Examining car park users' willingness to pay for design factors of car parks

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Master thesis

COLOPHON

Graduation subject

Theme:	Smart mobility and infrastructures
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Front page photo: Car park Houtwal (Gemeente Harderwijk)

PREFACE

This graduation thesis is conducted in order to accomplish the mastertrack Real Estate Management and Development of the Eindhoven University of Technology. This study investigates the importance of design related attributes of publicly accessible car parks and how much car drivers are willing to pay for each design related attribute. Before choosing for this subject I was already involved with the operational issues of parking. When I was studying, I also had a job on the side, being an administrator of several large car parks in Amsterdam, for example car park Markenhoven and car park Stopera. I have gained extensive experience meeting and greeting car park visitors in Amsterdam and gained awareness of the everyday problems involved in the use of car parks. This study gave me the opportunity to understand more about car drivers' preferences regarding design features of car parks.

At this point, completing this report would not have been possible without the support and advice of my graduation committee. I would like to thank my two main supervisors from the University dr. ing. P. van der Waerden, prof.dr. T.A. (Theo) Arentze and my supervisor from Q-Park Martje Hoofs. Peter, I really enjoyed our sessions with your enthusiasm about parking and appreciate your patience. It was nice to have you as my first supervisors and look back with great pleasure at what I been allowed to learn from you. Theo and Martje thank you for guidance and support during my graduation. For a certain time we have been discussing on how the questionnaire should be constructed which could lead to a significant contribution to the outcome of this study. Also, Peter Martens thank you for all your feedback, your contribution helped me to optimize the questionnaire.

Second, I would like to thank all the people who helped me to get many respondents for my research in such a short period of time. I would like to thank Martje Hoofs and Peter Martens for sharing the link to the questionnaire through their social network. Peter Maters, I really appreciate your contribution for sharing the link to the questionnaire online through Vexpan. My dear brother and sister, thank you for sharing the link to the questionnaire through your working company.

At last I would especially like to thank my family friends who supported me during this course and encouraged me to hold on in difficult times. I hope you enjoy reading this report.

Soufyan Agarad
Amsterdam, 19 January 2017

EXECUTIVE SUMMARY

Introduction

The world is becoming more motorized and this goes hand in hand with a tremendous change in the parking sector. Over the past years the number of cars sold worldwide have been increasing and has resulted into a greater demand for parking. A lot of people still prefer to travel by car instead of traveling by public transport (e.g. bus or train), and therefore, need to park their car at a certain location e.g. at home, at work, and at shopping and recreation area. However, when the increase in the demand for parking cannot be offset by the parking supply then it can have a negative impact on the environment and the accessibility of an area. For example, inner city areas (e.g., Amsterdam, Rotterdam) are becoming less attractive due to the increasing amount of pressure on parking accompanied by nuisance. The development of car parks (e.g. stimulate off-street parking) and the implementation of parking measures (e.g. paid parking) are appropriate instruments in dealing with peak demands on the scarcer space for parking and urban traffic problems.

Over the years, the car driver is becoming a more critical parking 'consumer' with specific requirements regarding the place where to park their car. While parking companies strive to attract as many car drivers as possible to their parking facilities in order to increase their occupancy rates and yield the maximum revenues they should pay more attention to the needs and wants of car park users. Many large parking companies (e.g. Q-Park, Vinci Park, Interparking, and Apcoa) recognize the importance to provide a high quality product that meets the needs and wants of car drivers. However, although a car park may be equipped with high-quality design, for example: good lighting, luxurious materials, high-security equipment, and ultrasonic parking space sensors, it does not guarantee more visitors because of the car park's parking tariff. Car drivers may prefer a car park with a less high internal quality, but nonetheless located closer the destination e.g. in center with a lot of shops, restaurants, cinemas, or lower parking tariff. The review of the existing literature reveals that there is a knowledge gap about the connection between parking tariffs and design related attributes.

Research objective

This study attempts to provide more insight into car park users' willingness to pay for design related attributes, in order to create competitive advantage and optimize profitability.

Research questions

The following research question are formulated:

1. For which design related attributes of publicly accessible car parks are users of car parks willing to pay?
2. How much are users of car parks willing to pay for design related attributes?

Scope

The emphasis of this study is put on paid car parks in inner-city areas that are accessible for all kind of visitors.

Methodology

In order to identify the car park users' preferences regarding the relationship between parking tariffs and design related attributes, a Stated Preference experiment is set up. Hereby, a questionnaire instrument is developed in which drivers can valuate several parking alternatives each described by several design related attributes and tariff schedule. Through a literature review, this study identified the most relevant car park design attributes which influences car drivers' parking choice behavior. Second, the method of Integrated Hierarchical Information Integration is used to categorize the identified design related attributes into different decision constructs so that the respondents do not lose their focus. Last but not least, in the constructed questionnaire respondents are asked to evaluate parking alternatives in addition to willingness to pay for certain design related attributes. The methodology of this study is based on the assumption that respondents are willing to trade-off between combination of attributes and attribute levels.

Review of Literature

The literature review provides an overview of different aspects that are covered by parking. There are parking facilities that differ regarding size and price at different locations, namely: parking facilities in suburbs, parking facilities in city centers, and parking facilities in residential areas. This study focuses on car parks located in city centers. These are often multi-level parking facilities (above or underground car parks) that are more expensive due to the densely built-up areas accompanied by high land prices.

Inner-city car parks are becoming more and more important for the functioning of city centers. The car usage in the upcoming years will be intensified and it is expected that large city centers are to become more attractive locations. Consequently, this could lead to additional traffic congestion and parking pressure. To tackle these problems, different actions can be performed. The parking volume can be increased by developing more car parks in order to meet the increased parking demand. The parking demand comes from functions which generate (car) traffic (e.g. shopping centers, office buildings). Large cities also introduced limited parking duration and paid parking in urban districts in order to prevent traffic congestion. The parking tariff is considered as one of the most successful parking measure to discourage car drivers to park in a certain area. In the Netherlands, the most expensive city to park a car is Amsterdam with an average parking price of €5.01 per 60 minutes followed by the city Utrecht (€4.53), Rotterdam (€3.33), and Den Haag (€2.60). Setting a higher parking tariff could decrease the attractiveness of a parking space and thus steer and direct car drivers' parking behavior.

It seems to be favorable for the attractiveness of car parks when on-street parking is more expensive than off-street parking. On the one hand, parking companies have a certain discretion to determining parking tariffs, but it mainly concerns the 'willingness to pay' principle. This means that the pricing strategy of parking companies can only work efficiently if it is within the framework of the municipal parking policy and car drivers' willingness to pay. This is because urban planners could use the pricing mechanism and stimulate off-streets parking by making on-street parking more expensive than off-street parking. On the other hand, the car driver has several options and possibilities to park his/her car, like choosing between different options of on-street parking and off-street parking facilities. The parking needs of the car driver differ from a free or paid parking space to a parking space that is on either short or long walking distance to the final destination. Although car drivers have several possibilities to park their car somewhere, in the end, the parking choice is based on personal preference.

Providing the right parking product and services to the car park user will give parking companies a favorable competitive position. Parking companies provide (paid) parking facilities for car drivers who are searching for a place to park their car. They are constantly working to improve their parking facilities by providing parkers a high-quality parking product (e.g. welcoming, clean, safe, accessible, and added-value services). On the other hand, parking associations, are set up in different countries in order to resolve several parking issues. They attache great importance to the way car drivers (users of car parks) perceive the image of car parks. Therefore, the umbrella organization of European Parking Association (EPA) has developed a quality checklist with different categories for assessing the internal design (quality) of car parks and introduced the EPA Standard Award (European Standard Parking Award, ESPA), and more recently also the Golden Award for car parks with a top-quality. This award represent a car park as: safe, qualitative product, and user-friendly.

Although there are (NEN) standards providing minimum building principles , various design handbooks *(e.g. CROW, 2011; Rinsma & Koens, 2007)*, and quality checklist (ESPA) available, these means do not ensure, by definition, well-functioning car parks. Various studies have been conducted to explore which factors have an influence on car drivers' parking choice behavior. Existing literature shows that the greatest sources of frustrations among car drivers are: a high parking tariff, small sized parking spaces, limited payment options, crowded, poor visibility, and personal safety *(ANWB, 2013; Menda & Wogalter, 2003)*. Similarly, Trendbox (2010)

found that the most important factors are: price level (most car drivers prefer free parking), chance of free parking space (always a space available), parking bays (wide enough for easy parking), safety (safe and well illuminated), parking location (close to final destination), payment methods (easy payment, all payment options and payments per minutes). According to Van der Waerden et al (2006), signposting and services are considered less important when parking in a car park. On the other hand, Van der Waerden et al (2005) showed that color of paint and the presence of exit ramps influence the overall evaluation score of parking garages.

Proposed Methodology

This study tries to investigate which value is place upon different design related attributes and how changes in the internal design and parking tariff affect the parking choice behavior of car drivers. And also how much car park users are willing to pay for each design related attribute. A very important issue here is the assessment of how car park users' may respond to appearances of the internal design of a car park which are available to them, in particular, the value that they place upon different design related attributes, and how changes in the internal design affect their parking preferences, parking choice behavior, and in addition, their willingness to pay. This is because it is not always feasible to look to the actual (revealed) behavior. The stated preference (SP) method allows examination of how individuals may respond to various price levels and different levels of design related attributes which are available to them. According to Gate (2010), willingness to pay studies are mainly based on stated preference data because data of actual market behavior are largely unavailable or do not currently exist. For this study the stated preference method is used because there are limited studies or examples of parking choice behavior related to car park. As shown in *Figure 0.1*, stated preference is covered by choice modeling in which respondents are asked to give their choice given a few hypothetical alternatives.

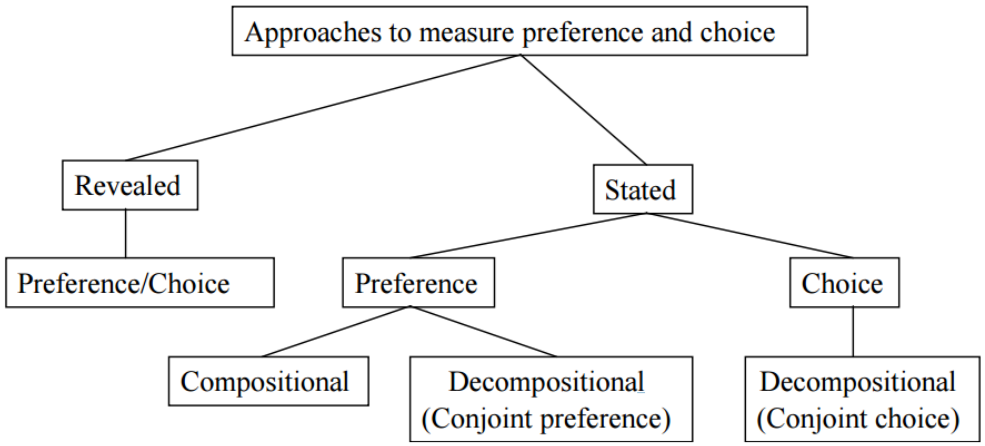


Figure 0.1 Approaches to measure preference and choice (Kemperman, 2000)

Stated choice

This study has chosen for choice modelling technique because it allows to describe a car park as a certain good in terms of its attributes and the levels that these attribute can take. This allows the researcher to present hypothetical car park alternatives (choice tasks) to respondents in which they can stated their choice by 'choosing' their most preferred alternative. In doing so, a number of systematically varied choice profiles are considered and the trade-offs between different attributes and attribute levels can be made.

