan in de tabel de vervoersoptie aan die uw voorkeur heeft.

Kenmerken	Trein			Auto
Reistijd in het voertuig	55 minuten			70 minuten
Wachttijd/zoektijd naar parkeerplaats	3 minuten			15 minuten
Kosten trein-/autoreis	18 euro			20 euro
Kosten parkeren auto				6 euro per uur
Kans op vertraging	5 procent			30 procent
Veiligheid	Geen maatregelen			Extra bewakingscamera's en beveiligingspersoneel
Mogelijkheid tot werken	Geen maatregelen			
	Voortransport			
	Bus	Fiets	Auto drop-off /parkeren	
Tijd om bij halte te komen	4 minuten			
Reistijd in/op het voertuig	20 minuten	20 minuten	15 minuten	
Tijd om op het perron te komen	3 minuten	2 minuten	5 minuten	
Rit-/stallingskosten	2 euro	0.50 euro per keer	4.00 euro per dag*	
Kans op vertraging	30 procent	0 procent	20 procent	
Bustype	Gewone bus			
Veiligheidsmaatregelen	Geen maatregelen	Gemiddelde aanwezigheid fietsvoorzieningen	Extra bewakingscamera's en beveiligingspersoneel	
Veiligheidsniveau omgeving	Hoog	Gemiddeld	Laag	
Uw voorkeur	○	○	○	○

* Dit tarief geldt enkel indien u uw auto in de buurt van het station parkeert.

Vorige Volgende

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TU/e Technische Universiteit Eindhoven University of Technology

Vervoermiddelkeuze en voortransport

Vink onderaan in de tabel de vervoersoptie aan die uw voorkeur heeft.

Kenmerken	**Trein**			**Auto**
Reistijd in het voertuig	50 minuten			50 minuten
Wachttijd/zoektijd naar parkeerplaats	9 minuten			9 minuten
Kosten trein-/autoreis	14 euro			20 euro
Kosten parkeren auto				6 euro per uur
Kans op vertraging	15 procent			20 procent
Veiligheid	Geen maatregelen			Geen maatregelen
Mogelijkheid tot werken	Speciale werkruimtes			
	Voortransport			
	Bus	**Fiets**	**Auto drop-off /parkeren**	
Tijd om bij halte te komen	4 minuten			
Reistijd in/op het voertuig	15 minuten	20 minuten	15 minuten	
Tijd om op het perron te komen	1 minuut	6 minuten	2 minuten	
Rit-/stallingskosten	2 euro	1.00 euro per keer	4.00 euro per dag*	
Kans op vertraging	15 procent	10 procent	0 procent	
Bustype	Gewone bus			
Veiligheidsmaatregelen	Geen maatregelen	Ruime aanwezigheid fietsvoorzieningen	Extra bewakingscamera's en beveiligingspersoneel	
Veiligheidsniveau omgeving	Gemiddeld	Laag	Hoog	
Uw voorkeur	○	○	○	○

* Dit tarief geldt enkel indien u uw auto in de buurt van het station parkeert.

Vorige | **Volgende**

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Vervoermiddelkeuze en voortransport

Vink onderaan in de tabel de vervoersoptie aan die uw voorkeur heeft.

Kenmerken	**Trein**			**Auto**
Reistijd in het voertuig	45 minuten			60 minuten
Wachttijd/zoektijd naar parkeerplaats	9 minuten			15 minuten
Kosten trein-/autoreis	14 euro			15 euro
Kosten parkeren auto				6 euro per uur
Kans op vertraging	5 procent			10 procent
Veiligheid	Extra bewakingscamera's			Geen maatregelen
Mogelijkheid tot werken	Geen maatregelen			
	Voortransport			
	Bus	**Fiets**	**Auto drop-off /parkeren**	
Tijd om bij halte te komen	7 minuten			
Reistijd in/op het voertuig	20 minuten	25 minuten	15 minuten	
Tijd om op het perron te komen	5 minuten	6 minuten	2 minuten	
Rit-/stallingskosten	1 euro	1.00 euro per keer	4.00 euro per dag*	
Kans op vertraging	0 procent	0 procent	20 procent	
Bustype	Gewone bus			
Veiligheidsmaatregelen	Extra bewakingscamera's en beveiligingspersoneel	Ruime aanwezigheid fietsvoorzieningen	Geen maatregelen	
Veiligheidsniveau omgeving	Hoog	Hoog	Hoog	
Uw voorkeur				

* Dit tarief geldt enkel indien u uw auto in de buurt van het station parkeert.

Vorige Volgende

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Vervoermiddelkeuze en voortransport

Vink onderaan in de tabel de vervoersoptie aan die uw voorkeur heeft.

Kenmerken	Trein			Auto
Reistijd in het voertuig	55 minuten			70 minuten
Wachttijd/zoektijd naar parkeerplaats	9 minuten			3 minuten
Kosten trein-/autoreis	14 euro			10 euro
Kosten parkeren auto				6 euro per uur
Kans op vertraging	10 procent			30 procent
Veiligheid	Extra bewakingscamera's en beveiligingspersoneel			Geen maatregelen
Mogelijkheid tot werken	Persoonlijke werktafels			
	Voortransport			
	Bus	Fiets	Auto drop-off /parkeren	
Tijd om bij halte te komen	1 minuut			
Reistijd in/op het voertuig	25 minuten	30 minuten	15 minuten	
Tijd om op het perron te komen	3 minuten	6 minuten	2 minuten	
Rit-/stallingskosten	3 euro	1.00 euro per keer	4.00 euro per dag*	
Kans op vertraging	30 procent	5 procent	10 procent	
Bustype	Gewone bus			
Veiligheidsmaatregelen	Extra bewakingscamera's	Ruime aanwezigheid fietsvoorzieningen	Extra bewakingscamera's	
Veiligheidsniveau omgeving	Laag	Gemiddeld	Hoog	
Uw voorkeur	○	○	○	○

* Dit tarief geldt enkel indien u uw auto in de buurt van het station parkeert.

Vorige | Volgende

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Vervoermiddelkeuze en voortransport

Vink onderaan in de tabel de vervoersoptie aan die uw voorkeur heeft.

Kenmerken	**Trein**			**Auto**
Reistijd in het voertuig	55 minuten			60 minuten
Wachttijd/zoektijd naar parkeerplaats	3 minuten			9 minuten
Kosten trein-/autoreis	14 euro			15 euro
Kosten parkeren auto				4 euro per uur
Kans op vertraging	5 procent			20 procent
Veiligheid	Geen maatregelen			Extra bewakingscamera's
Mogelijkheid tot werken	Persoonlijke werktafels			
	Voortransport			
	Bus	**Fiets**	**Auto drop-off /parkeren**	
Tijd om bij halte te komen	1 minuut			
Reistijd in/op het voertuig	25 minuten	25 minuten	10 minuten	
Tijd om op het perron te komen	1 minuut	4 minuten	2 minuten	
Rit-/stallingskosten	1 euro	1.00 euro per keer	4.00 euro per dag*	
Kans op vertraging	15 procent	5 procent	20 procent	
Bustype	Snelbus			
Veiligheidsmaatregelen	Extra bewakingscamera's	Beperkte aanwezigheid fietsvoorzieningen	Extra bewakingscamera's en beveiligingspersoneel	
Veiligheidsniveau omgeving	Gemiddeld	Hoog	Laag	
Uw voorkeur	○	○	○	○

* Dit tarief geldt enkel indien u uw auto in de buurt van het station parkeert.

Vorige | Volgende

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Vervoermiddelkeuze en voortransport

Vink onderaan in de tabel de vervoersoptie aan die uw voorkeur heeft.

Kenmerken	Trein			Auto
Reistijd in het voertuig	55 minuten			70 minuten
Wachttijd/zoektijd naar parkeerplaats	3 minuten			15 minuten
Kosten trein-/autoreis	18 euro			20 euro
Kosten parkeren auto				6 euro per uur
Kans op vertraging	5 procent			30 procent
Veiligheid	Geen maatregelen			Extra bewakingscamera's en beveiligingspersoneel
Mogelijkheid tot werken	Geen maatregelen			
	Voortransport			
	Bus	Fiets	Auto drop-off /parkeren	
Tijd om bij halte te komen	1 minuut			
Reistijd in/op het voertuig	25 minuten	30 minuten	10 minuten	
Tijd om op het perron te komen	1 minuut	6 minuten	2 minuten	
Rit-/stallingskosten	1 euro	1.50 euro per keer	3.50 euro per dag*	
Kans op vertraging	0 procent	10 procent	10 procent	
Bustype	Shuttle bus			
Veiligheidsmaatregelen	Extra bewakingscamera's en beveiligingspersoneel	Beperkte aanwezigheid fietsvoorzieningen	Extra bewakingscamera's	
Veiligheidsniveau omgeving	Laag	Hoog	Gemiddeld	
Uw voorkeur	○	○	○	○

* Dit tarief geldt enkel indien u uw auto in de buurt van het station parkeert.

Vorige   **Volgende**

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Vervoermiddelkeuze en voortransport

Vink onderaan in de tabel de vervoersoptie aan die uw voorkeur heeft.

Kenmerken	Trein			Auto
Reistijd in het voertuig	45 minuten			50 minuten
Wachttijd/zoektijd naar parkeerplaats	15 minuten			15 minuten
Kosten trein-/autoreis	18 euro			15 euro
Kosten parkeren auto				4 euro per uur
Kans op vertraging	10 procent			30 procent
Veiligheid	Geen maatregelen			Geen maatregelen
Mogelijkheid tot werken	Speciale werkruimtes			
	Voortransport			
	Bus	Fiets	Auto drop-off /parkeren	
Tijd om bij halte te komen	1 minuut			
Reistijd in/op het voertuig	15 minuten	25 minuten	10 minuten	
Tijd om op het perron te komen	3 minuten	6 minuten	5 minuten	
Rit-/stallingskosten	1 euro	0.50 euro per keer	4.00 euro per dag*	
Kans op vertraging	30 procent	10 procent	10 procent	
Bustype	Snelbus			
Veiligheidsmaatregelen	Extra bewakingscamera's	Ruime aanwezigheid fietsvoorzieningen	Extra bewakingscamera's en beveiligingspersoneel	
Veiligheidsniveau omgeving	Hoog	Laag	Gemiddeld	
Uw voorkeur	○	○	○	○

* Dit tarief geldt enkel indien u uw auto in de buurt van het station parkeert.

Vorige | Volgende

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Vervoermiddelkeuze en voortransport

Deel C: Persoonlijke Situatie

Tot slot worden u nog enkele vragen over uw persoonlijke situatie voorgelegd zodat de enquête in een goede context geplaatst kan worden. Deze gegevens worden uiteraard volledig anoniem verwerkt en zullen niet kunnen worden herleid naar een persoon of adres.