Integrated Hierarchical Information Integration

An important practical limitation in choice experiments is the ability to handle large numbers of potentially relevant attributes. When there are too many attributes in a survey, the predictive accuracy of choice tasks degrades due to the information overload and respondent burden. Oppewal, Louviere, & Timmermans (1994) introduced the integrated HII approach which allows integration of several attributes into a single choice experiments. In order to create and carry out the HII with integrated sub-experiments. A step by step plan,

developed by Molin and Timmermans (2009), can be followed. In the first stage the relevant attributes and attribute levels are selected. In the second stage the attributes are categorized and clustered into decision constructs. In the third stage sub-experiments are constructed for each of the decision constructs separately. Each sub-experiment includes a detailed description of one of the decision constructs in terms of the attributes that define this decision construct. Also, this sub-experiment includes the remaining decision constructs as additional factors. This ensures that the presented choice tasks describe different alternatives as combinations of attribute levels and decision construct levels. In the fourth stage respondents state their choice among two alternative profiles. In the fifth stage the stated choice data are analyzed with a multinomial logit models (MNL).

Stage one

The identification and selection of attributes to be analyzed in this study are based on literature and experts opinions. There were forty-seven interesting attributes identified by looking at different handbooks *(Louter & Van Savooyen, 2005; Rinsma & Koens, 2007; Hill, 2005; CROW, 2011)*, ESPA checklist, and several studies on car drivers parking choice behavior *(ANWB, 2013; Menda & Wogalter, 2003; Van der Waerden et al., 2006; Van der Waerden et al., 2005; Trendbox, 2010)*. The attributes are further classify into three attribute levels based on literature and author's expertise. This enables the author to identify also non-linear utility relationships.

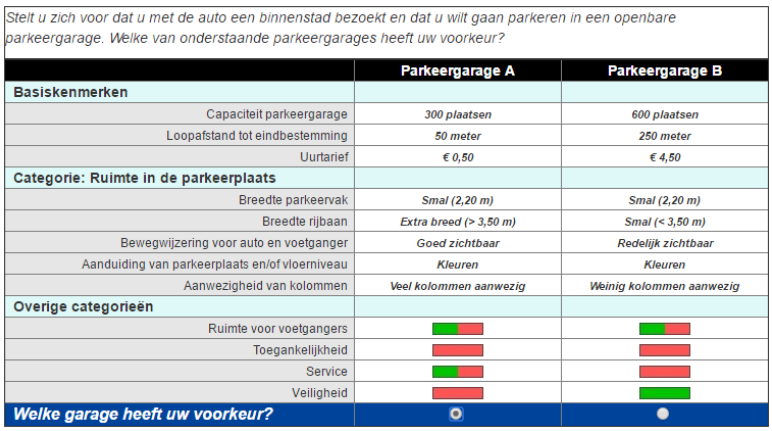
Stage two

According to several researchers an analysis should only include a small number of attributes in a single choice experiment otherwise both the required sample size increases exponentially and the choice tasks become overly complex for the respondent *(Molin & Timmermans, 2009; Breidert, Hahsler, & Reutterer, 2006; Gate, 2010)*. In order to formulate decision constructs for this research, the first step was to look at the ten main categories of the ESPA checklist. These categories are covered by different design aspects. After that, the ten categories are redesigning into five decision constructs: construct 1: Parking area, construct 2: Pedestrians environment, construct 3: Accessibility, construct 4: Service, and construct 5: Safety. The decision constructs are provided more clarification on how it should be interpret. Then, the author made a first attempt to categorize and clustered the forty-seven attributes in the most logical decision constructs. For clarity and in order to conduct an accessible survey each decision construct may only include five attributes. The author and two experts in the field of parking have selected, each of them, twenty-five (in their opinion) most important attributes. Finally, twenty-five of the forty-seven design related attributes are selected for this study and categorize and clustered in the corresponding decision constructs.

Stage three

Five different sub-experiments are constructed, each for every decision construct. In this study the choice tasks are developed with two product alternatives in the choice set (see *Figure 0.2*). Each choice task is composed out of three parts and comprises a total of twelve attributes:

1. three basic attributes each with three attribute levels describing the hypothetical parking situation in terms of:
    - Capacity : *1. 300 parking spaces 2. 600 parking spaces 3. 900 parking spaces*;
    - Distance to final destination: *1. 50 meter 2. 250 meter 3. 450 meter;*
    - Hourly rate: *1. € 0.50 2. € 2.50 3. € 4.50.*
2. five attributes of one specific decision construct each with three attribute levels as described in *Table 2*; and
3. the four remaining decision constructs each with three general construct levels: *1. limited supply 2. medium supply 3. wide supply.*



Stelt u zich voor dat u met de auto een binnenstad bezoekt en dat u wilt gaan parkeren in een openbare parkeergarage. Welke van onderstaande parkeergarages heeft uw voorkeur?

	Parkeergarage A	Parkeergarage B
Basiskenmerken		
Capaciteit parkeergarage	*300 plaatsen*	*600 plaatsen*
Loopafstand tot eindbestemming	*50 meter*	*250 meter*
Uurtarief	*€ 0,50*	*€ 4,50*
Categorie: Ruimte in de parkeerplaats		
Breedte parkeervak	*Smal (2,20 m)*	*Smal (2,20 m)*
Breedte rijbaan	*Extra breed (> 3,50 m)*	*Smal (< 3,50 m)*
Bewegwijzering voor auto en voetganger	*Goed zichtbaar*	*Redelijk zichtbaar*
Aanduiding van parkeerplaats en/of vloerniveau	*Kleuren*	*Kleuren*
Aanwezigheid van kolommen	*Veel kolommen aanwezig*	*Weinig kolommen aanwezig*
Overige categorieën		
Ruimte voor voetgangers		
Toegankelijkheid		
Service		
Veiligheid		
Welke garage heeft uw voorkeur?		

Figure 0.2 Example of a choice task

The software SAS is used to generate a fractional factorial design that consist of fifty-four profiles for each sub-experiment. The design is based on main-effects only, without any interaction-effects. If interaction effects were included, the amount of profiles would be higher and impractical to handle by respondents. The fifty-four profiles are randomly subdivided into twenty-seven choice sets for each sub-experiment. In this case, only 135 respondents were needed to get sufficient observations for the Stated Choice experiment. This is because each respondent has to evaluate ten choice tasks (two times five constructs).

Stage four

The BergSystem of the Eindhoven University of Technology is used to construct and distribute an online questionnaire. In stated choice experiment, respondents have become familiar with the context of the study. Therefore, the questionnaire is composed out of one selection part and three main parts. First of all, to find the right target group for the data analyses, the respondents are asked two questions: (1) if they hold a driving license and (2) if they ever have visited a car park before (selection part). In order to participate in the questionnaire, both answers has to be 'YES'. In the second part of the questionnaire, the respondents are asked how they experience parking on-street and parking off-street. In this way, the respondent becomes familiar with the study context and is warmed up for the stated preference part. In the stated preference part the respondent is asked to choose the preferred parking situation (car park **A** or car park **B**). The last part is about the characteristics of the respondents, e.g. gender, residence, education, and date of birth. In here, respondents have to answer only simple questions. Furthermore, additional questions are asked about: whether or not the respondent is professionally involved (e.g. advisor, operator, supplier) in the parking, how long they hold a driving license, and if they have any disabilities. These additional questions are asked in regard with the representativeness of the sample.

Stage five

The Stated Choice data of the five sub-experiments are analyzed using multinomial logit model as implemented in the NLOGIT software (version 5). The MNL predict the probability that a certain alternative i will be chosen from choice set A given the attribute levels of all alternatives in the choice set. The following equation for the MNL function is be used:

$$P(i, A) = \frac{exp\,(V_i)}{\Sigma_{i \epsilon A}\, exp\,(V_i)}$$

where,

- $P(i, A)$ = the probability that alternative i is chosen from choice set A.
- V_i = the structural utility of the alternative.

As described earlier, for each decision construct an sub-experiment is constructed. In each sub-experiment all the assumed subsets of attributes as well as the represented constructs are outlined to the respondent. Therefore, the equation of the systematic utility V_{ik} of an alternative $_i$ in sub-experiment $_k$ can be written as:

$$V_{ik} = \Sigma_j \boldsymbol{\beta}_j \boldsymbol{X}_{ij} + \Sigma_{j \epsilon Jk} \boldsymbol{\beta}_j \boldsymbol{X}_{ij} + \Sigma_{k' \neq k} \boldsymbol{\gamma}_{k'} \boldsymbol{C}_{ik'}$$

where,

- V_{ik} = the deterministic part of the utility for alternative i in sub-experiment/construct k
- j = attribute j
- J_k = detailed design related attributes J of construct k
- $\boldsymbol{\beta}_j$ = a vector of attribute parameters $\beta_{1,\ldots;}\beta_j$
- $\boldsymbol{X}_{ij}$ = a vector of the attribute levels j in alternative i
- k'≠k = all other constructs that are not presented at detailed level k', except construct k
- $\boldsymbol{\gamma}_{k'}$ = a vector of parameters $\gamma_{1,\ldots;}\gamma_{k'}$ of all other constructs that are not presented at detailed level
- $\boldsymbol{C}_{ik'}$ = a vector of the attribute levels that are not presented at the detailed level of other constructs k' in alternative i

The goodness of fit for the statistical model is evaluated, in order to know how well the model describes a set of observations. The log-likelihood ratio statistic and the rho-square are used, in order to give an indication of how well the predictability is resulting from the model. This method assumes that the closer the log-likelihood value comes to zero, the better the predictability is resulting from the model (the range vary from –infinite to zero). Additionally, the different models can be compared by looking at the difference between log-likelihoods, resulting in the log likelihood ratio statistic (LRS). The LRS is chi-square distributed and can be used to test if the optimal model performs significantly better than the constant only model. The calculation is as follow:

$$\boldsymbol{LRS} = -2\ [\boldsymbol{LL}\ (optimal) - \boldsymbol{LL}\ (constant)\ ]$$

The rho-square is used to show how much variation in choice is explained from the model. Hensher et al (2005, p.338) point out that rho-square values between 0.2 and 0.4 represents a decent model fit. The calculation is as follow:

$$\boldsymbol{Rho\text{-}square} = 1 - \frac{\boldsymbol{LL}\ (optimal)}{\boldsymbol{LL}\ (constant)}$$

The estimated parameters of the model are used to calculated the part-worth utilities of the attributes and attribute levels. They are also used for calculating the willingness to pay for each design related attribute. The is calculated as follow:

$$\mathrm{WTP}_j = \left(\frac{\beta_j}{\beta_c} \right)$$

where,

- WTP_j = the willingness to pay for attribute j
- β_j = the design related attribute's parameter
- β_c = the cost attribute parameter

Data collection

Due to the small budget and limited time for this study, the author has chosen for a convenience sampling technique rather than field research; visit several car parks, and/or asking people directly if they would like to participate in the questionnaire. The BergSystem provided a link to the questionnaire which is share on different ways. This link is shared: through authors' social media networks, through LinkedIn by two professionals in the field of parking with a large social network, shared internally in two large companies through Yammer and Intranet. The questionnaire was published online via Vexpan website *(Vexpan, 2016)*.

Findings

The first part of the analysis include descriptive statistics of car drivers' characteristics. It shows that the sample was not representative for the Dutch population. The sampling frame was not known, and therefore, it is not fully clear if the sample is representative for the car park users. The results of the respondents' experience of parking on-street and off-street are shown in *Figure 0.3*. The respondents could rank several parking factors between two extremes on a scale one to five. An example of the interpretation of *Figure 0.3* is that the parking tariff for off-street parking is experienced more expensive than on-street parking. It seems that the whole parking experience of both parking on-street and parking off-street is more on the less positive extreme side.

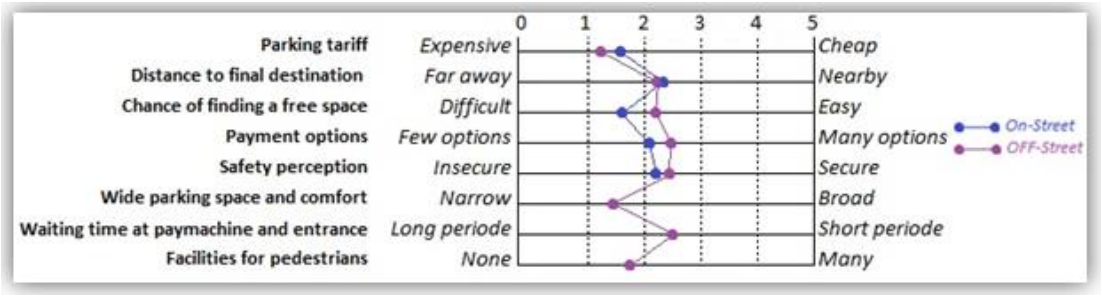


Figure 0.3 Respondents' parking experience on-street and off-street

The second part of the analyses provide a better understanding of the most important design related attributes and respondents' willingness to pay. The results of the model evaluation are composed in *Table 0.1*. It seems that the model has a decent fit.

Output Nlogit	
Observations	3061
Estimated parameters	66
Iterations	6
Log likelihood Optimal model	-1498.87
Log likelihood Constant only model	-2121.65
Degree of freedom (DF)	65
Log likelihood ratio statistic (LRS)	1245.56
Rho-square	0.29
Adjusted rho-square	0.28
Critical Chi² ratio	84.82

Table 0.1 Model performance

The results of the model parameter estimates are presented in *Figure 0.4*. The attributes and constructs that are not found significant are marked in red and were excluded for further research. It seems that there are fourteen design related attributes that influence car drivers' parking choice behavior significantly.

Basic attributes	Coefficient	Sign.
Capacity1	0.0197	NS
Capacity2	-0.0267	
Location1	0.2386	***
Location2	0.0496	
Parking tariff1	0.9841	***
Parking tariff2	0.0865	*

Attributes of Parking area	Coefficient	Sign.
Width parking space1	-0.4771	***
Width parking space2	0.0218	
Width road lane1	-0.3376	***
Width road lane2	0.0640	
Clear signing car & pedestrian1	-0.1526	NS
Clear signing car & pedestrian2	-0.1034	
Type of floor level identification1	-0.0405	NS
Type of floor level identification2	-0.0266	
Presence of columns1	0.0661	NS
Presence of columns2	0.1442	

Attributes of Pedestrians environment	Coefficient	Sign.
Pedestrians routes1	-0.0268	
Pedestrians routes2	0.2970	**
Entrance regime pedestrians1	-0.0024	NS
Entrance regime pedestrians2	0.0328	
Width staircases1	-0.1486	NS
Width staircases2	-0.0048	
Type of elevator points1	-0.3631	***
Type of elevator points2	-0.0110	
Walking distance parking space to the stairway1	0.1109	NS
Walking distance parking space to the stairway2	-0.1174	

Attributes of Accessibility	Coefficient	Sign.
Type access control system1	-0.1797	
Type access control system2	-0.2168	*
Width entrance lanes1	-0.2104	**
Width entrance lanes2	0.1361	
Average waiting time at entrance1	0.0782	NS
Average waiting time at entrance2	0.1228	
Average waiting time at payment terminals1	0.0728	NS
Average waiting time at payment terminals2	-0.0187	
# special places reserved1	0.1007	
# special places reserved2	-0.1977	*

Attributes of Service	Coefficient	Sign.
Presence of parking guidance systems1	-0.2958	***
Presence of parking guidance systems2	0.2949	***
Payment options1	-0.9337	***
Payment options2	0.3829	***
Presence music and/or fragrance system1	0.1877	NS
Presence music and/or fragrance system2	0.0471	
# electrical charing points1	-0.1806	NS
# electrical charing points2	-0.0636	
# toilets inside1	-0.2807	**
# toilets inside2	0.0289	

Attributes of Safety	Coefficient	Sign.
Level of lighting1	0.3599	***
Level of lighting2	0.1447	
Security1	-0.0212	
Security2	-0.2133	*
Presence of ramps1	0.2580	**
Presence of ramps2	0.0805	
Marked escape routes1	-0.2063	NS
Marked escape routes2	0.2068	
Cleanliness and maintanance1	0.4506	***
Cleanliness and maintanance2	0.4192	***

Constructs	Coefficient	Sign.
Parking area1	-0.4347	***
Parking area2	0.0837	
Pedestrians environment1	-0.1421	***
Pedestrians environment2	0.0093	
Accessibility1	-0.1556	***
Accessibility2	-0.0187	
Service1	-0.0293	NS
Service2	-0.0332	
Safety1	-0.3511	***
Safety2	0.0248	

Figure 0.4 Model estimation results of the multinomial logit model

Effect coding is used to calculate the part-worth utilities of the attribute levels. The difference between the highest and lowest part-worth utility is the range of the attribute. The most important attribute has the highest range and has also the highest influence on the respondents' parking choice behavior. The range of the attribute is also used for the calculation of the willing to pay for design related attributes. The WTP for design related attribute j is calculated as the derivative of the measured design related attribute's utility parameter (β_j) with respect to cost attribute's utility parameter (β_c). For instance, the cost attribute's utility parameter (β_c = 2.0547) which is the range of the attribute 'parking tariff', and is hence, equivalent to an amount of €4.00 (difference between €0.50 to €4.50). Therefore after β_j is divided by the β_c this outcome will be multiplied by € 4.00. The result of this calculation is how much respondents are willing to pay for design related attribute j. *Table 0.2* shows the results of part-worth utilities of the attribute levels, Utility parameter of the attributes, and the willingness to pay for each design related attribute. It seems that attribute number one (=payment options) has the highest influence and number fourteen (number of special places reserved) the lowest influence on the respondents' parking choice behavior. This finding has amazed the author because it was not expected that 'payment options' would have the highest influence on the respondents' parking choice behavior. This is because no such link was apparent on the basis of a thorough study of the literature.

Cost attribute		Part-worth utility	Utility parameter (β_{Ci})	
Parking tariff per hour			**2.0547**	
	€ 0.50	*0.9841*		
	€ 2.50	*0.0865*		
	€ 4.50	*-1.0706*		
Design related attributes		**Part-worth utility**	**Utility parameter (β_{Xi})**	**WTP**
1 Payment options			**1.4845**	**€ 2.89**
Only cash		*-0.9337*		*€ -1.82*
Cash and bank cards		*0.3829*		*€ 0.75*
Cash, bank cards and mobile		*0.5508*		*€ 1.07*
2 Cleanliness and maintenance			**1.3204**	**€ 2.57**
No dirt and debris		*0.4506*		*€ 0.88*
Little dirt and debris		*0.4192*		*€ 0.82*
Much dirt and debris		*-0.8698*		*€ -1.69*
3 Width parking space			**0.9542**	**€ 1.86**
Small (2.20 m)		*-0.4771*		*€ -0.93*
Medium (2.35m)		*0*		*€ 0.00*
Very wide (2.50 m)		*0.4771*		*€ 0.93*
4 Type of elevator points			**0.7262**	**€ 1.41**
Stairs		*-0.3631*		*€ -0.71*
Elevator		*0*		*€ 0.00*
Stairs and elevator		*0.3631*		*€ 0.71*
5 Level of lighting			**0.7198**	**€ 1.40**
No dark spaces		*0.3599*		*€ 0.70*
Minimal dark spaces		*0*		*€ 0.00*
Much dark spaces		*-0.3599*		*€ -0.70*
6 Width road lane			**0.6752**	**€ 1.31**
Small (<3.50 m)		*-0.3376*		*€ -0.66*
Average (3.50m)		*0*		*€ 0.00*
Very wide (>3.50 m)		*0.3376*		*€ 0.66*
7 Pedestrians routes			**0.594**	**€ 1.16**
No separated walking route		*0*		*€ 0.00*
Separated walking route		*0.297*		*€ 0.58*
Separated and marked walking route		*-0.297*		*€ -0.58*
8 Presence of parking guidance systems			**0.5907**	**€ 1.15**
Not present		*-0.2958*		*€ -0.58*
At > to floor levels & rows		*0.2949*		*€ 0.57*
At parking space		*0.0009*		*€ 0.00*
9 Number of toilets inside			**0.5614**	**€ 1.09**
None		*-0.2807*		*€ -0.55*
1 unisex toilet		*0*		*€ 0.00*
Separate toilets		*0.2807*		*€ 0.55*
10 Presence of ramps			**0.516**	**€ 1.00**
None		*0.258*		*€ 0.50*
Present in limited number		*0*		*€ 0.00*
Present in high number		*-0.258*		*€ -0.50*
11 Type access control system			**0.4336**	**€ 0.84**
Licence plate recognition		*0*		*€ 0.00*
Staff access		*-0.2168*		*€ -0.42*
Entry ticket machine		*0.2168*		*€ 0.42*
12 Security			**0.4266**	**€ 0.83**
Video surveillance		*0*		*€ 0.00*
Staff present		*-0.2133*		*€ -0.42*
Staff and video surveillance		*0.2133*		*€ 0.42*
13 Width entrance lanes			**0.4208**	**€ 0.82**
Small (<3.00 m)		*-0.2104*		*€ -0.41*
Normal (3.00m)		*0*		*€ 0.00*
Very wide (>3.00 m)		*0.2104*		*€ 0.41*
14 Number of special places reserved			**0.3954**	**€ 0.77**
None		*0*		*€ 0.00*
1 % of total spaces		*-0.1977*		*€ -0.38*
5 % of total spaces		*0.1977*		*€ 0.38*

Table 0.2 Willingness to pay for design related attribute

Conclusion and discussion

The purpose of this study was to obtain insight into car park users' preferences regarding the relationship between parking tariffs and design related attributes and ultimately to provide an answer on the main questions of this study. This study is based on the assumption that respondents are willing to trade-off between combination of attributes and attribute levels. The integrated HII approach with the Stated preference experiment proves to be a highly useful, efficient methodology for understanding car drivers' parking choice behavior. This study is a first attempt that shows how much car drivers are willing to pay for different design related attributes. Indeed, this study shows which value is placed upon different design related attributes and also that car drivers are willing to pay a higher tariff for several design features.

In contrast to findings of the literature review, it appears that different payment options have the most influence on car drivers' willingness to choose for a certain car park. A likely explanation for this finding is that respondents were not willing to trade-off between combinations of payment options. It would have been interesting to include a 'no-choice' option in the choice task. Now the respondents were forced to choose between two hypothetical car parks. For further research it could be interesting to explore more deeply the value placed upon payment options in car park. Finally it can be concluded that the following recommendations have a positive influence on car driver parking choice behavior (see *Table 0.3*).

Description
Allow different payment possibilities
Make sure that the car park is regularly cleaned and maintained
Ensure that the inside of the car park is well illuminated
Ensure that the parking spaces are at least 2.35 meter wide
Ensure that there are separate toilets and are kept clean
Ensure that car drivers are directed to the most the most suitable floor level & parking row
Ensure a good and safe parking environment by use of staff- and video surveillance
Do not use ramps or at the very least only a limited number to control or manage vehicular traffic
Ensure that the entrance of the car park is at least 2.30 meter wide and is equipped with an entry ticket machine
In case of a multilevel car park ensure that there is both stairs and an elevator

Table 0.3 Recommendations for car park design

This study also shows how much car drivers are willing to pay a additional design features. Furthermore, the findings of willingness to pay can serve as a reference for determining parking tariffs. In the current literature there is little known about the justification of parking tariffs and many municipalities and also car park companies are looking elsewhere (e.g. competitors). In general, the parking tariff is perceived by car drivers as being high.