Dit wordt u gevraagd om de representativiteit van het onderzoek te kunnen beoordelen, en om te kunnen onderzoeken of de gemaakte keuzes in de voorgaande keuzesituaties gerelateerd zijn aan bepaalde persoonlijke factoren.

Vorige | Volgende

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Vervoermiddelkeuze en voortransport

Deel C: Persoonlijke Situatie

Wat is uw geslacht?

- Man
- Vrouw

Wat is uw leeftijd?

- jonger dan 20 jaar
- 20-29 jaar
- 30-39 jaar
- 40-49 jaar
- 50-64 jaar
- 65 jaar en ouder

Wat is het hoogste opleidingsniveau dat u heeft genoten?

- Lager- of basisonderwijs
- Voortgezet onderwijs
- Middelbaar beroepsonderwijs (MBO)
- Hoger beroepsonderwijs (HBO)
- Wetenschappelijk onderwijs (WO)
- Anders, namelijk:

Vorige **Volgende**

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Vervoermiddelkeuze en voortransport

Deel C: Persoonlijke Situatie

Kunt u gratis reizen met het openbaar vervoer?

- Altijd
- Soms
- Nooit

Heeft u de mogelijkheid om een auto te gebruiken?

- Altijd
- Soms
- Nooit

Heeft u de mogelijkheid om een elektrische fiets te gebruiken?

- Altijd
- Soms
- Nooit

Vorige **Volgende**

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Vervoermiddelkeuze en voortransport

Deel C: Persoonlijke Situatie

Wat zijn de vier cijfers van de postcode van uw woonlocatie?

Hoe is uw gezin samengesteld?

- Alleenstaand (inclusief samenwonend met huisgenoten)
- Thuiswonend bij ouders
- Alleenstaand met thuiswonend(e) kind(eren)
- Met partner zonder thuiswonend(e) kind(eren)
- Met partner en met thuiswonend(e) kind(eren)

Vorige | **Volgende**

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Vervoermiddelkeuze en voortransport

Eventuele opmerkingen over het onderzoek of de enquête:

Vorige | **Volgende**

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Appendix C. Percentage and count of respondents per postal area

Postcode

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	5501	5	1,2	1,2	1,2
	5502	6	1,4	1,4	2,7
	5503	2	,5	,5	3,1
	5504	8	1,9	1,9	5,1
	5505	5	1,2	1,2	6,3
	5506	4	1,0	1,0	7,2
	5508	18	4,3	4,3	11,6
	5509	4	1,0	1,0	12,5
	5524	1	,2	,2	12,8
	5551	9	2,2	2,2	14,9
	5552	7	1,7	1,7	16,6
	5554	12	2,9	2,9	19,5
	5555	3	,7	,7	20,2
	5556	1	,2	,2	20,5
	5611	3	,7	,7	21,2
	5612	14	3,4	3,4	24,6
	5613	8	1,9	1,9	26,5
	5614	1	,2	,2	26,7
	5615	11	2,7	2,7	29,4
	5616	22	5,3	5,3	34,7
	5617	1	,2	,2	34,9
	5621	4	1,0	1,0	35,9
	5622	8	1,9	1,9	37,8
	5623	12	2,9	2,9	40,7
	5624	13	3,1	3,1	43,9
	5625	18	4,3	4,3	48,2
	5626	5	1,2	1,2	49,4
	5627	17	4,1	4,1	53,5
	5628	18	4,3	4,3	57,8
	5629	10	2,4	2,4	60,2
	5631	3	,7	,7	61,0
	5632	25	6,0	6,0	67,0
	5641	12	2,9	2,9	69,9
	5642	10	2,4	2,4	72,3
	5643	12	2,9	2,9	75,2
	5644	7	1,7	1,7	76,9
	5645	5	1,2	1,2	78,1
	5646	6	1,4	1,4	79,5
	5651	3	,7	,7	80,2
	5652	11	2,7	2,7	82,9
	5653	9	2,2	2,2	85,1
	5654	12	2,9	2,9	88,0
	5655	7	1,7	1,7	89,6
	5658	12	2,9	2,9	92,5
	5671	11	2,7	2,7	95,2
	5672	9	2,2	2,2	97,3
	5673	9	2,2	2,2	99,5
	5674	2	,5	,5	100,0
	Total	415	100,0	100,0	

Appendix D. SPSS output of gender

Statistics

Geslacht

N	Valid	415
	Missing	0

Geslacht

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Man	189	45,5	45,5	45,5
	Vrouw	226	54,5	54,5	100,0
	Total	415	100,0	100,0	

Appendix E. SPSS output of age

Statistics

Leeftijd

N	Valid	415
	Missing	0

Leeftijd

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	jonger dan 20 jaar	12	2,9	2,9	2,9
	20-29 jaar	63	15,2	15,2	18,1
	30-39 jaar	63	15,2	15,2	33,3
	40-49 jaar	83	20,0	20,0	53,3
	50-64 jaar	130	31,3	31,3	84,6
	65 jaar en ouder	64	15,4	15,4	100,0
	Total	415	100,0	100,0	

Appendix F. SPSS output of educational level

Statistics

Opleidingsniveau

N	Valid	415
	Missing	0

Opleidingsniveau

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Lager- of basisonderwijs	15	3,6	3,6	3,6
	Voortgezet onderwijs	49	11,8	11,8	15,4
	Middelbaar beroepsonderwijs (MBO)	124	29,9	29,9	45,3
	Hoger beroepsonderwijs (HBO)	173	41,7	41,7	87,0
	Wetenschappelijk onderwijs (WO)	50	12,0	12,0	99,0
	Anders, namelijk:	4	1,0	1,0	100,0
	Total	415	100,0	100,0	

Appendix G. SPSS output of household type

Statistics

Gezinssituatie

N	Valid	415
	Missing	0

Gezinssituatie

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Alleenstaand (inclusief samenwonend met huisgenoten)	114	27,5	27,5	27,5
	Thuiswonend bij ouders	22	5,3	5,3	32,8
	Alleenstaand met thuiswonend(e) kind(eren)	22	5,3	5,3	38,1
	Met partner zonder thuiswonend(e) kind(eren)	159	38,3	38,3	76,4
	Met partner en met thuiswonend(e) kind(eren)	98	23,6	23,6	100,0
	Total	415	100,0	100,0	

Appendix H. SPSS output of frequency of city visits

Number assigned to the city in SPSS data

Number	City
1	Utrecht
2	Amsterdam
3	Nijmegen
4	Arnhem
5	Heerlen
6	Maastricht
7	Rotterdam
8	Den Haag

Statistics

		Bstad1	Bstad2	Bstad3	Bstad4	Bstad5	Bstad6	Bstad7	Bstad8
N	Valid	415	415	415	415	415	415	415	415
	Missing	0	0	0	0	0	0	0	0

Bstad1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Nooit	97	23,4	23,4	23,4
	Soms	249	60,0	60,0	83,4
	Regelmatig	57	13,7	13,7	97,1
	Vaak	12	2,9	2,9	100,0
	Total	415	100,0	100,0	

Bstad2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Nooit	80	19,3	19,3	19,3
	Soms	272	65,5	65,5	84,8
	Regelmatig	54	13,0	13,0	97,8

		Frequency	Percent	Valid Percent	Cumulative Percent
	Vaak	9	2,2	2,2	100,0
	Total	415	100,0	100,0	

Bstad3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Nooit	222	53,5	53,5	53,5
	Soms	150	36,1	36,1	89,6
	Regelmatig	37	8,9	8,9	98,6
	Vaak	6	1,4	1,4	100,0
	Total	415	100,0	100,0	

Bstad4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Nooit	281	67,7	67,7	67,7
	Soms	115	27,7	27,7	95,4
	Regelmatig	16	3,9	3,9	99,3
	Vaak	3	,7	,7	100,0
	Total	415	100,0	100,0	

Bstad5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Nooit	311	74,9	74,9	74,9
	Soms	88	21,2	21,2	96,1
	Regelmatig	12	2,9	2,9	99,0
	Vaak	4	1,0	1,0	100,0
	Total	415	100,0	100,0	

Bstad6

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Nooit	148	35,7	35,7	35,7
	Soms	226	54,5	54,5	90,1
	Regelmatig	37	8,9	8,9	99,0
	Vaak	4	1,0	1,0	100,0
	Total	415	100,0	100,0	

Bstad7

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Nooit	182	43,9	43,9	43,9
	Soms	194	46,7	46,7	90,6
	Regelmatig	29	7,0	7,0	97,6
	Vaak	10	2,4	2,4	100,0
	Total	415	100,0	100,0	

Bstad8

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Nooit	191	46,0	46,0	46,0
	Soms	183	44,1	44,1	90,1
	Regelmatig	32	7,7	7,7	97,8
	Vaak	9	2,2	2,2	100,0
	Total	415	100,0	100,0	

Appendix I. SPSS output of travel purpose per city

Number assigned to the city in SPSS data

Number	City
1	Utrecht
2	Amsterdam
3	Nijmegen
4	Arnhem
5	Heerlen
6	Maastricht
7	Rotterdam
8	Den Haag

	All*
Valid	415
Missing	0

* For all tables in this appendix

Werk1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	355	85,5	85,5	85,5
	True	60	14,5	14,5	100,0
	Total	415	100,0	100,0	

Studie1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	401	96,6	96,6	96,6
	True	14	3,4	3,4	100,0
	Total	415	100,0	100,0	

Recreatie1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	195	47,0	47,0	47,0
	True	220	53,0	53,0	100,0
	Total	415	100,0	100,0	

Anders1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	346	83,4	83,4	83,4
	True	69	16,6	16,6	100,0
	Total	415	100,0	100,0	

Studie2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	410	98,8	98,8	98,8
	True	5	1,2	1,2	100,0
	Total	415	100,0	100,0	

Recreatie2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	138	33,3	33,3	33,3
	True	277	66,7	66,7	100,0

		Frequency	Percent	Valid Percent	Cumulative Percent
	Total	415	100,0	100,0	

Anders2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	353	85,1	85,1	85,1
	True	62	14,9	14,9	100,0
	Total	415	100,0	100,0	

Werk3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	385	92,8	92,8	92,8
	True	30	7,2	7,2	100,0
	Total	415	100,0	100,0	

Studie3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	410	98,8	98,8	98,8
	True	5	1,2	1,2	100,0
	Total	415	100,0	100,0	

Recreatie3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	285	68,7	68,7	68,7
	True	130	31,3	31,3	100,0
	Total	415	100,0	100,0	

Anders3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	325	78,3	78,3	78,3
	True	90	21,7	21,7	100,0
	Total	415	100,0	100,0	