TABLE OF CONTENT

1 Introduction

In this chapter, the three elements of the problem definition in terms of reasoning, research objective(s) and research question are described. The first paragraph provides an introduction which serves as the motivation for this research. This is followed by a description of the main objective, main question, and associated sub-questions. The last part elaborates on the action plan of this research.

1.1 Problem Introduction

As far as the future concerns, the world is becoming more motorized which goes hand in hand with a tremendous change in the parking sector. Over the past years the number of cars sold worldwide have been increasing *(Statista, 2017)*. Moreover, the Dutch vehicle fleet has grown to approximately 10.8 million vehicles possibly due to the increase in the population of 18 years and older, the growth of the working population, and the growth of the number of households *(CBS, 2015)*. The continuing growth of car ownership should bring a greater demand for parking; people will still use their car for different trip purpose and need to park their car somewhere e.g. at home, at work, and at shopping and recreation area. A lot of commuters still prefer to travel by car than travel by public transport (e.g. bus or train). However, if the increase in the demand for parking cannot be offset by the parking supply then it can have negative impact on the environment and the accessibility of an area.

More and more cities putting efforts to make public spaces physically more attractive and more accessible by developing parking policies that aim for low-traffic urban areas and stimulates off-street parking *(e.g. Gemeente Amsterdam, 2012)*. Moreover, parking is used by municipalities, whether on-street or off-street, as a tool in controlling travel demand and suppress traffic congestion in densely populated cities *(Pierce, Willson, & Shoup, 2015; Simićević, Vukanović, & Milosavljević, 2015)*. Nowadays, for example, inner city areas (e.g., Amsterdam, Rotterdam) are becoming less attractive due to the increasing amount of pressure on parking accompanied by nuisance *(Gemeente Amsterdam, 2012)*. Even a small search time per car can create a surprising amount of traffic leading to traffic congestion which causes a waste of time and fuel for other drivers *(Shoup, 2006)*. The development of car parks (e.g. stimulate off-street parking) and the implementation of parking measures (e.g. paid parking) are appropriate instruments in dealing with peak demands on the scarcer space for parking and urban traffic problems *(CROW, 2011)*. Thus, when cities are aiming for attractive public spaces low-traffic (urban) areas then they have to find a way to attract car drivers to car parks.

Off-street parking, particularly in inner city areas, and the parking product provided are becoming more and more important for parking companies. Nowadays, competition between public accessible inner-city car parks is growing due to societal and environmental changes (changes in consumer preferences and behavior). Moreover, the earlier perception on car parks focused on quantity instead of quality. A repository for as many cars as possible in as little space as possible *(Louter & Van Savooyen, 2005)* is considered out-of-date and no longer appropriate to the present time. For instance, Louter & van Savooyen (2005) reported that in the past unattractive parking garages only for temporary storage of cars with no mixed-use elements and no supervision has led to dark, vacant, and degraded spaces. In addition, according to different authors in specialized journals (e.g. Parkeer24 and Vexpansie), the car driver is becoming a more critical parking 'consumer' with specific requirements where to park their car. The parking consumer sees increasingly more value on different aspects of car parks such as the ease of use, social safety, price level, amenity value, available services and quality *(Van der Waerden P. , 2015; NRW en SOAB, 2014)*. To respond optimally to those changes, parking companies have to concentrate on the wants and needs of their (potential) customers. Commercial parking companies (e.g. Q-Park, Vinci Park, Interparking, and Apcoa) provide paid parking facility for car drivers who are searching for a place to park their car. Parking companies are there to satisfy car drivers, providing parking comfort, and guarantee a pleasurable e.g. shopping experience *(CROW, 2011)*. The practice shows that many large car park operators are putting effort to create a good first impression to their customers by providing a high-quality parking product (e.g. welcoming, clean, safe, accessible and with added-value services). They put effort in

establishing a recognizable name and brand identity so that they can communicate with their customers in a consistent manner *(Q-Park, 2016; Apcoa, 2013; Interparking, 2015)*.

1.2 Problem definition

Many cities have introduced paid parking as a part of urban planning and regulations in order to contribute to a livable and attractive city *(Mcshane & D. Meyer, 1982)*. This is because the parking tariff is one of the important factors that is considered when looking for a suitable parking space. Research has shown that lowering or raising the parking tariff can influence the parking behavior of a car driver and therefore could either deter or attract drivers to a certain parking space or facility *(Shoup, 2006)*. This is because setting a higher parking tariff could decrease the attractiveness of a parking space and thus steer and direct car drivers' parking behavior *(Mcshane & D. Meyer, 1982)*. Commercial parking companies have a certain discretion to determining parking charges, but it mainly concerns the 'willingness to pay' principle. Moreover, the price strategy of private operators can only work efficiently if it is within the framework of the municipal parking policy. This is because urban planners could use the pricing mechanism and stimulate off-streets parking by making on-street parking more expensive than off-street parking. According to Shoup (2006) car drivers are more likely to cruise for a cheap parking on the street when off-street parking is more expensive leading to additional traffic congestion, pollution and noise.

However, not only the parking tariff but also other aspects may influence the car drivers' parking choice behavior and their willingness to pay for a certain parking product that is provided. Research has shown that car drivers are willing to pay for parking; sometimes more and sometimes less depending on the trip purpose and other factors *(KpVV, 2012; Newmark & Shiftan, 2007)*. For example, the study of Trendbox (2010) pointed out that car drivers (e.g. shoppers) do not mind to pay for an available parking space near the destination and that a large group of car drivers are willing to pay more for a safe parking space. Although parking is not an end itself, it is a part of the customer journey and if the customer's mood remains relaxed after parking it could contribute towards for example a positive experience of a customer and the shopping or leisure experience *(Cox, 2016; NRW en SOAB, 2014)*. This could lead, as a result of increased emotion excitement, to possible more purchases during that day in favor of several other stakeholders. Hart, Stachow, Rafiq, & Laing, (2014) found that heighten enjoyment among shoppers lead to more spending.

Also, due to the fact that humans are creatures of habit *(Nilsen, Roback, Brostrom, & Ellstrom, 2012)*, a satisfied car driver is very likely to return to the same parking space or car park on the next trip *(Van der Waerden, Timmermans, & Da Silva, 2014)*. After all, off-street parking is not just about a building with enough provided parking spaces, but different aspects of a car park that could influence the car drivers feeling and perception matters. Therefore, parking companies recognize the importance to provide a high quality product that meets the needs and wants of car drivers. To achieve this, sometimes high level of investments are needed. For example, acquiring advanced payment terminals that accepts several payment options in order to increase consumers' freedom of payment choice (see *Figure 1*). Another example is reducing the number of parking spaces available by making the parking spaces wider in order to provide more parking comfort. In return, a parking operator can increase the parking tariff to a certain level for recouping the investments made. In return, car park users have to be prepared to pay more for the improvements made in the car park, in order sufficient returns can be achieved for the operator. In other words, identify the factors that are related to the hourly parking rate breakpoint at which car park visitors will change travel behavior and no longer drive to the car park. Therefore, when designing or upgarding a car park, it is useful to have more detailed insights into which design factors have an influence on the willingness to pay of car park users.

Figure 1 Automated payment terminals (SKIDATA, 2007)

1.3 Research Introduction

The emphasis of this study will be on paid car parks in inner-city areas that are accessible for all kind of visitors. Moreover, parking companies who strive to attract as many car drivers as possible to their parking facilities in order to increase their occupancy rates and yield the maximum revenues should pay more attention to the needs and wants of car park users. Providing the right parking product and services to the consumer will give parking companies a favorable competitive position. Besides a 'good' location of the car park there are other factors involved that play a role in the car drivers' parking choice behavior and thus the visit of a particular car park:

- Location factors e.g. the type of area and orientation of the car park;
- Service factors e.g. amenities of the surrounding area, place reservation and car service point;
- Price factors e.g. tariff regime and tariff levels;
- Design factors e.g. layout of the car park, presence of (day) light and air-condition.

Furthermore, a considerable amount of studies has been carried out looking on ways to improve the competitive position of car parks and their environment *(e.g. Van der Waerden, 2015; Van der Waerden, 2011; Cox, 2016; Dijkstra et al., 2015)*. However, little is known about the relationship between design related attributes and car drivers' willingness to pay. In other words, although the question is studied how to optimize the design of a car park, in order for example to increase car drivers comfort, little is known about car drivers' willingness to pay a higher parking tariff for design features *(KpVV, 2012)*. In the context of this study design features concern a competitive set of design related attributes influencing the inner-quality and internal design of a car park. Furthermore, this study tries to investigate which value is place upon different design related attributes and how changes in the internal design and parking tariff affect the parking choice behavior of car drivers.

As shown in *Figure 4*, the parking consumers' willingness to pay for a certain car park is assumed to be influenced by design, service, and location related attributes. Although a car park may be equipped with high-quality design, for example: good lighting, luxurious materials, high-security equipment, and ultrasonic parking space sensors, it does not guarantee more visitors because of the parking tariff. Car drivers may prefer a car park with a less high internal quality, but nonetheless located closer the destination e.g. in center with a lot of shops, restaurants, cinemas or lower parking tariff. However, in Den Bosch, for example, the car pars St-Jan (*Figure 1*) and Wolvenhoek (*Figure 2*) are both located in the city center and have the same parking tariff (€2.20 per hour).

Figure 2 car park St-Jan Den Bosch (Short Title, 2015)

Figuur 3 car park Wolvenhoek (Schildpad, 2016)

The car park St-Jan Den Bosh is, however, furnished to a higher standard (e.g. good lighting and luxurious materials). To this end, car drivers could prefer to park in the St-Jan and willing to pay a higher parking tariff

because the internal design is of a higher quality. Due to the limited period of time this study will mainly focus on the design related attributes of a car park in relation to the parking tariff.

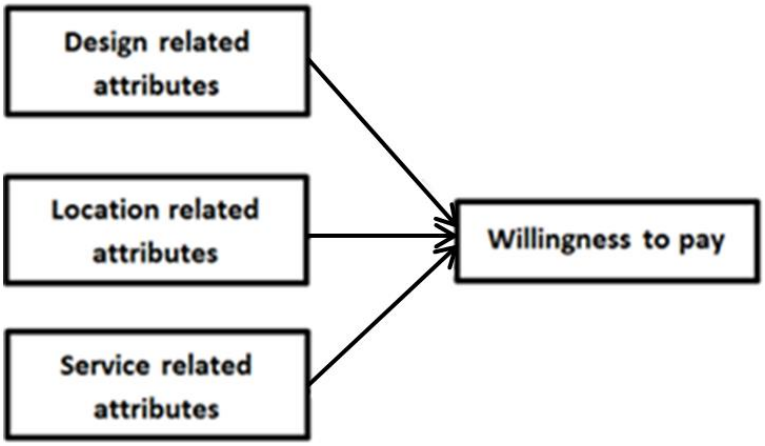


Figure 4 Conceptual model

1.3.1 Research aim

The aim of this study is to: *provide more insight into car park users' willingness to pay for design related attributes, in order to create competitive advantage and optimize profitability.*

1.3.2 Research questions

This study tries to understand if there is a connection between parking tariffs and design related attributes in car parks. Therefore the main questions of this study is:

'For which design related attributes of publicly accessible car parks are users of car parks willing to pay? '
And
'How much are users of car parks willing to pay for design related attributes? '

Additionally there are five sub-questions formulated which will help answering the main question:

1) *How is the parking stock built up?*
2) *What could be considered as design factors of a car park?*
3) *How are car parks being evaluated?*
4) *How could users' willingness to pay be measured?*
5) *How much are users of inner-city car parks willing to pay (extra) for design related attributes?*

1.4 Relevance

Relevance of this study can be divided in theoretical and practical relevance. The theoretical relevance describes the value of this study for parking in general whereas the practical relevance put its focus on the use of information for supporting practitioners like parking companies.

1.4.1 Theoretical Relevance

According to the author's knowledge, it seems that there might be a mismatch between produced scientific knowledge and practice to recover the cost of debt service and operations of car parks *(Pierce, Willson, & Shoup, 2015)*. Thus, this study helps to gain further understanding of the 'willingness to pay' principle by searching for new knowledge about which design related attributes influences parking tariff levels. Therefore, it is of interest to come up with a ranking of influencing car park design attributes on parking tariff levels.

1.4.2 Practical Relevance

Ideally, car park operators can use the result of this study because it creates a competitive advantage by anticipating and meeting consumers' preferences. Furthermore, decision making on investments will be

decidedly more justified based on more knowledge and facts, which is exactly what is aimed for in this study: informing future parking companies in order to create competitive advantage and optimize profitability by studying the relationship between parking tariffs and design related attributes. Also, the outcome of the study could be used by other organizations (e.g. municipalities, investors) that would like to improve their car parks and its environment. And last but not least, in favor of real estate investors, a greater insight is provided into the investment performances (return-on-investment) of a car park in comparison to other real estate sectors (e.g. retail, offices, etc.).

1.5 Research methode

In order to identify the car park users' preferences regarding the relationship between parking tariffs and design related attributes, a Stated Preference experiment is set up. Moreover, a questionnaire instrument is developed in which drivers can valuate several parking alternatives each described by several design related attributes and tariff schedule. Through a literature review, this study tries to identify the most relevant car park design attributes which influences car park users' willingness to pay that will be defined later on in the report. Second, the method of Integrated Hierarchical Information Integration is used to categorize the possible large amount of design related attributes into different constructs so that the respondents do not lose their focus. Last but not least, a questionnaire will be created and the respondent is asked to evaluate parking alternatives in addition to willingness to pay for certain design related attributes.

1.7 Reading process

This report is built up as follows. The previous chapther described the motivation for this study. Chapter 2 sets out the findings of the literature review carried out for this study. The chapter is divided into three different parts:. The first part focuses on the description of the parking stock, the second part focuses on the description of the different aspects of the car park design process, and the thirth part focuses on the description of how a car park is being evaluated from different points of view. In chapter 3, the research approach is described. This section elaborates on the methods and techniques concerning the data collection necessary for this study. In chapter 5, the analyses of the collected data are presented and more insight is gained into the willingness to pay for design related attributes by car park users. Finally, chapter 5 outlines the final conclusion of this study. In summary, the different steps of the report are visualized below in *Figure 5*.

Figure 5 Different steps of the research process

2 Parking

This chapter describes the various aspects concerning the problem definition of this study. First, the parking stock will be detailed in terms of parking supply and demand. The second paragraph describes how a car park is designed and the car parks characteristics. Finally, the last paragraph describes how a car park is evaluated by the different groups of stakeholders.

2.1 Parking supply

In parking, the parking supply is all about what kind of options and possibilities are offered to car drivers who want to park their car. In the literature, there is a large amount of information available covering the different aspects of an existing parking supply (e.g. see *Figure 6*). When using the car, the car driver has several options and possibilities to park his/her car. For instance, choosing between on-street parking and off-street parking like a car park (a building for parking cars) or a parking facility located in the suburbs *(Rinsma & Koens, 2007)*. The parking facilities differ in functionality. There are car parks that are accessible for everyone (mostly for short-term parkers) but there are also car parks only for prive use (long-term parkers). A private parking facility has the aim of ensuring parking spaces to a limited group of visitors, that only gain access to the car park through a pass, a key, or other personal identification. It sometimes happen that the parking supply is shared between public and private use in order to achieve a balance between the parking supply and demand *(CROW, 2011)*. As shown in *Figure 6*, parking spaces also differ from free parking, parking spaces for licensees, and paid parking. To this end, the parking policy is a tool in controlling travel demand and suppress traffic congestion in densely populated cities *(Pierce, Willson, & Shoup, 2015)*.

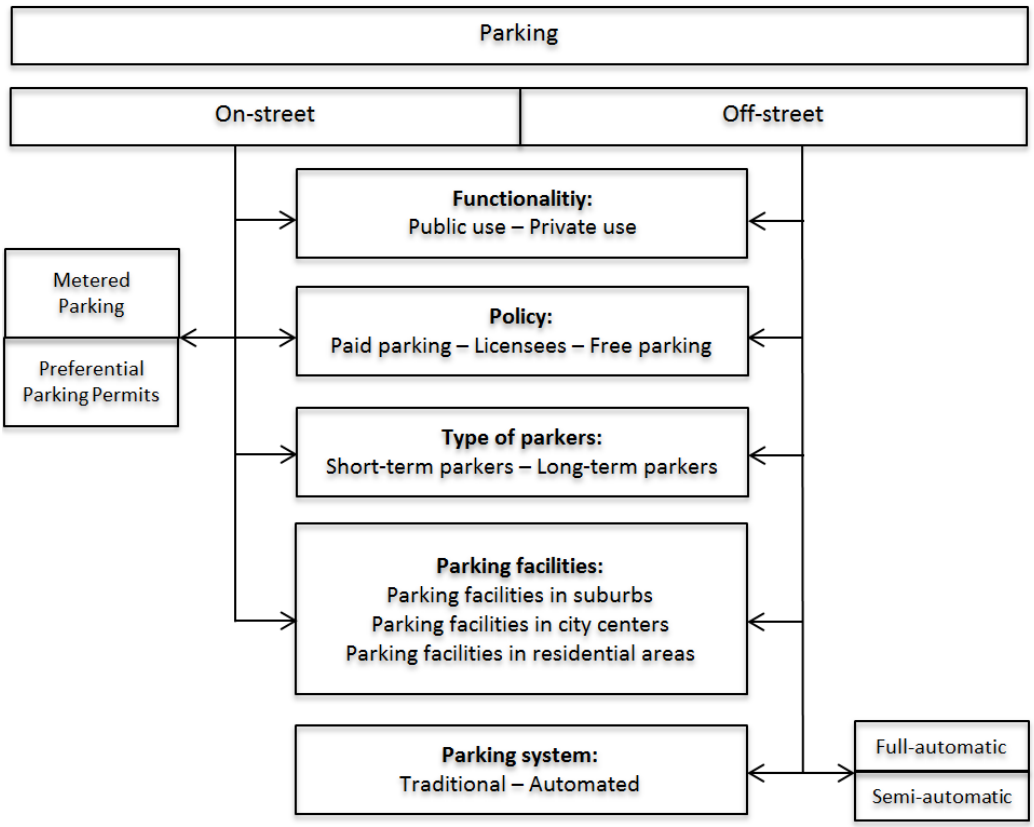


*Figure 6 Different aspects of the parking supply, *Own modification*
(CROW, 2004; Louter. & Van Savooyen., 2005; Rinsma & Koens, 2007)

Another aspect is the parking system (e.g. traditional or automated parking) of parking facilities. Traditional parking is the general way of parking in which the car driver enter for example a building for parking cars followed by parking the car and leaving the builing. On the other hand, parking facilities with automated parking systems provides parking spaces on multiple levels that are vertically, in order to maximize the number

of parking spaces while minimizing land usage *(Rinsma & Koens, 2007)*. Hereby, the car driver does not enter a building for parking the car. *Figure 7* below shows an example of an automated parking garage in the city Rotterdam.

Figure 7 The first automated parking garage in Rotterdam (Kers, 2010)

In addition, there is a large amount of parking facilities offered in which car drivers can choose where to park their car. Furthermore, most parking facilities differ regarding size and price at different locations.

- Parking facilities in suburbs (e.g. Park and Ride facilities) are mostly accessible to the public, larger in size and cheaper in price. They are often located at the outskirts of a city to encourage visitors of a city to subdivide their journeys into two parts; park the car (P) outside the central area and travel (R) into the city center by using a certain type of public transport. In many cases, these parking facilities are developed in order to control travel demand and suppress traffic congestion in densely populated cities *(Gemeente Amsterdam, 2012; Parkhurst & Meek, 2014)*.
- Parking facilities in city centers are often multi-level parking facilities (above or underground car parks) that are more expensive due to the densely built-up areas accompanied by high land prices. In the Netherlands, the most expensive city to park a car is Amsterdam with an average parking price of €5.01 per 60 minutes followed by the city Utrecht (€4.53), Rotterdam (€3.33), and Den Haag (€2.60) *(Detailhandel Nederland, 2015; centrumparkeren, 2016)*. In addition, off-street parking facilities can be a part of a building or complex, or part of a more general location with variety of function mix. The buildings are an appropriate mean in dealing with peak demands on the scarcer space for parking *(CROW, 2011)*. In addition, more and more cities put effort to make public spaces, in particular inner city areas, physically more attractive and more accessible by developing parking policies that aim for low-traffic urban areas and stimulates off-street parking (e.g., Amsterdam, Rotterdam, Toulouse, Bordeaux).
- Parking facilities in residential areas both on-street and multi-level parking facilities (above or underground car parks) are mostly available for residents (private use) and intended for permit-holders.

2.2 Parking demand

Parking demand comes from functions which generate (car) traffic. The demand for parking has changed over the years. Moreover, in the Netherlands, as a general trend, car ownership and kilometers travelled by car have been increasing *(CBS, 2015)*. The number of passenger cars increased by 55 percent to more than 7.9 million compared to 25 years ago. This together with more and more densely built-up areas should bring a greater demand for parking *(Vermeulen, Groot, Marlet, & Teulings, 2011; Louter & Van Savooyen, 2005)*. Although the parking demand and supply must be constantly balanced, in practice this is often not the case. For example, on a daily basis, it is estimated that residents of the city of Amsterdam with a car are cruising for a parking spot and it takes an average of 12 minutes, especially in the city center, to find a suitable/available space. This searching leads to almost 50,000 unnecessary car kilometers per day *(Gemeente Amsterdam, 2012)*. Even a small search time per car can create a surprising amount of traffic leading to traffic congestion which causes a waste of time and fuel for other drivers *(Shoup, 2006)*.

Additionally, this does not mean that car drivers avoid cruising, but they cruise till they find a parking space that fits their needs. The parking needs of the car driver can differ from a free or paid parking space to a parking space that is on either short or long walking distance to the final destination *(Shoup, 2006)*. Although car drivers have a lot of possibilities to park their car somewhere in the end, the parking choice is mostly the results of a personal preference. Furthermore, the parking consumer sees increasingly more value on different aspects of parking such as the ease of use, social safety, price level, amenity value, available services, and quality. Furthermore, there are many studies available that examined how to attract car drivers to different parking facilities. Although relatively many studies have placed the emphasis on the external factors of parking facilities, such as location, tariff, number of shops in the surrounding area *(Van der Waerden P. , 2015; NRW en SOAB, 2014)*, there is very few scientific studies available that focuses on the internal factors of parking facilities i.c. which internal factors (design related factors) trigger car drivers to visit a certain parking facility. Thus, when providing a parking space in a certain parking facility (e.g. underground car park), it is useful to have insight in the different design related aspects that play a role in satisfying consumers' needs and wants *(CROW, 2011)*. Paragraph 2.4 goes into more detail on this aspect and elaborates further on how a parking facility is assessed from different points of view in order to get a better understanding of how different parties look at parking.