Werk4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	398	95,9	95,9	95,9
	True	17	4,1	4,1	100,0
	Total	415	100,0	100,0	

Studie4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	413	99,5	99,5	99,5
	True	2	,5	,5	100,0
	Total	415	100,0	100,0	

Recreatie4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	292	70,4	70,4	70,4
	True	123	29,6	29,6	100,0
	Total	415	100,0	100,0	

Anders4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	350	84,3	84,3	84,3
	True	65	15,7	15,7	100,0
	Total	415	100,0	100,0	

Werk5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	391	94,2	94,2	94,2
	True	24	5,8	5,8	100,0
	Total	415	100,0	100,0	

Studie5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	413	99,5	99,5	99,5
	True	2	,5	,5	100,0
	Total	415	100,0	100,0	

Recreatie5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	323	77,8	77,8	77,8
	True	92	22,2	22,2	100,0
	Total	415	100,0	100,0	

Anders5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	341	82,2	82,2	82,2
	True	74	17,8	17,8	100,0
	Total	415	100,0	100,0	

Werk6

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	384	92,5	92,5	92,5
	True	31	7,5	7,5	100,0
	Total	415	100,0	100,0	

Studie6

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	411	99,0	99,0	99,0
	True	4	1,0	1,0	100,0
	Total	415	100,0	100,0	

Recreatie6

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	190	45,8	45,8	45,8
	True	225	54,2	54,2	100,0
	Total	415	100,0	100,0	

Anders6

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	359	86,5	86,5	86,5
	True	56	13,5	13,5	100,0
	Total	415	100,0	100,0	

Werk7

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	386	93,0	93,0	93,0
	True	29	7,0	7,0	100,0
	Total	415	100,0	100,0	

Studie7

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	412	99,3	99,3	99,3
	True	3	,7	,7	100,0
	Total	415	100,0	100,0	

Recreatie7

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	230	55,4	55,4	55,4
	True	185	44,6	44,6	100,0
	Total	415	100,0	100,0	

Anders7

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	347	83,6	83,6	83,6
	True	68	16,4	16,4	100,0
	Total	415	100,0	100,0	

Werk8

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	389	93,7	93,7	93,7
	True	26	6,3	6,3	100,0
	Total	415	100,0	100,0	

Studie8

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	412	99,3	99,3	99,3
	True	3	,7	,7	100,0
	Total	415	100,0	100,0	

Recreatie8

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	237	57,1	57,1	57,1
	True	178	42,9	42,9	100,0
	Total	415	100,0	100,0	

Anders8

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	347	83,6	83,6	83,6
	True	68	16,4	16,4	100,0
	Total	415	100,0	100,0	

Appendix J. SPSS output of used transportation mode to cities

Number assigned to the city in SPSS data

Number	City
1	Utrecht
2	Amsterdam
3	Nijmegen
4	Arnhem
5	Heerlen
6	Maastricht
7	Rotterdam
8	Den Haag

	All*
Valid	415
Missing	0

* For all tables in this appendix

Auto1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	247	59,5	59,5	59,5
	True	168	40,5	40,5	100,0
	Total	415	100,0	100,0	

Trein1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	211	50,8	50,8	50,8
	True	204	49,2	49,2	100,0
	Total	415	100,0	100,0	

Andersvm1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	404	97,3	97,3	97,3
	True	11	2,7	2,7	100,0
	Total	415	100,0	100,0	

Auto2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	271	65,3	65,3	65,3
	True	144	34,7	34,7	100,0
	Total	415	100,0	100,0	

Trein2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	169	40,7	40,7	40,7
	True	246	59,3	59,3	100,0
	Total	415	100,0	100,0	

Andersvm2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	405	97,6	97,6	97,6
	True	10	2,4	2,4	100,0
	Total	415	100,0	100,0	

Auto3

		Frequency	Percent	Valid Percent	Cumulative Percent

Valid	False	256	61,7	61,7	61,7
	True	159	38,3	38,3	100,0
	Total	415	100,0	100,0	

Andersvm3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	395	95,2	95,2	95,2
	True	20	4,8	4,8	100,0
	Total	415	100,0	100,0	

Auto4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	302	72,8	72,8	72,8
	True	113	27,2	27,2	100,0
	Total	415	100,0	100,0	

Trein4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	357	86,0	86,0	86,0
	True	58	14,0	14,0	100,0
	Total	415	100,0	100,0	

Andersvm4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	396	95,4	95,4	95,4
	True	19	4,6	4,6	100,0
	Total	415	100,0	100,0	

Auto5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	317	76,4	76,4	76,4
	True	98	23,6	23,6	100,0
	Total	415	100,0	100,0	

Trein5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	361	87,0	87,0	87,0
	True	54	13,0	13,0	100,0
	Total	415	100,0	100,0	

Andersvm5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	393	94,7	94,7	94,7
	True	22	5,3	5,3	100,0
	Total	415	100,0	100,0	

Auto6

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	233	56,1	56,1	56,1
	True	182	43,9	43,9	100,0
	Total	415	100,0	100,0	

Trein6

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	292	70,4	70,4	70,4
	True	123	29,6	29,6	100,0
	Total	415	100,0	100,0	

Andersvm6

		Frequency	Percent	Valid Percent	Cumulative Percent

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	398	95,9	95,9	95,9
	True	17	4,1	4,1	100,0
	Total	415	100,0	100,0	

Auto7

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	275	66,3	66,3	66,3
	True	140	33,7	33,7	100,0
	Total	415	100,0	100,0	

Trein7

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	286	68,9	68,9	68,9
	True	129	31,1	31,1	100,0
	Total	415	100,0	100,0	

Andersvm7

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	398	95,9	95,9	95,9
	True	17	4,1	4,1	100,0
	Total	415	100,0	100,0	

Auto8

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	276	66,5	66,5	66,5
	True	139	33,5	33,5	100,0
	Total	415	100,0	100,0	

Trein8

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	291	70,1	70,1	70,1
	True	124	29,9	29,9	100,0
	Total	415	100,0	100,0	

Andersvm8

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	401	96,6	96,6	96,6
	True	14	3,4	3,4	100,0
	Total	415	100,0	100,0	

Appendix K. Omgevingsadressendichtheid of Dutch cities

City	Addresses environment density (Omgevingsadressendichtheid)*
Utrecht	3155
Amsterdam	6056
Nijmegen	2233
Arnhem	2011
Heerlen	1672
Maastricht	2163
Rotterdam	3859
Den Haag	4720

* Source: (RIVM, 2014)

Appendix L. SPSS output of used pre-transportation mode

Statistics

Voortransportmiddelen

N	Valid	282
	Missing	133

Voortransportmiddelen

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bus	130	31,3	46,1	46,1
	Hoogwaardig openbaar vervoer (Phileas)	5	1,2	1,8	47,9
	Met de auto weggebracht worden	26	6,3	9,2	57,1
	Fiets	62	14,9	22,0	79,1
	Wisselend	35	8,4	12,4	91,5
	De auto (parkeren nabij het station)	24	5,8	8,5	100,0
	Total	282	68,0	100,0	
Missing	System	133	32,0		
Total		415	100,0		

Appendix M. SPSS output of used pre-transportation modes per postal area

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Postcode * Voortransportmiddelen	282	68,0%	133	32,0%	415	100,0%

Postcode * Voortransportmiddelen Crosstabulation

Count

		Voortransportmiddelen						Total
		Bus	Hoogwaardig openbaar vervoer (Phileas)	Met de auto weggebracht worden	Fiets	Wisselend	De auto (parkeren nabij het station)	
Postcode	5501	2	0	0	1	0	0	3
	5502	1	0	1	0	2	1	5
	5503	1	0	0	0	0	0	1
	5504	2	0	1	0	1	0	4
	5505	3	0	1	0	0	0	4
	5506	1	0	0	0	0	0	1
	5508	12	0	1	0	0	1	14
	5509	2	0	0	0	0	0	2
	5524	0	0	0	1	0	0	1
	5551	3	0	0	1	1	3	8
	5552	1	0	0	1	0	1	3
	5554	0	0	4	0	0	0	4
	5555	1	0	1	0	0	0	2
	5556	0	0	1	0	0	0	1
	5611	1	0	0	0	1	0	2
	5612	3	0	0	4	2	0	9
	5613	2	0	0	4	1	0	7
	5614	0	0	0	1	0	0	1
	5615	6	0	0	2	1	0	9
	5616	5	1	0	7	4	2	19
	5617	0	1	0	0	0	0	1
	5621	1	0	0	2	1	0	4
	5622	2	0	1	3	0	0	6
	5623	5	0	1	2	1	2	11
	5624	3	0	0	5	3	2	13
	5625	12	0	0	2	1	0	15
	5626	2	0	2	0	0	1	5
	5627	8	0	2	0	2	0	12
	5628	9	0	0	0	0	1	10
	5629	2	0	0	1	1	1	5
	5631	1	0	0	0	1	0	2
	5632	6	0	1	1	3	2	13
	5641	3	0	4	2	0	1	10
	5642	0	0	1	3	1	0	5
	5643	2	0	1	2	3	0	8
	5644	4	0	0	2	1	0	7
	5645	1	0	0	1	0	0	2
	5646	3	0	0	0	0	0	3
	5651	1	1	0	0	0	0	2
	5652	0	0	1	3	0	0	4
	5653	0	0	0	5	1	1	7
	5654	2	0	0	4	0	0	6

	5655	2	0	1	0	0	1	4
	5658	3	2	0	1	0	2	8
	5671	5	0	0	0	2	0	7
	5672	3	0	0	0	0	2	5
	5673	3	0	1	0	1	0	5
	5674	1	0	0	1	0	0	2
Total		130	5	26	62	35	24	282

Appendix N. Discrete choice (multinomial logit) model Output from Nlogit

```
--------------------------------------------------------------------------
--
Discrete choice (multinomial logit) model
Dependent variable                Choice
Log likelihood function      -5177.76648
Estimation based on N =    3735, K =   1
Inf.Cr.AIC  =  10357.5 AIC/N =     2.773
Model estimated: Jul 06, 2015, 13:26:19
R2=1-LogL/LogL* Log-L fncn R-sqrd R2Adj
Constants only  -5131.6066 -.0090-.0091
Response data are given as ind. choices
Number of obs.=  3735, skipped    0 obs
--------+-----------------------------------------------------------------
--
        |                Standard            Prob.      95% Confidence
    ICHO|  Coefficient     Error        z    |z|>Z*        Interval
--------+-----------------------------------------------------------------
--
  ITRAIN|     .01110         .03789      .29  .7696     -.06317    .08537
--------+-----------------------------------------------------------------
--
Note: ***, **, * ==>  Significance at 1%, 5%, 10% level.
--------------------------------------------------------------------------
--

|-> DISCRETECHOICE;Lhs = icho
    ;Choices = 1,2,3,4
    ;Rhs     = icst1,icst2,icst3$
Normal exit:   4 iterations. Status=0, F=    5131.607

--------------------------------------------------------------------------
--
Discrete choice (multinomial logit) model
Dependent variable                Choice
Log likelihood function      -5131.60661
Estimation based on N =    3735, K =   3
Inf.Cr.AIC  =  10269.2 AIC/N =     2.749
Model estimated: Jul 06, 2015, 13:36:45
R2=1-LogL/LogL* Log-L fncn R-sqrd R2Adj
Constants only  -5131.6066  .0000-.0003
Response data are given as ind. choices
Number of obs.=  3735, skipped    0 obs
--------+-----------------------------------------------------------------
--
        |                Standard            Prob.      95% Confidence
    ICHO|  Coefficient     Error        z    |z|>Z*        Interval
--------+-----------------------------------------------------------------
--
   ICST1|     .21054***      .04421     4.76  .0000      .12388    .29719
   ICST2|     .01181         .04634      .25  .7988     -.07901    .10263
   ICST3|    -.23920***      .04951    -4.83  .0000     -.33625   -.14215
--------+-----------------------------------------------------------------
--
Note: ***, **, * ==>  Significance at 1%, 5%, 10% level.
--------------------------------------------------------------------------
--

|-> DISCRETECHOICE;Lhs = icho
    ;Choices = 1,2,3,4
```

```
    ;Rhs      = icst1,icst2,icst3,

itr1a,itr1b,itr2a,itr2b,itr3a,itr3b,itr4a,itr4b,itr5a,itr5b,itr6a,itr6b,

ibu1a,ibu1b,ibu2a,ibu2b,ibu3a,ibu3b,ibu4a,ibu4b,ibu5a,ibu5b,ibu6a,ibu6b,
    ibu7a,ibu7b,ibu8a,ibu8b,

ibi1a,ibi1b,ibi2a,ibi2b,ibi3a,ibi3b,ibi4a,ibi4b,ibi5a,ibi5b,ibi6a,ibi6b,

ido1a,ido1b,ido2a,ido2b,ido3a,ido3b,ido4a,ido4b,ido5a,ido5b,ido6a,ido6b,

ica1a,ica1b,ica2a,ica2b,ica3a,ica3b,ica4a,ica4b,ica5a,ica5b,ica6a,ica6b$
Normal exit:   5 iterations. Status=0, F=    5054.449

---------------------------------------------------------------------------
--
Discrete choice (multinomial logit) model
Dependent variable                Choice
Log likelihood function      -5054.44948
Estimation based on N =    3735, K =  67
Inf.Cr.AIC  =  10242.9 AIC/N =    2.742
Model estimated: Jul 06, 2015, 13:36:55
R2=1-LogL/LogL* Log-L fncn R-sqrd R2Adj
Constants only  -5131.6066  .0150 .0091
Response data are given as ind. choices
Number of obs.=  3735, skipped    0 obs
--------+------------------------------------------------------------------
--
```

ICHO	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
ICST1	.21436***	.04517	4.75	.0000	.12583	.30290
ICST2	.01759	.04720	.37	.7093	-.07491	.11010
ICST3	-.23756***	.05051	-4.70	.0000	-.33656	-.13856
ITR1A	.01549	.05501	.28	.7783	-.09234	.12331
ITR1B	-.04737	.05376	-.88	.3783	-.15274	.05800
ITR2A	.01438	.05474	.26	.7928	-.09290	.12166
ITR2B	.04758	.05530	.86	.3896	-.06081	.15597
ITR3A	.08385	.05564	1.51	.1318	-.02519	.19290
ITR3B	-.03757	.05441	-.69	.4899	-.14421	.06907
ITR4A	.00612	.05452	.11	.9106	-.10073	.11297
ITR4B	.07954	.05563	1.43	.1527	-.02948	.18857
ITR5A	.04260	.05472	.78	.4363	-.06465	.14986
ITR5B	-.03379	.05404	-.63	.5318	-.13970	.07212
ITR6A	-.02384	.05462	-.44	.6625	-.13090	.08322
ITR6B	.02249	.05483	.41	.6817	-.08497	.12995
IBU1A	.13531***	.05049	2.68	.0074	.03634	.23427
IBU1B	.01923	.05038	.38	.7027	-.07951	.11797
IBU2A	.08758*	.05017	1.75	.0809	-.01076	.18592
IBU2B	.05365	.05083	1.06	.2912	-.04598	.15328
IBU3A	.02922	.05100	.57	.5667	-.07074	.12918
IBU3B	-.03238	.05098	-.64	.5253	-.13231	.06754
IBU4A	.16690***	.05023	3.32	.0009	.06846	.26534
IBU4B	-.10278**	.05152	-1.99	.0460	-.20376	-.00180
IBU5A	.18281***	.05015	3.65	.0003	.08451	.28110
IBU5B	-.04436	.05092	-.87	.3837	-.14415	.05544
IBU6A	.04151	.05087	.82	.4145	-.05820	.14122
IBU6B	-.08505*	.05124	-1.66	.0970	-.18548	.01539
IBU7A	-.11817**	.05129	-2.30	.0212	-.21869	-.01765
IBU7B	.09765*	.05005	1.95	.0511	-.00045	.19574

IBU8A	-.09016*	.05097	-1.77	.0769	-.19006	.00974
IBU8B	.05239	.05089	1.03	.3033	-.04736	.15213
IBI1A	.14824***	.05308	2.79	.0052	.04420	.25228
IBI1B	.02722	.05397	.50	.6140	-.07856	.13300
IBI2A	.06609	.05372	1.23	.2186	-.03920	.17138
IBI2B	-.01445	.05370	-.27	.7878	-.11969	.09079
IBI3A	.12766**	.05316	2.40	.0163	.02346	.23186
IBI3B	-.05090	.05456	-.93	.3508	-.15783	.05603
IBI4A	.00241	.05398	.04	.9644	-.10339	.10822
IBI4B	.08082	.05330	1.52	.1294	-.02364	.18527
IBI5A	-.06888	.05492	-1.25	.2098	-.17653	.03877
IBI5B	-.03074	.05466	-.56	.5738	-.13788	.07639
IBI6A	-.00931	.05377	-.17	.8626	-.11470	.09608
IBI6B	.05564	.05373	1.04	.3004	-.04966	.16095
IDO1A	.21124***	.05745	3.68	.0002	.09865	.32383
IDO1B	-.00732	.05892	-.12	.9011	-.12281	.10816
IDO2A	.15203***	.05777	2.63	.0085	.03880	.26526
IDO2B	-.05007	.05933	-.84	.3987	-.16634	.06621
IDO3A	.08288	.05854	1.42	.1568	-.03185	.19761
IDO3B	-.01381	.05894	-.23	.8148	-.12933	.10171
IDO4A	.04976	.05856	.85	.3955	-.06502	.16455
IDO4B	.09021	.05839	1.54	.1223	-.02423	.20465
IDO5A	-.02123	.05899	-.36	.7189	-.13686	.09439
IDO5B	.02736	.05884	.46	.6420	-.08797	.14269
IDO6A	-.05112	.05935	-.86	.3891	-.16746	.06521
IDO6B	.03491	.05822	.60	.5487	-.07919	.14902
ICA1A	.15205***	.05364	2.83	.0046	.04691	.25718
ICA1B	-.08857	.05515	-1.61	.1083	-.19666	.01951
ICA2A	.04577	.05413	.85	.3979	-.06033	.15187
ICA2B	.04985	.05463	.91	.3614	-.05721	.15692
ICA3A	.09140*	.05393	1.69	.0901	-.01430	.19709
ICA3B	.07656	.05404	1.42	.1566	-.02936	.18248
ICA4A	.12914**	.05340	2.42	.0156	.02447	.23381
ICA4B	.00571	.05457	.10	.9167	-.10124	.11266
ICA5A	.01399	.05482	.26	.7986	-.09346	.12143
ICA5B	-.02109	.05457	-.39	.6991	-.12804	.08586
ICA6A	-.00663	.05504	-.12	.9042	-.11451	.10126
ICA6B	.01754	.05427	.32	.7466	-.08883	.12391

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

Appendix O. Table with coefficients for all attribute levels and impact of the attributes (significance of significant attribute levels are arced)

Transportation mode	Attributes	Attribute levels	β	Impact	Sign.
Train	In vehicle time (IVT)	45 minutes	0,01549	0,07925	0,7783
		50 minutes	-0,04737		0,3783
		55 minutes	*0,03188*		
	Waiting time (WT)	3 minutes	0,01438	0,10954	0,7928
		9 minutes	0,04758		0,3896
		15 minutes	*-0,06196*		
	Costs of travel	10 euro	0,08385	0,13013	0,1318
		15 euro	-0,03757		0,4899
		20 euro	*-0,04628*		
	Chance of delay	5 percent	0,00612	0,16520	0,9106
		10 percent	0,07954		0,1527
		15 percent	*-0,08566*		
	Safety	No additional measures	0,04260	0,07639	0,4363
		Additional security cameras	-0,03379		0,5318
		Additional security cameras and staff	*-0,00881*		
	Possibility to work	No additional facilities	-0,02384	0,04633	0,6625
		Personal work tables	0,02249		0,6817
		Special work cabins	*0,00135*		
Car	In vehicle time (IVT)	50 minutes	0,15205	0,24062	0,0046
		60 minutes	-0,08857		0,1083
		70 minutes	*-0,06348*		
	Parking search time (PST)	3 minutes	0,04577	0,14547	0,3979
		9 minutes	0,04985		0,3614
		15 minutes	*-0,09562*		
	Costs of travel	10 euro	0,09140	0,25936	0,0901
		14 euro	0,07656		0,1566
		18 euro	*-0,16796*		
	Parking costs	2 euro per hour	0,12914	0,26399	0,0156
		4 euro per hour	0,00571		0,9167
		6 euro per hour	*-0,13485*		
	Chance of congestion	10 percent	0,01399	0,03508	0,7986
		20 percent	-0,02109		0,6991
		30 percent	*0,00710*		
	Safety	No additional measures	-0,00663	0,02845	0,9042
		Additional security cameras	0,01754		0,7466
		Additional security cameras and staff	*-0,01091*		
Pre-transport Public transport	Time to get to bus stop	1 minutes	0,13531	0,28985	0,0074
		4 minutes	0,01923		0,7027
		7 minutes	*-0,15454*		
	In vehicle time	15 minutes	0,08758	0,22881	0,0809