2.3 Design process of car parks

It is necessary to understand when and where the quality of a car park is determined, in order to provide a high quality product that meets the needs and wants of parkers. Therefore more understanding is needed in the different steps of the design process (see *Figure 8*). Moreover, the steps of the car park design process is briefly explained *(CROW, 2011)*:

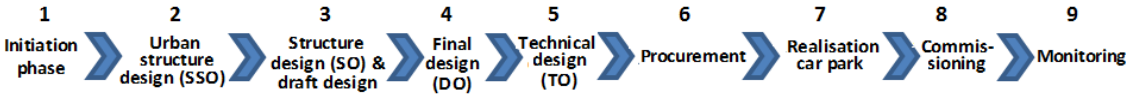


Figure 8 Car park design process (CROW, 2011)

In real estate each project is unique and requires keen consideration of several requirements, such as parking regulations, accessibility, safety, urban planning, and quality. The beginning of each project and also the development and design of a car park starts with an initiative. Additionally, the general requirements of a car parks' design is outlined to provide more understanding in the client and future users' point of view, objectives and ambition, and the spatial consequences. Moreover, a further briefing of the project has to be made in terms of the car park: size, location, type, and type of use. To that end, the parking policy of the municipality is taken into account since there are important aspect in regard to the parking volume, regulation, users profile, and time limit parking *(CROW, 2004)*. In the Netherlands the parking policy of municipalities focuses on the following three themes *(CROW, 2004; CROW, 2011)*:

1. *Parking volume*
    - Parking volume is about the number of parking spaces necessary in a certain area. The number of spaces is mostly based on standards provided by an authority specialized in parking and spatial planning like CROW. Furthermore, sometimes it is necessary to increase the parking supply (e.g. developing car parks) in a region due to the increased parking demand or for achieving certain goals for sustainable urban mobility e.g. improving the quality or liveability of the public areas by stimulating cars to park cars off-street.
2. *Regulation in terms of time and place*
    - Many large cities suffer from the lack of parkings spaces. Therefore these cities have implemented a number of parking measures such as limited parking duration and paid parking in order to contribute to e.g. lowering the parking pressure. In the Netherlands, paid parking is introduced in almost all urban districts. In order to park in a metered parking area for a limited period of time, car drivers have to buy a parking ticket at the ticket machines on

the street. Sometimes, the parking tariff is increased to make a parking area less attractive to park in. This is because the parking tariff is considered as one of the most successful parking measure to discourage car drivers to park in a certain area (see before). There are also 'blue zones' in which car drivers with a blue parking disc can park for free in the designated area for a limited period of time. Over time the 'blue zone area' are often replaced by paid parking. This depends on the extent of the parking problem.

3. *Enforcement and control*
    - As described above, the implementation of parking measures (e.g. paid parking, time restriction) are appropriate instruments in dealing with peak demands on the scarcer space for parking and urban traffic problems. However, both the permitted parking time must not be exceeded and in case of paid parking the parking fee has to be paid and therefore control is necessary. This also combat illegally parked vehicles. In the Netherlands, the parking ticket must be displayed in the front window if the car is parked at metered parking areas. Otherwise the car driver risks a fine.

In addition, in the next phases of the design process (*draft design and final design*) more insight is gained into the functional requirement (FPOR) which is further elaborated upon in the required floor area, level of quality, and use of materials. Hence, setting up the requirements is a key element in the determination of the quality level of the car park and is important in regard to this study. First, the briefing will discuss the relevant topics such as the layout, structural principles, engineering, technical installations, and functional detailing. Next, the final design provides more understanding about design details and, therefore, addresses subjects such as floor and wall finishing, lighting, services, and sizes. Moreover, a car park must meet many (legal) requirements regarding size, construction, accessibility, and safety. In the Netherlands, quite a few of the demands are described in the Buildings Decree [Bouwbesluit], the municipal building regulations and NEN standards (e.g. NEN 2443) *(NEN, 2014)*.

2.3.1 Car parks characteristics

Various handbooks are available for design and management of car parks *(Louter & Van Savooyen, 2005; Rinsma & Koens, 2007; Hill, 2005)*. Looking to these design handbooks four car park elements can be distinguished. *Table 1* shows the different car park elements that each consist of a number of factors. The factors belonging to the general element and external element may be considered less meaningful for this study. In this the emphasis is on the aspects of the design element and at a certain level of technical element because these aspects focus on the internal design and the layout of a car park. These design factors affect the internal quality of a car park and also the way car drivers experience parking in the car park. As an aside, the list may not be exhaustive, however, the author did try to identify all the relevant factors of car park.

General element	External element	Technical element	Design element
Functionality	Access to road network	Electrische installaties	Parking spaces
Architecturally	External signage	Lighting	Car entry / car exit
	Environmental requirements	Ventilation	Vehicle ramps
		security installations	Finish parking floor
		Parking equipment	Height
		Communication equipment	Parking road
		Additional installation (sound and scent)	Columns
		Mobile coverage	Traffic lanes
			Pedestrians facilities
			Doors
			Elevator points
			Comfort
			Layout
			Safety
			Finishing level

Table 1 Own modification of car park characteristics (Louter & Van Savooyen, 2005; Rinsma & Koens, 2007; Hill, 2005)

Design related attributes

The factors of the technical element and design element consist of a number of attributes that affect the internal quality of a car park. For example, 'size' and 'marking' are both important attributes of the parking space that can contribute to added convenience of the parking process. In a crowded car park it is more comfortable to park in a wide parking space rather than in a small sized parking space. Another aspect is that over the years the width of modern cars increased, and therefore, modern cars need modern parkings paces (e.g. see *Figure 9*). According to Tallantyre (2014), the parking spaces in Madrid and Barcelona's public car parks are tighter than everywhere in Europe.

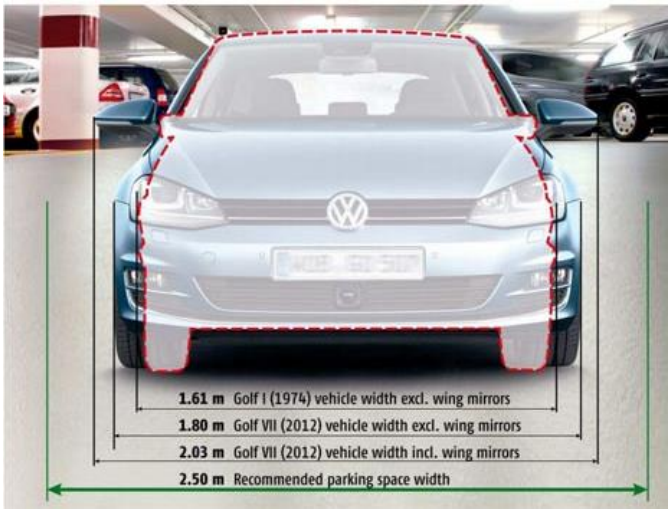


Figure 9 Modern cars need modern parking spaces

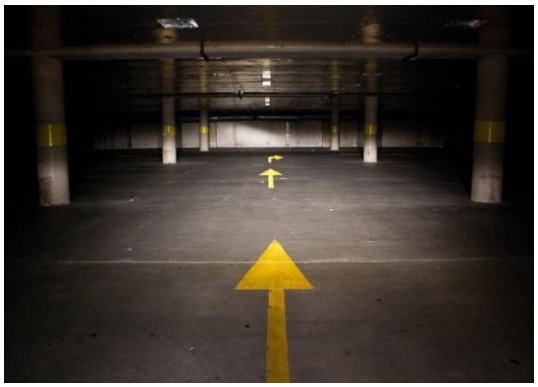
On the other hand, marking parking spaces for special target groups is also widely deployed. Besides parking space for disable people, there are also parking spaces for women only or for families with children, see *Figure 10*.

Figure 10 Parking space for family (Jess, 2014)

Parking space for women only (Stump, 2016)

Another example is the 'visibility' in car park which is an important attribute of the design factor lighting. In a well-illuminated car park the car drivers and pedestrians are more visible, and therefore, more safer for parkers. *Figure 11* shows a car park with good lighting and bad lighting.

Figure 11 well illuminated car park (Malaysia, 2017)



Poor lit car park with much dark spaces (Kate, 2012)

Another example is the internal layout of the car park. An important attribute of the layout is the colomn distance. A car park with large column-free areas create a large space with an open and light character, see *Figure 12*. It also reduce blind spots and could contribute to a more convenient parking experience.

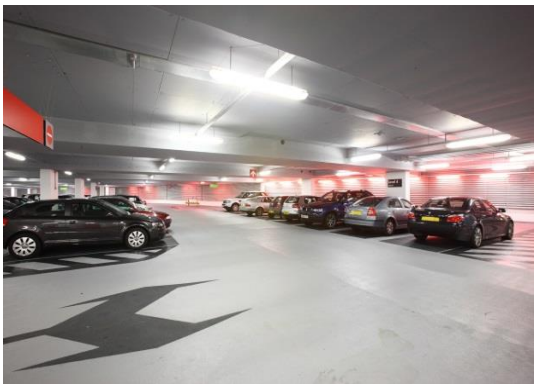


Figure 12 Column-free area (Liverpool, 2016)

Columns in the parking garage (RLLDesign, 2013)

In summary, each design factors is represented by several design attributes. The design related attributes not only affects the inner-quality of a car park but also the way car drivers experience parking as a whole. Part of this study tries to investigate which value is place upon different design related attributes. Chapter 3 of this report will go further into this.

2.4 Evaluation of car parks

In general, the evaluation of a car park is assessed from different points of view; parking companies, parking association, and by different user groups (car park users).

2.4.1 Parking companies

Parking companies (e.g., Q-Park, Vinci Park, Interparking, and Apcoa) provide (paid) parking spaces for car drivers who are searching for a suitable place to park their car. Parking companies are there to satisfy consumers, contribute to his/her comfort and guarantee him/her a pleasurable shopping experience *(CROW, 2011)*. Moreover, parking operators are constantly working to improve their parking facilities by investing in research and development. They make effort in establishing a recognizable name and brand identity so that they can communicate with customers in a consistent manner *(e.g. Q-Park, 2016; Apcoa, 2013; Interparking, 2015)*. For instance, the quality brand of Q-park is their logo. It is always used in the same way (colours black red and white) and gives the company a distinct identity. It points out the company's quality and is used to communicate with their customers across Europe (see *Figure 13*).

Figure 13 Q-Park Liverpool ONE (Q-park, n.d.)

Furthermore, the practice shows that many large private parking companies are putting effort to create a good first impression to customers by providing parkers a high-quality parking product (e.g. welcoming, clean, safe, accessible, and added-value services). For instance, the municipal parking garages in Enschede and the parking garage Q-Park Zuidplein in Rotterdam provide more service and speed to car visitors due to a new parking system with license plate recognition at the entrances and exits and touch-free payments system *(Verkeersnet, 2015; Verkeersnet, 2013)*. *Figure 14* shows the technique behind the License Plate Recognition system.

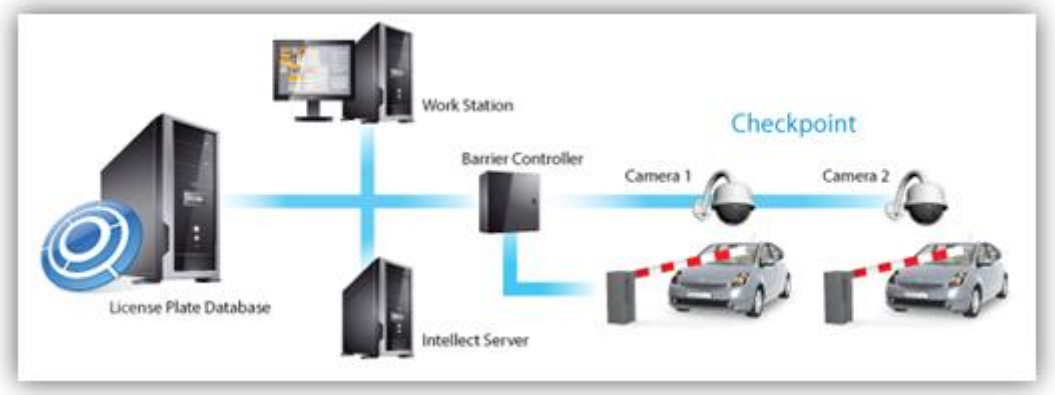


Figure 14 License Plate Recognition (FidPark, 2017)

Although there are various investment possibilities that could lead to a more ease of parking, (private) operators strive to attract as many car drivers as possible to their parking facilities in order to increase their occupancy rates and yield the maximum revenues *(Pierce, Willson, & Shoup, 2015)*.