	(IVT)	20 minutes	0,05365		0,2912
		25 minutes	*-0,14123*		
	Time to get to railway platform	1 minute	0,02922	0,06160	0,5667
		3 minutes	-0,03238		0,5253
		5 minutes	*0,00316*		
	Costs of travel	1 euro	0,16690	0,26968	0,0009
		2 euro	-0,10278		0,0460
		3 euro	*-0,06412*		
	Chance of delay	0 percent	0,18281	0,32126	0,0003
		15 percent	-0,04436		0,3837
		30 percent	*-0,13845*		
	Type of bus	Regular bus	0,04151	0,12859	0,4145
		Express bus	-0,08505		0,0970
		Shuttle bus	*0,04354*		
	Safety measures	No additional measures	-0,11817	0,21582	0,0212
		Additional security cameras	0,09765		0,0511
		Additional security cameras and staff	*0,02052*		
	Safety level of the environment	Low	-0,09016	0,14255	0,0769
		Moderate	0,05239		0,3033
		High	*0,03777*		
Pre-transport Bicycle	On vehicle time	20 minutes	0,14824	0,32370	0,0052
		25 minutes	0,02722		0,6140
		30 minutes	*-0,17546*		
	Time to get to railway platform	2 minutes	0,06609	0,11773	0,2186
		4 minutes	-0,01445		0,7878
		6 minutes	*-0,05164*		
	Costs of parking bicycle	0.50 euro per time	0,12766	0,20442	0,0163
		1.00 euro per time	-0,05090		0,3508
		1.50 euro per time	*-0,07676*		
	Chance of delay	0 percent	0,00241	0,16405	0,9644
		5 percent	0,08082		0,1294
		10 percent	*-0,08323*		
	Safety measures	Bad presence of cycling facilities	-0,06888	0,16850	0,2098
		Moderate presence of cycling facilities	-0,03074		0,5738
		Good presence of cycling facilities	*0,09962*		
	Safety level of the environment	Low	-0,00931	0,10197	0,8626
		Moderate	0,05564		0,3004
		High	*-0,04633*		
Pre-transport Car	In vehicle time (IVT)	10 minutes	0,21124	0,41516	0,0002
		15 minutes	-0,00732		0,9011
		20 minutes	*-0,20392*		
	Time to get to railway platform	2 minutes	0,15203	0,25399	0,0085
		5 minutes	-0,05007		0,3987
		8 minutes	*-0,10196*		
	Costs of parking car	3.00 euro per day	0,08288	0,15195	0,1568
		3.50 euro per day	-0,01381		0,8148

		4.00 euro per day	*-0,06907*		
	Chance of delay	0 percent	0,04976	0,23018	0,3955
		10 percent	0,09021		0,1223
		20 percent	*-0,13997*		
	Safety measures	No additional measures	-0,02123	0,04859	0,7189
		Additional security cameras	0,02736		0,6420
		Additional security cameras and staff	*-0,00613*		
	Safety level of the environment	Low	-0,05112	0,08603	0,3891
		Moderate	0,03491		0,5487
		High	*0,01621*		

English summary

INVESTIGATION OF THE ROLE OF PRE-TRANSPORT IN TRAVELERS' TRANSPORTATION MODE CHOICE

A study conducted in the region of the railway station of Eindhoven

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Construction, Management and Engineering 2014-2015

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ABSTRACT
It is desirable to reduce private car use in the Netherlands because of the consequences it has for environmental and societal costs. The increase of motorized vehicle use brings many problems with it globally, while alternative transportation modes are less harmful for the environment. Travelers changing their transportation mode choice from the private car to less harmful alternatives like the train could contribute to solving the previously mentioned problems. Many travelers are deterred from using the train due to aspects of the railway journey they do not like. It is important to know which characteristics of different journeys affect transportation mode choice in order to address the problem. A stated preference experiment is used to collect data of travelers transportation mode choice. This data is analyzed using a multinomial logit model to see which characteristics of the journeys affect transportation mode choice the most. Time and monetary cost related characteristics proved to be the most important in transportation mode choice.

Keywords: Transportation mode choice, human behavior, Multimodal railway journey, Railway station accessibility, Car travel

INTRODUCTION
Car ownership and use in the Netherlands have increased tremendously since the 1960's. Between 80% and 90% of all passenger kilometers are made by car. Traffic and transportation nowadays are serious causes of an increase of environmental and societal costs such as congestion, noise, air pollution, depletion of energy, and substantial use of land. In many urban areas these consequences already lead to urgent problems e.g. (Redman, et al., 2013). Especially congestion is a major issue. It is often cited as the most important concern of urban dwellers of large metropolitan areas. Congestion involves not only personal costs, but also major social costs. Therefore it is desirable to reduce private car use in the Netherlands. Reducing private car use has been one of the objectives of the environment policies of the Dutch government over the last few decades e.g. (Buehler,

2011). The amount of vehicle kilometers and vehicle hours lost will remain to rise if no more additional lanes will be built. And even if there would be built more lanes, this would cause more people to use the private car and therefore increase pollution and other environmental disadvantages. Therefore it would be desirable to promote an alternative transportation mode that is more sustainable and safer. The most commonly used alternative for the car is public transport, and for longer distances especially the train.

Governments and people are increasingly interested in a sustainable and healthy environment in the future. Therefore transportation policies in the Netherlands and Europe are differencing. Pre-transport as an access mode to the railway station has been researched for the last decades. In these past decades the amount of use of different modes of pre-transportation shifted over time. But what modes of pre-transport are used nowadays what characteristics of pre-transportation modes influence transportation mode choice the most is only partly known.

RESEARCH AIM

The aim of the research is to investigate how potential train users perceive pre-transport, how they make choices for the transportation mode they tend to use and how are these choices influenced by the characteristics of the different types of pre-transport. The most important objective of this research is to determine the influence of different pre-transportation modes on the choice between train and car, for a large distance (50 to 150 kilometers) journey, of travelers.

This has led to the following research question:

“What is the role of the characteristics of pre-transport in the travelers’ decision making process of using the train as transportation mode or the car?”

The main research objectives are to investigate the role of pre-transport and its characteristics in a multimodal railway trip and to what extent it influences transportation mode choice. Important is that the research is not conducted from existing railway users only, but from a target group that has divers characteristics and use many types of transportation modes.

THEORETICAL FRAMEWORK

presents the most important definitions, explanations and descriptions of specific methods that are used in the research and are related to the problem that is defined. First the different types of journeys that are applicable for the research are illustrated. The following two types of journeys are important for the research, the car journey and the multimodal railway journey. Finally the research framework will be explained, this part consists of an explanation of the used research methods and the analytical framework that is used to achieve the goals that are set.

Journeys

A journey is a continues travel from door-to-door that consists out of one or more transportation modes from the start-point to the end-point or activity. In the research two different journeys are considered. The first journey is the car journey and the second is the multimodal railway journey (Givoni & Rietveld(2), 2007).

A car journey consist of a few different parts, also called trips. The most important and time consuming part is the car trip. The trip from home to the parking place near the end destination is the car trip. The route that is chosen for the car trip is mostly the route that takes the least time. Sometimes monetary costs and congestion are also taken into account when the route is chosen. The advantage of the car that it has no fixed route and its flexibility gives the opportunity to take another route when desired. It is also possible and more convenient to use the car for multipurpose journeys where different travel purposes are combined (Ye, et al., 2007).

A railway journey includes a trip to, the access mode, and later from, the egress mode, the railway station by different modes of transportation. So the railway journey is a multimodal trip with the train as main transportation mode. The access trip is the trip from starting point to the Railway Station (RS), this trip is in the research called, the *pre-transport*. The train trip runs between the railway stations. Within this train trip there are possible transfers at a railway stations. The final trip from the railway station to the end point is the egress trip.
Both type of journeys that are included in the research are shown in Figure 1.

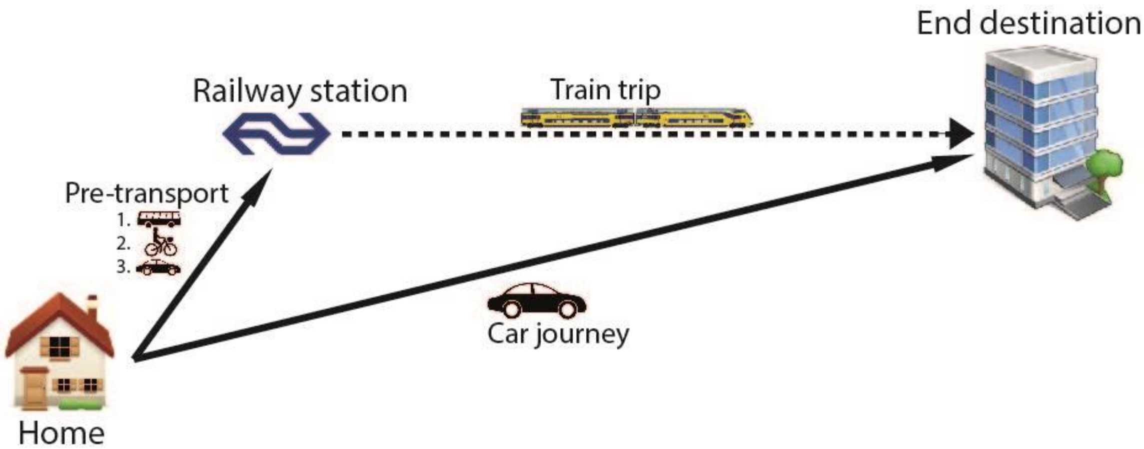

Figure 27. Different types of journeys that are included in the research.

The car journey is a single modal journey, but the railway journey is multimodal. An important part of the multimodal railway journey is the pre-transport trip. The pre-transport is the access trip that people have to make to get to the railway station. In the research it is investigated to what extent the overall quality of a railway journey depends on the quality of the pre-transport. It is concluded that travelers place importance on the pre-transport, which indicates that some people avoid using the railway due to the discontent about the railway station and its accessibility.

Transportation mode choice
To describe how people choose a transportation mode for their travel purposes, a theory of mode choice decisions is described by Schneider (2013). In his theory is suggested that there are five steps in the transportation mode choice decision process. The first part, awareness and availability, determine the possible transportation mode choices available for the travel. The following three elements, basic safety and security, convenience and cost, and enjoyment assess situational tradeoffs between the possible transportation modes. These three elements, in this theory known as the situational tradeoffs may be considered

simultaneously in the choice sequence. The first four elements are all influenced by socioeconomic factors. A fifth element is of influence in the transportation mode choice, habit has the effect that people that choose a particular transportation mode regularly, are more likely to consider it as an option in the future.

Household and individual socio-demographics have a strong influence on transportation mode choice decisions for commuter traffic, which is a large share of the total traffic in the Netherlands. Specifically, income, lifestyle, perceived service level, willingness to pay, type of journey, travel time, gender, employment status and car ownership affect transportation mode choice.

Methods and techniques

A stated preference approach is used to collect the data from respondents. Multinomial logit will be used to analyze the collected data because it is a discrete choice model that can help to understand and predict choices between several alternatives. A stated preference (SP) approach is considered to be a good method to perform a hypothetical study. The attribute values are controllable, therefore SP can be used to research hypothetical situations. So unlike revealed preference (RP), which is based on individuals' real choices, SP can give insight in situations that do not exist yet, it allows us to explore issues outside of the technological frontier. This information can be used to predict the consequences of changing and adjusting the current situation. The stated preference approach is based on individuals' choices of hypothetical transportation mode alternatives. This approach is widely used and accepted in travel behavior research and practice to identify behavioral responses of travelers to choice situations which are not revealed in the market. So to collect the data that is needed for the research SP will be used.

The data that is collected with a stated preference experiment can be analyzed with a discrete choice model. For the data analysis a Multinomial logit (MNL) model will be used to estimate the parameters of the stated preference experiment. A MNL model is a discrete choice model which can help to understand and predict choices between several alternatives. Train (2009) states that it is by far the easiest and most widely used discrete choice model in the world. The popularity of MNL is due to the fact that its formula for the choice probabilities take a closed form and therefore is readily interpretable.

MODEL

The experiment is about a journey from the home of the respondents to one of the following large cities of the Netherlands: Utrecht, Amsterdam, Nijmegen, Arnhem, Heerlen, Maastricht, Rotterdam and Den Haag. All these cities are accessible by car, but also by train via the railway station of Eindhoven. Key to the experiment is the transportation mode choice. In the SP experiment the target group respondents will make a choice out of four different modes of transportation. Each alternative mode of transportation has attributes that characterize it.

Stated preference experiment

The experiment consists of four transportation alternatives to make a journey, shown in Figure 1. The first alternative is using the train with bus as mode of pre-transportation. Second is using the train with bicycle as mode of pre-transportation. The third alternative is the last one, it has train as main transportation mode and the car as a form of pre-transportation. The pre-transport of this alternative is divided into two different possibilities. The car is used to get from home to the railway station, at the railway station the car can be parked, or the traveler can be dropped off by someone at the railway station. These are the two different forms of pre-transport with the car. The last alternative is to use the car for the journey instead of the train.

For the SP experiment 81 profiles were randomly created with each its own characteristics. The profiles are created by combining one of the three possible attribute levels for each attribute with each other. In each profile four alternative transportation mode options are presented from which the respondents has to choose one. 32 Attributes are defined for the experiment in order to give a good impression of the influence of all characteristics of transportation modes. Because of the amount of attributes and attribute levels that are included in the research, it is desirable that each of the 81 profiles is valuated about 30 to 40 times to make the research representable. Each respondent is presented with 9 profiles, so to desired minimal number of filled in questionnaires is (9*40)= 360. Because the questionnaire is designed for a specific target group in the Netherlands, the questionnaire is completely in Dutch. The questionnaire consists of three different parts, each part has a particular purpose. The first part is intended to find out what the current travel behavior of the respondents is. In the second part of the questionnaire the stated preference experiment is presented to the respondent. After the explanation of the attributes and attribute levels the respondents will be presented with choice tasks in which they each time have to choose one of the four presented alternatives. Figure 2 shows an example of a choice task in the questionnaire.

Vervoermiddelkeuze en voortransport

Vink onderaan in de tabel de vervoersoptie aan die uw voorkeur heeft.

Kenmerken	Trein			Auto
Reistijd in het voertuig	55 minuten			60 minuten
Wachttijd/zoektijd naar parkeerplaats	15 minuten			3 minuten
Kosten trein-/autoreis	18 euro			10 euro
Kosten parkeren auto				4 euro per uur
Kans op vertraging	15 procent			20 procent
Veiligheid	Extra bewakingscamera's			Geen maatregelen
Mogelijkheid tot werken	Geen maatregelen			
	Voortransport			
	Bus	Fiets	Auto drop-off /parkeren	
Tijd om bij halte te komen	1 minuut			
Reistijd in/op het voertuig	25 minuten	25 minuten	20 minuten	
Tijd om op het perron te komen	5 minuten	4 minuten	2 minuten	
Rit-/stallingskosten	2 euro	1.50 euro per keer	3.50 euro per dag*	
Kans op vertraging	30 procent	10 procent	20 procent	
Bustype	Gewone bus			
Veiligheidsmaatregelen	Extra bewakingscamera's en beveiligingspersoneel	Gemiddelde aanwezigheid fietsvoorzieningen	Extra bewakingscamera's en beveiligingspersoneel	
Veiligheidsniveau omgeving	Gemiddeld	Laag	Hoog	
Uw voorkeur	○	○	○	○

* Dit tarief geldt enkel indien u uw auto in de buurt van het station parkeert.

Vorige | Volgende

Figure 28: Choice task in questionnaire.

In the third and last part of the questionnaire some personal characteristics of the respondents' situation are asked. These personal questions are asked at the end because the respondents are almost done with the questionnaire and the focus may be a little bit less than before. The personal questions are only facts and therefore easy to fill in for the respondents.

The data is not randomly collected for the SP experiment. Because of the design of the research the data will be collected from a target group. The target group of the experiment is specifically, residents from the urban and suburban areas around the railway station of Eindhoven. Veldhoven, Nuenen, Valkenswaard and the city of Eindhoven except for the city center are areas around the railway station of Eindhoven that have a bus connection, car connection and bicycle connection with the railway station of Eindhoven and do not have another railway station nearby. The target group is chosen because of the following reasons. First, people that live in the suburban areas have to use a certain pre-transportation way to get to the railway station if they use the train as transportation mode. Therefore the pre-transport affects the transportation mode choice of these people. When a decision has to be made whether to use the train or car for a journey, the pre-transport will be taken into account. Second, there is no other large railway station present in any of the areas of the target group. So when the train is used as transportation mode, they are presumed to use a form of pre-transport. Third, the distance between the respondents and the railway station of Eindhoven is from about one to 17 kilometers. Within this range three forms of pre-transport are most likely to be used, the bus, bicycle or car. The postal code of the respondents will be asked in the questionnaire, so the transportation mode and possibly the pre-transportation mode choice can be linked to geographical characteristics of respondents.

DATA ANALYSIS
Table 1 shows a part of the output table of the Multinomial logit model. In the table only the attributes that are significant are included, so the attributes that are not included are left out. The first thing that was noticed when looking at table 1 is that none of the attributes of the train trip are included and thus none of these attributes have a significant contribution to the transportation mode choice. This could be due to the decision making process of the respondents. When using between the car and one of the three train alternatives the characteristics of the pre-transportation modes may have been more important for the decision than the characteristics of the train trip. So this indicates that the pre-transport has more influence on the transportation mode choice than the train trip itself.

Table 16. Significant results of multinomial logit model

Transportation mode	Attributes	Attribute levels	β	Sign.
Car	In vehicle time (IVT)	50 minutes	0,15205	0,0046
		60 minutes	-0,08857	0,1083
		70 minutes	*-0,06348*	
	Costs of travel	10 euro	0,09140	0,0901
		14 euro	0,07656	0,1566
		18 euro	*-0,16796*	
	Parking costs	2 euro per hour	0,12914	0,0156
		4 euro per hour	0,00571	0,9167

		6 euro per hour	*-0,13485*	
Pre-transport Public transport	Time to get to bus stop	1 minutes	0,13531	0,0074
		4 minutes	0,01923	0,7027
		7 minutes	*-0,15454*	
	In vehicle time (IVT)	15 minutes	0,08758	0,0809
		20 minutes	0,05365	0,2912
		25 minutes	*-0,14123*	
	Costs of travel	1 euro	0,16690	0,0009
		2 euro	-0,10278	0,0460
		3 euro	*-0,06412*	
	Chance of delay	0 percent	0,18281	0,0003
		15 percent	-0,04436	0,3837
		30 percent	*-0,13845*	
	Type of bus	Regular bus	0,04151	0,4145
		Express bus	-0,08505	0,0970
		Shuttle bus	*0,04354*	
	Safety measures	No additional measures	-0,11817	0,0212
		Additional security cameras	0,09765	0,0511
		Additional security cameras and staff	*0,02052*	
	Safety level of the environment	Low	-0,09016	0,0769
		Moderate	0,05239	0,3033
		High	*0,03777*	
Pre-transport Bicycle	On vehicle time	20 minutes	0,14824	0,0052
		25 minutes	0,02722	0,6140
		30 minutes	*-0,17546*	
	Costs of parking bicycle	0.50 euro per time	0,12766	0,0163
		1.00 euro per time	-0,05090	0,3508
		1.50 euro per time	*-0,07676*	
Pre-transport Car	In vehicle time (IVT)	10 minutes	0,21124	0,0002
		15 minutes	-0,00732	0,9011
		20 minutes	*-0,20392*	
	Time to get to railway platform	2 minutes	0,15203	0,0085
		5 minutes	-0,05007	0,3987
		8 minutes	*-0,10196*	

Inspecting Table 1 a little bit more reveals that most attributes that contribute to the transportation mode choice are travel time and monetary cost related. Only some attributes of public transport as mode of pre-transportation deviates from that. The outcome that most attributes related to travel time and monetary costs contribute to the transportation mode choice is in accordance with the expectations because transportation mode choice strongly depends on the time and money a journey or trip costs (Schneider, 2013). Besides the time and money related attributes, public transport as pre-transportation mode has more attributes that are of significant importance for the mode choice. First, chance of delay proves to be important, this attribute is related to time, but it has also to do with the uncertainty which travelers dislike. According to Brons and Rietveld (2008) travel time reliability is one of the most important aspects of quality for public transport trips. So if the travel time is uncertain due to a high chance of delay, it is less likely for travelers to choose that alternative. Second, the type of bus is of importance, people are less likely to choose the express bus. This could be due to the fact that people like to choose what they know, which is probable the regular bus. Third, the safety measures influence the transportation mode choice.

The impact that attributes have indicate the weight of the contribution to the mode choice. Figure 3 shows the relative importance of each significant attribute of the research. The in vehicle time of the car as form of pre-transportation is the attribute with the highest impact of all. So it is likely that if the in vehicle time of this transportation mode is short, this mode will be chosen. Also the chance of delay and costs of travel for public transport as pre-transportation mode is of high influence. The in vehicle time for the car as well as the on vehicle time of the bicycle as mode of pre-transportation are two important characteristics in transportation mode choice.