2.4.2 Parking association

The parking association attaches great importance to the way parking consumers (users of car parks) perceive the image of car parks. In this regard, both an appropriate fit with the environment and the internal design of car parks are of great importance on the personal perception of car drivers *(CROW, 2011)*. Moreover, the internal design of car parks are assessed by experts, for example, from European Parking Association (EPA) on the basis of a number of points. The EPA is the umbrella organization of 22 European parking associations. Vexpan, a parking association in the Netherlands is one of the members of the EPA. Although, as mentioned earlier, there are (NEN) standards providing minimum building principles and various design handbooks available *(e.g. CROW, 2011; Rinsma & Koens, 2007)*, they do not ensure, by definition, well-functioning car parks. Therefore, in addition to the NEN standards, the umbrella organisation of European Parking Association (EPA) has developed a quality checklist with different categories for assessing the internal design (quality) of car parks and introduced the EPA Standard Award (European Standard Parking Award), and most recently also the Golden Award for car parks with a top-quality *(EPA, 2011; VEXPAN, 2016)*. Moreover, *APPENDIX C* describes the ten different categories (design related factors) covered by its aspects that are assessed and scored by the expert. Although the relative importance of each category is not evenly spread, in total 100 points can be

obtained whereby the total points obtained is the sum of the points obtained for each category. To this end, the categories that can obtain the highest points and have the most impact on the overall assessment are (20) parking area, followed by (16) lighting and (16) pedestrian access.

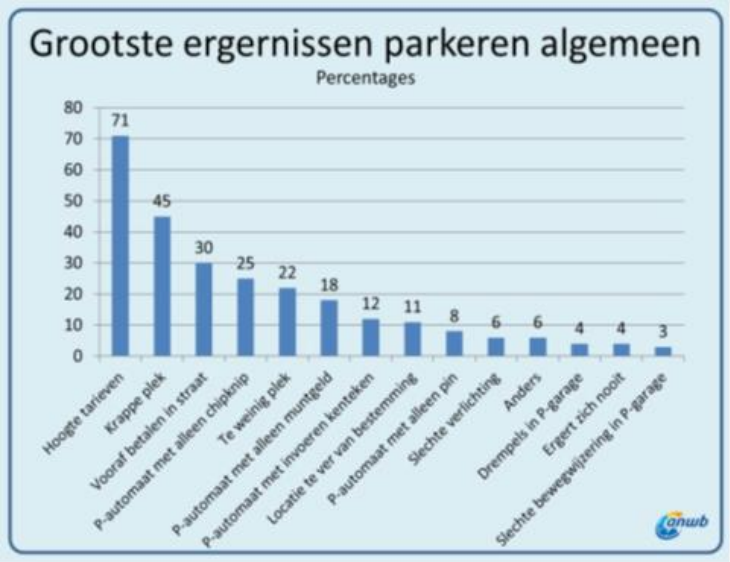
In the Netherlands the ESPA is granted by the Dutch parking platform VEXPAN to car parks that meet the corresponding set of requirements. With this award, a quality label, the operator/investor can benefit from a positive publicity during or prior to the start of operations. This award represent a car park as: safe, qualitative product, and user-friendly. In the Netherlands there are 144 parking facilities that received an ESPA award, with more than a quarter to (46) Q-Park parking facilities followed by (28) Interparking parking facilities *(VEXPAN, 2016)*.

2.4.3 Parking consumer

In the context of this study, the parking consumer is a car driver who is searching for a place to park his/her car that fits his/her needs. Moreover, the drivers' preferences for a parking space is partly determined by the trip purpose (e.g. at home, work, shop, recreation area). For example, the study of Trendbox (2010) pointed out that people (e.g. shoppers) do not mind to pay for an available parking space near the destination and that a large group of people are willing to pay more for a safe parking space. Thus, in order to provide a safe parking environment, a much closer look will need to be taken on the design characteristics of a parking facility.

Moreover, there are several studies carried out on how car drivers evaluate the characteristics of parking garages and which characteristics have a strong influence on car drivers' parking choice behavior. For instance, *ANWB (2013) and Menda & Wogalter,(2003)* presented a study concerning ANWB members' evaluation and use of car parks. The focus of this study was to address the greatest sources of frustrations among car drivers (see *Figure 15*). Similarly, Menda & Wogalter, (2003) concluded that the things that irritate car drivers the most are:

- Price level (not satisfied with the parking tariff);
- Size parking bays (parking bays are too tight);
- Payment methods (pay in advance, and paying with the Chipknip);
- Crowded (too many vehicles, people);
- Poor visibility (bad lighting, blind corners);
- Personal safety.



Negative Aspects	Frequency	%
Crowded	125	39
Visibility	123	39
Personal Safety	94	29
Confusing	53	17
Accidents	50	16
Theft	50	16
Cost	29	9
Aesthetics	22	7
Lack of Cleanliness	10	3
Reckless Drivers	10	3
Small Spaces	7	2
Poorly Parked Vehicles	5	2
Numerous Handicap Spots	4	1
Other	32	10

Figure 15 Biggest annoyance in parking (ANWB, 2013; Menda & Wogalter, 2003)

In another study of VEXPAN, executed by Trendbox (2010), the requirements regarding parking related to the trip purpose were investigated. Regardless of the trip purpose, the study showed that the top 6 most important factors are:

- Price level (most prefer free parking);
- Chance of free parking space (always a space available);
- Parking bays (wide enough for easy parking);
- Safety (safe and well illuminated);
- Parking location (close to final destination);
- Payment methods (easy payment, all payment options and payments per minutes).

Additionally, Van der Waerden et al (2006) found that car drivers consider the parking location, followed by the price level and opening hours as the most important factors when parking in a car park. Less relevant factors are signposting and services. In another study concerned design-related characteristics, Van der Waerden et al (2005) showed that color of paint and the presence of exit ramps influence the overall evaluation score of parking garages. Additionally, in the UK car drivers consider the following factors as important *(British Parking Association, 2016)*:

- Safety (drivers and their passengers want to feel safe as they walk to and from their car);
- Lighting levels (people can fear dark areas and therefore they want to see and be seen as they walk);
- Clean (clean and well-kept car parks reassure drivers they are in a safer environment);
- Chance of free parking space (drivers want easy access and quickly find a space that is stress-free).

2.4 Conclusion

The literature review provides an overview of different aspects that are covered by parking. There are parking facilities that differ regarding size and price at different locations, namely: parking facilities in suburbs, parking facilities in city centers, and parking facilities in residential areas. This study focuses on car parks located in city centers. These are often multi-level parking facilities (above or underground car parks) that are more expensive due to the densely built-up areas accompanied by high land prices. It became clear that, although car drivers have several possibilities to park their car, in the end, the parking choice is based on personal preference. It seems that, besides the parking tariff and the location of the car park, design related attributes are also considered important by car drivers and thus could influence the car drivers' parking choice behavior. The literature showed that car drivers value different aspects of car parks such as the ease of use, social safety, price level, amenity value, available services and quality. Therefore, at the design phase of new car parks the setting up of requirements is a key element in the determination of the quality level of the car park. Already at an early stage a considerable attention must be paid to the needs and wants of car drivers.

In addition, paragraph 3.1 presents the different ways of looking at a car park: the perspective of parking companies, the perspective of the parking association, and the perspective of the car park users. First of all, parking companies provide (paid) parking facilities for car drivers. They are constantly working to improve their parking facilities by providing visitors the right parking product (e.g. welcoming, clean, safe, accessible, and added-value services). On the other hand, parking associations, are set up in different countries in order to address and resolve different kinds of parking issues. They also attache great importance to the way car drivers experience parking in car parks. The umbrella organization of European Parking Association (EPA) has developed a quality checklist with different categories for assessing the internal design (quality) of car parks. Car parks that meet the requirements of the ESPA checklist are awarded with the European Standard Parking Award, ESPA or Golden Award. This award represent a car park as: safe, qualitative product, and user-friendly. Last but not least, the author tried to identify all the relevant design related attributes of car park that affect the inner-quality and also car drivers' parking choice behavior. Part of this study tries to investigate which value is place upon the different design related attributes. This will be outlined in the next Chapter 3.

3 Research design

3.1 Introduction

In this study the interest focuses on which design related attributes of publicly accessible car parks have an influence on car park users' parking choice behavior and also how much they are willing to pay for each design related attribute. In the context of a car park as a product provided, design related attributes are an important competitive set of attributes for differentiating from car parks of competitors. For it is indeed possible that an improvement/increasement of the internal quality of a car park could lead to e.g. increased brand awareness and customers loyalty which in turn may lead to a greater visitor return or a longer stay. A very important issue here is the assessment of how car park users' may respond to appearances of the internal design of a car park which are available to them, in particular, the value that they place upon different design related attributes, and how changes in the internal design affect their parking preferences, parking choice behavior and in addition their willingness to pay. This is because it is not always feasible to look to the actual (revealed) behaviour. For example, assume that it is necessary to know if car drivers are willing to pay more for a very wide parking space than a small size parking space. It is almost impossible to investigate this matter when there are only car parks with small parking spaces. In other words, sometimes the behavior that is of interest to the researcher may not be observable or currently available in reality.

In order to gain more insight in terms of price setting, features prioritizing, and product optimizing, there are several methods available. All methods aim on the collection of data and analyze this data after they are collected. *Figure 16* shows the different methods used in previous studies to estimate WTP. The first group of methods concerns revealed preference (RP) or revealed choice methods which are based on observations in real market situations *(Breidert, Hahsler, & Reutterer, 2006)*. The methods represent real-world evidence because individuals are empowered to exercise real choices as their personal data *(Gate, 2010)*. However, as described above, the behavior of interest may not be available, and it can happen that judgements about e.g. potential impacts of a renovation project of a car park have to be made. The judgements would be made in the lack of real-world evidence on how car park users may respond to this renovation. The stated preference (SP) methode allows examination of how individuals may respond to various price levels and different levels of design related attributes which are available to them. According to Gate (2010), willingness to pay studies are mainly based on stated preference data because data of actual market behavior are largely unavailable or do not currently exist. With a SP approach respondents are asked to give their preference given one or more hypothetical alternatives.

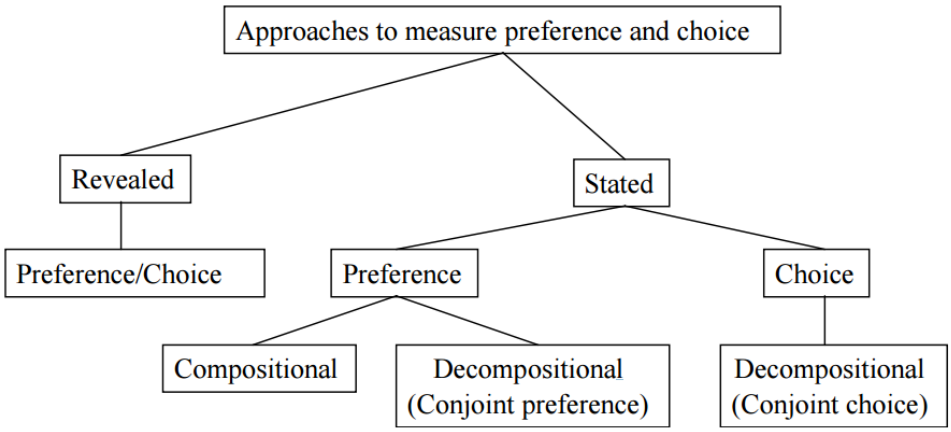


Figure 16 Methods to measure willingness-to-pay (Kemperman, 2000).