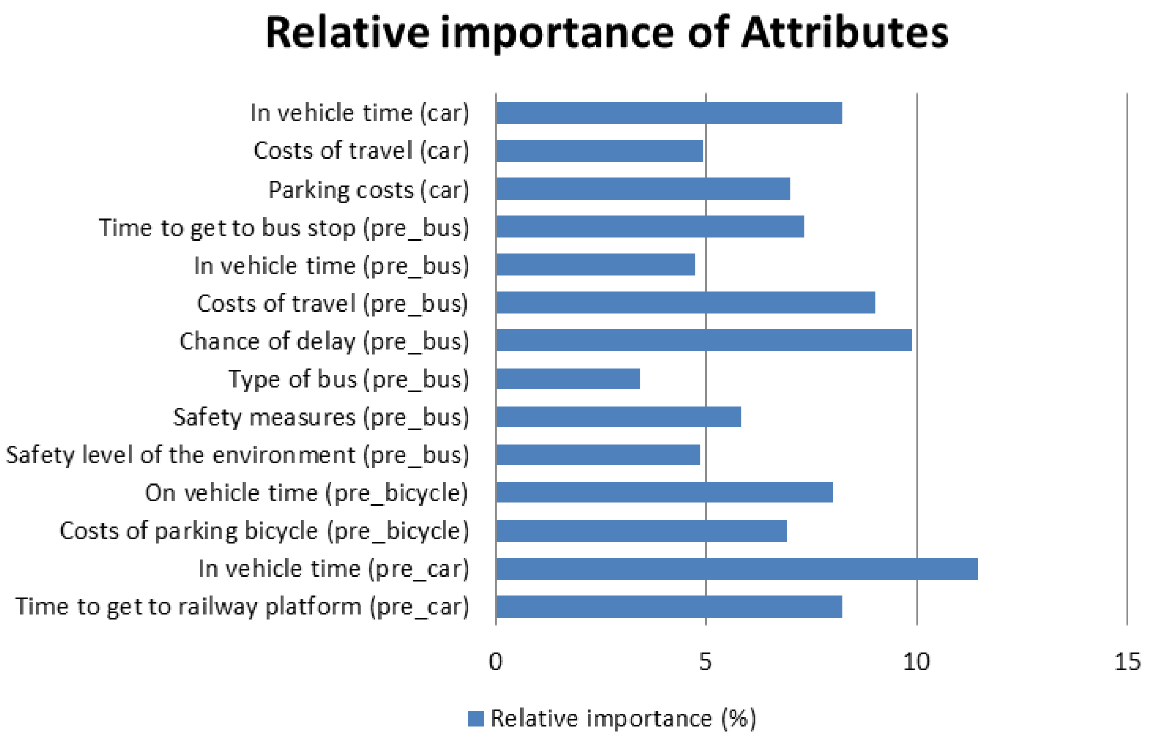

Figure 29. Relative importance of significant attributes include in the research.

CONCLUSIONS

The research in this thesis addresses a study of the influence of transportation mode characteristics on transportation mode choice. To collect data about the transportation mode choice, a research was set up and conducted in the region of Eindhoven. Respondents that are likely to use a form of pre-transportation when traveling with the train from the railway station of Eindhoven were approached to fill in a questionnaire including a stated preference experiment.

The results of the sample description of the research showed that the research reached the target group that was aimed for, people that live on a distance from the railway station that ensures a pre-transport trip when the train is used. These group of potential travelers proved to be a group with a wide variation and many different travel behaviors. The distribution of characteristics of the respondent group that was aimed for proved to be present. The respondents that participated in the research are an acceptable representation of the Dutch population according to the sample description, this is useful information for parties that tend to use the research results for specific purposes. The current travel behavior of the respondents showed that journeys to cities could have different travel purposes. Each city has a different distribution of travel purposes. Also, the type of city seems to influence transportation mode choice. Cities with a high 'omgevingsadressendichtheid' tend to be visited more by public transport relative to the car. The pre-transportation mode of respondents shows a big difference with previous researches about the use of pre-transportation modes. Comparing the results with a research from Givoni and Rietveld (2) (2007) that was based on the Dutch Railways (NS) customer satisfaction survey carried out in 2005, differences in pre-transportation mode use are present. In the research from Givoni and Rietveld the bicycle was used much more and public transport less. The differences between the researches are probably due to the differences in respondents characteristics. The pre-transportation modes that is used most by respondents in this research about the railway station of Eindhoven is the bus, followed by the bicycle.

The MNL model proved to be significant relative to the null-model according to the likelihood ratio statistics, but the ρ^2 was not really high which indicates that it is not a really good fit on all aspects. Noticeable about the results was that attributes related to time and costs were most important on the transportation mode choice, this was expected due to previous researches that revealed that time and monetary costs are important aspects in choosing a specific transportation mode. Striking was that none of the attributes of the train trip were of significant importance to transportation mode choice. This indicates that the decision between the car and train as transportation mode choice depends on the characteristics of the car trip and the pre-transportation trips. So the characteristics of the pre-transport are really important factors for the transportation mode choice of the train and thus of the railway journey. If it is tried to influence transportation mode choice, changing time and money related characteristics would have the most influence.

RECOMMENDATIONS

The main conclusions of the results is that monetary cost and time related characteristics of trips are the most important in transportation mode choice. So when changes in transportation mode choice have to be achieved, it is best to make a change in those characteristics. To make a transportation mode more attractive, characteristics that influence transportation mode choice could be made more appropriate for the customers. Also, considering that push measurements are often much more effective than pull measurements, maybe the characteristics of transportation modes that should be used less, could be influenced negatively to reach the goal.

For governmental parties the results and conclusions of the research are relevant information about transportation mode choice of people. In policymaking the information can be used to form strategical policies and a tactical approach to address current problems. Governments have influence on many aspects and characteristics of transportation mode, direct as well as indirect. Increasing, e.g. excises and taxes, could be really useful ways of changing transportation mode choices of people and reducing private car use. Governments could also promote the positive aspects of public transportation and the benefits it has to use them with the help of literature that is reviewed and shown in this thesis.

The Dutch Railways (NS) and other public transport facilitators, i.e. bus companies, could also benefit from the research. The most important characteristics for transportation mode choice are revealed and shown. These stakeholders could respond to the available information about the base of the transportation mode choice. Especially for bus companies it is important that the safety measurements are improved and the chance of delay is as low as possible. These proved to be two relatively unknown factors that are really important for the transportation mode choice.

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PERSONAL INFORMATION

This summary is the result of my graduation thesis about the role of pre-transport in travelers’ transportation mode choice. I conducted this research about mobility and transportation aspects because the current relevance of these subjects and my personal interest in it. The graduation research was interesting and inspiring to do. I gained a lot of knowledge and experience while working on it and I hope that the conclusions of the research contribute to a better understanding of the transportation mode choice.

2015	Graduation project TU/e
2013-2015	Master Construction Management and Engineering TU/e
2010-2013	Bachelor Architecture, Building and Planning TU/e

Nederlandse Samenvatting
ONDERZOEK NAAR DE ROL DIE VOORTRANSPORT SPEELT IN DE REIZIGERS VERVOERMIDDELKEUZE
Een studie uitgevoerd in de regio van het treinstation van Eindhoven

Auteur: K. (Koen) Sanders

Afstudeerprogramma
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Afstudeerdatum
17-08-2015

SAMENVATTING
Dit paper beslaat het onderwerp dat gaat over de vervoermiddelkeuze van reizigers en hoe zij tot die keuze komen. In het onderzoek zal specifiek gekeken worden of en hoeveel invloed het voortransport heeft op de vervoermiddelkeuze van reizigers die een afweging maken tussen het reizen met de auto of met de trein. De keuze voor een vervoermiddel wordt een steeds belangrijker onderwerp omdat het gebruik van de auto nog steeds aan het toenemen is. Deze toename van autogebruik in Nederland heeft vele gevolgen voor het milieu en de omgeving van de infrastructuur. Veel van deze gevolgen zijn negatief, daarom is het wenselijk om het autogebruik terug te dringen. Het beste alternatief voor autogebruik op de langere afstand is vaak de trein. Maar de trein heeft een slecht imago en veel potentiele gebruikers worden afgeschrikt door de negatieve aspecten van het treingebruik. In dit onderzoek zal worden onderzocht hoe de verschillend vervoermiddelen in elkaar zitten, en daarnaast zal specifiek gekeken worden naar de vervoermiddelkeuze die reizigers maken. In het onderzoek zal met behulp van een Stated Preference (SP) experiment data worden verzameld uit de omgeving van Eindhoven van respondenten die een vervoermiddelkeuze moeten maken in een bepaalde situatie. De verzamelde data zal vervolgens worden geanalyseerd door middel van een Multinomial Logit (MNL) model. Hieruit zal blijken welke aspecten en karakteristieken van bepaalde vervoermiddelen het zwaarste wegen in een vervoermiddelkeuze.

Trefwoorden: Vervoermiddelkeuze, menselijk gedrag, multimodale treinreis, bereikbaarheid van treinstations, autoreis

INTRODUCTIE
Autobezit en gebruik is enorm toegenomen in de laatste decennia in Nederland. Dit heeft gelijk tot veel problemen en negatieve gevolgen voor het milieu. Niet alleen de CO_2 uitstoot zorgt voor problemen, ook verkeersopstoppingen, geluidsoverlast, luchtvervuiling, het gebruik van veel land en het gebruik van fossiele brandstoffen. Vooral door het verstoppen

van verkeersaders worden deze problemen veroorzaakt en vergroot. In grote steden wordt vertraging en verstopping in het verkeer aangeduid als een van de grootste ergernissen in het verkeer. Het reduceren van autogebruik is al tijden een van de doelen van de beleidsvoering omtrent omgeving en duurzaamheid van de Nederlandse overheden. Door deze doelen wordt het gebruik van alternatieven vervoermiddelen gestimuleerd en gepromoot. Alternatieven vervoermiddelen zijn vaak energiezuiniger en veiliger dan het gebruik van de auto, maar toch worden zij vaak gezien als een slecht alternatief. In dit onderzoek zal een middellange tot lange 'reis' centraal staan binnen Nederland, dat wil zeggen een reis van tussen de 50 en 150 kilometer ongeveer. Het beste alternatief voor auto gebruik op deze afstand is de trein.

Doordat overheden en de bevolking steeds meer geïnteresseerd raken in duurzaamheid en een gezonde leefomgeving in de toekomst, zullen de eerder besproken alternatieve vervoermiddelen meer aandacht krijgen. Dus het zou bijdragen aan deze ontwikkelen om meer inzicht te krijgen in het beste alternatief voor de auto, de trein. Vele onderzoeken zijn bekend over treingebruik in de wereld. Daaruit blijkt dat van de treinreis de overstappen en het voortransport gedeelte niet op prijs worden gesteld door de reizigers. Over het voortransport is nog niet zo veel bekend, de bestaande onderzoeken over dit onderwerp zijn gedaan met treinreizigers. Niet-treinreizigers zijn niet bij de onderzoeken betrokken, terwijl dit toch te groep is die potentieel gebruik zouden kunnen maken van de trein. Daarom zal in dit onderzoek onderzocht worden hoe mensen, treinreizigers en niet-treinreizigers, denken over het voortransport en hoeveel invloed de karakteristieken van het voortransport hebben op de vervoermiddelkeuze.
Dat heeft de volgende onderzoeksvraag opgeleverd:

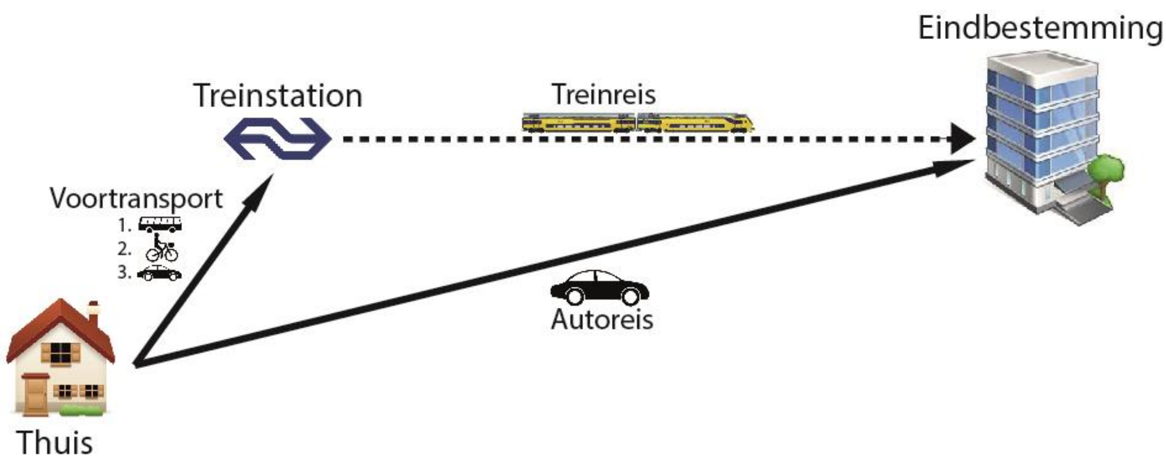
Wat is de rol van de kenmerken van voortransport op de vervoermiddelkeuze van reizigers, met in het bijzonder de keuze tussen het gebruik van de auto en de trein?

Het doel van het onderzoek is om te onderzoeken wat de rol is van het voortransport en de kenmerken daarvan in een multimodale treinreis en tot op welke hoogte dit invloed heeft op iemands vervoermiddelkeuze.

ONDERZOEKSOPZET
In het onderzoek zal op de eerste plaats een literatuurstudie worden gedaan om inzicht te krijgen in het onderwerp en de zaken gerelateerd aan de onderzoeksvraag. Vervolgens zal aan de hand van de bevindingen in de literatuurstudie een onderzoek worden geformuleerd om data te verzamelen en te analyseren. Een onderzoek zal worden gedaan in de regio rond het treinstation in Eindhoven. Respondenten uit de regio Eindhoven die voldoen aan de volgende eisen zullen worden benaderd: De respondenten wonen op een afstand van het station waardoor zij bij een treinreis genoodzaakt zijn om een vorm van voortransport te gebruiken, de respondenten moeten 18 jaar of ouder zijn zodat zij zich in kunnen leven in de keuzesituatie met als vervoermiddel de auto. Van deze groep respondenten zal door middel van een SP experiment data worden verzameld die vervolgens geanalyseerd zal worden door middel van een MNL model.

THEORETISCH KADER
In het theoretisch kader zullen de belangrijkste definities uitgelegd worden.

De verschillende soorten reizen
De verschillende soorten reizen die in het onderzoek van toepassing zijn worden weergegeven in Figuur 1. De eerste reis die zal worden besproken is de autoreis. De autoreis is een eenvoudige reis van thuis naar de eindbestemming. Op de eindbestemming zal moeten worden geparkeerd, dit is na de autotrip zelf het belangrijkste onderdeel van de autoreis. Parkeerkosten worden in Nederland ervaren als een belangrijk knelpunt in de autoreis. De grootste voordelen van de autoreis zijn dat het flexibel is, men zit niet aan een vaste route gebonden, het is vaak snel en de auto word gezien als status symbool.



Figuur 30: Verschillende soorten reizen toegepast in het onderzoek.

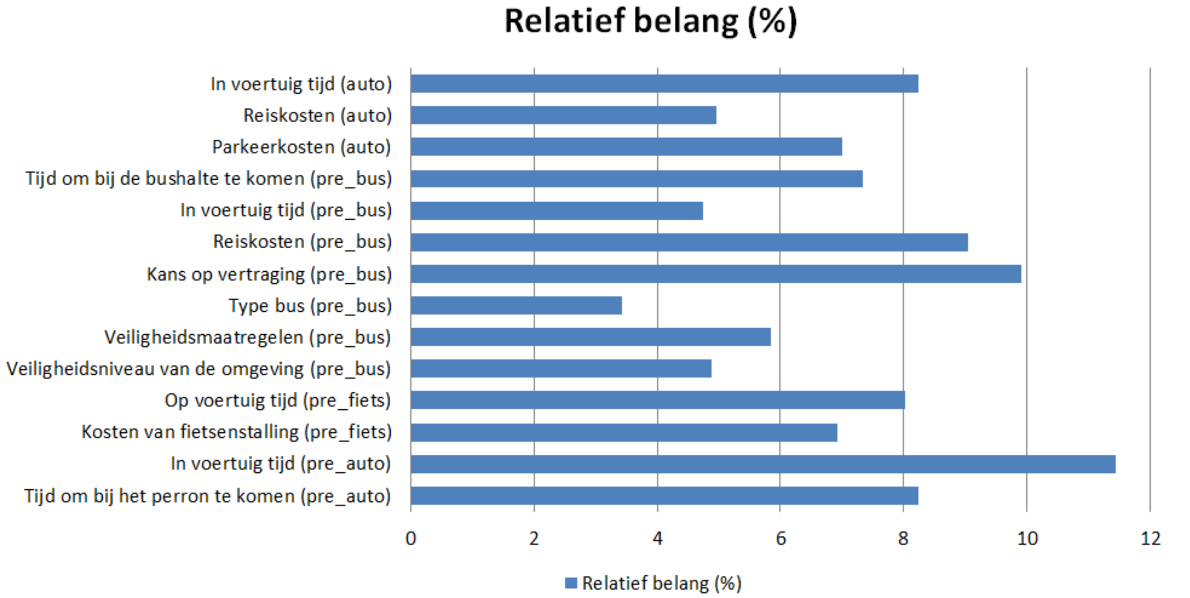
Naast de autoreis is er de treinreis, in het geval van dit onderzoek is dat een multimodale treinreis waarbij de aandacht ligt op het voortransport. De multimodale treinreis bestaat uit het voortransport van thuis naar het treinstation, op het station zal overgestapt worden op een trein, die daarna naar de eindbestemming gaat, al dan niet met extra overstappen tussendoor. Het voortransport in het onderzoek zal bestaan uit drie mogelijkheden; de bus, de fiets en de auto.

Vervoermiddelkeuze
De vervoermiddelkeuze hangt af van verschillende invloeden. In het onderzoek wordt uitgegaan van vijf stappen in het vervoermiddelkeuze proces. De eerste stap is het bewustzijn en de beschikbaarheid van het vervoermiddel, men moet wel weten dat het bestaat en mogelijk is. De volgende drie elementen; veiligheid en beveiliging, gemak en kosten en het plezier dat wordt beleeft aan de reis zijn elementen die tegelijkertijd in het keuzeproces worden afgewogen. Deze vier elementen die tot nu toe zijn besproken zijn allen afhankelijk van sociaaleconomische factoren van mensen. Een vijfde element dat van invloed is in het keuzeproces is de gewoonte. Gewoonte is een sterk mechanisme in het menselijk lichaam dat ervoor zorgt dat de vervoermiddelkeuze sterk beïnvloed wordt. Wanneer iemand altijd een bepaald vervoermiddel gebruikt, is het lastig om deze persoon in te laten zien dat er ook andere vervoermiddelen zijn en om de persoon daar bewust van te maken.

MODEL

Het onderzoek gaat over een reis van het huis van de respondenten naar een van de volgende steden in Nederland: Utrecht, Amsterdam, Nijmegen, Arnhem, Heerlen, Maastricht, Rotterdam en Den Haag. Al deze steden zijn voor de respondenten bereikbaar met de auto, maar ook via een multimodale treinreis.

Met behulp van een SP experiment die in een online enquête aan de respondenten wordt voorgelegd, zal data worden verzameld over de vervoermiddelkeuze. Iedere respondent krijgt keuzesituaties voorgelegd waarin zij moeten afwegen wat voor hen de beste optie is. De verschillende kenmerken van de vervoermiddelen zal hierin de doorslag geven. Nadat de data is verzameld zal deze worden geanalyseerd met een MNL model. De resultaten van het MNL model worden weergegeven in Figuur 2.



Figuur 31: Relatief belang van kenmerken van de reis.

CONCLUSIES EN AANBEVELINGEN

Naast het SP experiment in het onderzoek zijn ook vragen gesteld over het huidige verplaatsingsgedrag van respondenten. Daaruit bleek dat de vervoermiddelkeuze wanneer gereisd wordt naar bepaalde steden sterk bepaald wordt door het soort stad dat wordt bezocht, de 'omgevingsadressendichtheid' (oad) leek invloed te hebben op de vervoermiddelkeuze die wordt gebruikt voor het bezoek aan een stad. Het oad heeft te maken met de dichtbevolktheid van een stad. Uit de resultaten in figuur 2 blijkt dat vooral tijd en kost gerelateerde kenmerken van vervoermiddelen van belang zijn voor de vervoermiddelkeuze. De in voertuigtijd van de auto als voortransport en de kans op vertragingen en reiskosten van de bus blijken het meest van invloed te zijn geweest op de vervoermiddelkeuze in het onderzoek.

Het is voor stakeholders als NS, overheden en busmaatschappijen aan te raden om de resultaten van het onderzoek in acht te nemen bij nieuwe ontwikkelingen. Wanneer het doel is om meer mensen gebruik te laten maken van de trein zou het beste aanpassingen gemaakt kunnen worden in de kenmerken die het meeste invloed hebben op vervoermiddelkeuze, dat zijn de tijd en kosten gerelateerde kenmerken.