3.2 Methods and techniques

3.2.1 Stated Choice

This study use the SP approach in order to collect data on car drivers responses to changes in design related attributes. SP is covered by stade choice (choice modeling) which allows to describe a car park as a certain good in terms of its attributes and the levels that these attribute can take. This allows the researcher to present hypothetical car park alternatives (choice tasks) to respondents in which they can stated their choice by 'choosing' their most preferred alternative *(Kemperman, 2000)*. From a practical standpoint stated choice has several advantages. First, it allows the researcher to vary not only the proposed price but also pre-specify other attributes and their levels. Second, with stated choice the respondents are shown multiple evaluation or choice tasks each of which has different attribute levels. Also, the influences of the different attributes on the dependent attribute can be measured independently from each other *(Hensher, Rose, & Greene, 2005)*. Thus, it could provide insight into the willingness to pay for a certain composed (hypothetical) product and takes into account several aspects of importance to the customer.

3.2.2 Willingness to pay

As decribed above, stated choice can also be used to estimate WTP using the price variable based on data collected within a discrete choice task *(Gate, 2010)*. The choice experiments (choice tasks) are described by a series of attributes e.g a car park can have different design related attributes and some additional basic attributes such as parking tariff and location. In general, choice tasks are developed with two or more competing product alternatives (attribute combinations) in which respondents are asked to stated their preferred choice *(Gate, 2010; Breidert, Hahsler, & Reutterer, 2006)*. In doing so, a number of systematically varied choice profiles are considered and the trade-offs among costs and design related attributes can be made. The attribute weights (parameters) in choice experiments can be valued using several discrete choice models based on Random Utility Theory (e.g., multinomial logit, nested logit, and mixed logit), see *sub paragraph 3.2.4*. From this trade-off data, insight is gained into the willingness to pay. According to Hackbarth & Madlener (2013): ''*the WTP is a measure to derive the monetary amount that an individual is willing to disburse to acquire benefits or prevent costs from specific (policy) actions*'', in this study context e.g. widening the parking spaces in order to provide more parking comfort. Hence, it is possible to estimate (in euros) car drivers' willingness to pay for design related attributes of car parks. Hensher, Rose, & Greene (2005) pointed out that the WTP measure is calculated as the ratios of two parameters, formula:

$$WTP_j = \left(\frac{\beta_j}{\beta_c} \right)$$

Formula 1

where,

- WTP_j = the willingness to pay for attribute j
- β_j = the design related attribute's parameter
- β_c = the cost attribute parameter

As an aside, it is important to note that both attributes to be used in the c alculation should be statistically significant, otherwise no relevant WTP measure can be calculated. These will be further described in *Chapter 4*.

3.2.3 Integrated Hierarchical Information Integration

An important practical limitation in DCE is the ability to handle large numbers of potentially relevant attributes. For instance, when there are too many attributes in a survey, the predictive accuracy of choice tasks degrades due to the information overload and respondent burden. An increase amount of attributes goes hand in hand with an exponentially increase of the size and complexity of the choice task. This can eventually influence the

validity of the experiment. To deal with this problem and to avoid the risk of a high number of dropouts, an alternative method can be used namely the Hierarchical Information Integration (HII) approach *(Molin & Timmermans, 2009; Vyvere, Oppewal, & Timmermans, 1988)*.

With the HII approach it is possible to minimize the complexity of multi-attributes and reduce the consumers' choice task burden. This is done by categorizing the relevant attributes into meaningful subsets also known as decision constructs. Moreover, in order to reduce the complexity of the design it requires creating both sub-experiments (each sub-experiment represents a decision constructs) and a bridging experiment. First, the sub-experiments are constructed for each decision construct separately in which the respondents are requested to give their summary ratings of the subset profiles or to choose among choice alternatives; a sub-experiment is also called a choice task. Second, a bridging experiment is constructed in which the decision constructs are used as attributes in order to estimate how the preferences of the constructs are integrated into overall preference.

As an extension to the original HII approach, Oppewal, Louviere, & Timmermans (1994) introduced the integrated HII approach which allows integration of several attributes into a single choice experiments. Hereby a separate bridging experiment may be excluded because now all decision constructs are included in each sub-experiment. Moreover, in each sub-experiment one decision construct is expressed in the attributes that define this decision construct, while the remaining decision constructs are expressed as factors (less detailed). In order to create and carry out the HII with integrated sub-experiments. A step by step plan, developed by Molin and Timmermans (2009), can be followed. There are five steps and will be described below.

1. The relevant attributes and attribute levels are selected.
2. The attributes are categorized and clustered into decision constructs.
3. Sub-experiments are constructed for each of the decision constructs separately. Each sub-experiment includes a detailed description of one of the decision constructs in terms of the attributes that define this decision construct. Also, this sub-experiment includes the remaining decision constructs as additional factors. This ensures that the presented choice tasks describe different alternatives as combinations of attribute levels and decision construct levels (e.g. '+ +', '+ -' and '- -').
4. Individuals express an overall choice among two or more alternative profiles.
5. The responses obtained in step 4 (choice data) are analyzed with a multinomial logit models (MNL).

3.2.4 Multinomial logit model

Discrete mode choice models have become widely used in choice studies *(Sørensen, 2003)*. In order to analyse which design factors of inner city car parks influences parkers' willingness to pay the Integrated Hierarchical Information Integration (IHII) approach suggested by Oppewal, Louviere, and Timmermans (1994) can be applied. By means of NLOGIT software the multinomial logit modeling (MNL) can be used to analyze the stated choices. The MNL predict the probability that a certain alternative $_i$ will be chosen from choice set $_A$ given the attribute levels of all alternatives in the choice set. The following equation for the MNL function can be used:

$$P(i, A) = \frac{exp\ (V_i)}{\Sigma_{i \epsilon A}\ exp\ (V_i)}$$

Equation 1

where,

- $P(i, A)$ = the probability that alternative i is chosen from choice set A.
- V_i = the structural utility of the alternative.

Furthermore, the chosen alternative is seen as the dependent variable (y). The dependent variable (y) is categorically distributed and known as a nominal variable. The independent variable (x) is used to predict the dependent variable. The equation of the basic description of the utility and estimation procedure can be written as:

$$U_i = V_i + \varepsilon$$

Equation 2

where,

- U_i = the utility for alternative *i*
- V_i = the deterministic part of the utility for alternative i
- ε = the unexplained variation in the utility function

As described earlier, the IHII approach is used and therefore for each decision construct an sub-experiment will be constructed. Hereby in each sub-experiment all the assumed subsets of attributes as well as the represented constructs are outlined to the respondent. Therefore, the equation of the systematic utility V_{ik} of an alternative $_i$ in sub-experiment $_k$ can be written as *(Keuchel & Richter, 2011)*:

$$V_{ik} = \Sigma_j \boldsymbol{\beta}_j \boldsymbol{X}_{ij} + \Sigma_{j \epsilon J_k} \boldsymbol{\beta}_j \boldsymbol{X}_{ij} + \Sigma_{k' \neq k} \boldsymbol{\gamma}_{k'} \boldsymbol{C}_{ik'}$$

Equation 3

where,

- V_{ik} = the deterministic part of the utility for alternative i in sub-experiment/construct k
- j = attribute j
- J_k = detailed design related attributes J of construct k
- $\boldsymbol{\beta}_j$ = a vector of attribute parameters $\beta_{1,\ldots,}\beta_j$
- $\boldsymbol{X}_{ij}$ = a vector of the attribute levels j in alternative i
- $k' \neq k$ = all other constructs that are not presented at detailed level k', except construct k
- $\boldsymbol{\gamma}_{k'}$ = a vector of parameters $\gamma_{1,\ldots,}\gamma_{k'}$ of all other constructs that are not presented at detailed level
- $\boldsymbol{C}_{ik'}$ = a vector of the attribute levels that are not presented at the detailed level of other constructs k' in alternative i

3.2.5 Goodness of fit

In order to show how well the model describes a set of observations, the goodness of fit for the statistical model has to be evaluated. To this end, the log-likelihood ratio statistic and the rho-square are used, in order to give an indication of how well the predictability is resulting from the model *(Sørensen, 2003)*. The value of the log-likelihoods and R-square can be derived from the output of the NLOGIT software. Furthermore, NLOGIT calculates the log-likelihood for different models:

- the optimal model, in NLOGIT described as Log likelihood function; and
- the constant only model, in NLOGIT described as Constant only.

This method assumes that the closer the log-likelihood value comes to zero, the better the predictability is resulting from the model (the range vary from –infinite to zero). For example, a log-likelihood value of -5 is better than -10. Additionally the different models can then be compared by looking at the difference between log-likelihoods, resulting in the log likelihood ratio statistic (LRS). The LRS is chi-square distributed and can be used to test if the optimal model performs significantly better than the constant only model. The calculation is as follow:

$$\boldsymbol{LRS} = -2\ [\boldsymbol{LL}\ (optimal) - \boldsymbol{LL}\ (constant)\ ]$$

Formula 2

As mention above, the next important factor to describe to overall model is the rho-square. This can be used to to show how much variation in choice is explained from this model *(Hensher et al., 2005)*. However, the R^2 for a regression model is interpreted differently from a choice model. Therefore, in order to calculate the rho-square for a choice model the following equation (see below *Formula 3*) can be used. Hensher et al (2005, p.338) point out that rho-square values between 0.2 and 0.4 represents a decent model fit.

$$\textbf{Rho-square} = 1 - \frac{LL\ (optimal)}{LL\ (constant)}$$

Formula 3

3.3 Data collection

Paragraph 3.1 explained which methods and techniques can be used for examining users' willingness to pay for design related attributes of car parks. In this part the construction of the questionnaire will be elaborated. In general, the steps described by Molin and Timmermans (2009) are followed for the constructing of the stated choice experiment. First, it is important to select the relevant attributes and corresponding attribute levels and the clustering of the attributes into 'decision constructs' (steps 1 and 2). The second stage is about designing the choice profiles and creating the real questionnaire (step 3). Last but not least, the final step is distributing the questionnaire and conducting the analyses of the data (step 4 and 5).This part will be elaborated on later in chapter 4.

3.3.1 Selecting design attributes and attribute levels for research

Attributes

The identification and selection of attributes to be analyzed in this study are based on literature and experts opinions. Furthermore, there are a number handbooks *(e.g., Louter & Van Savooyen, 2005; Rinsma & Koens, 2007; Hill, 2005)* and institutions (e.g., EPA and Vexpan), that tried to characterize a car park for a variety of purposes (e.g., constructing, evaluating). By looking at those different sources a large number of potential attributes related to the design are identified. These identified attributes are relevant to parking companies and operators and also meaningful and important to users of car parks. A list of attributes from different sources is shown in *APPENDIX A*. Moreover, the attributes found from the different sources are aligned at the left side of the table. Additionally the table shows where the attributes are coming from and where they overlap. As an aside, although this study tries to identify the most important design related attributes, it is important to note that the assembled list may not be exhaustive.

Attribute levels

At this point there are 47 interesting attributes identified. The next step is to assign attribute levels to each attribute. Although more attribute levels are more likely to provide richer and more accurate information *(Gate, 2010)*, the choice has been made to further classify the attributes into three attribute levels (see *APPENDIX B*: Attributes and attribute levels). Including more than two attribute levels enables the author to identify non-linear utility relationships (see *paragraph 4.2.2*). According to Gate (2010), the attribute levels should be plausible to the respondents, provide meaningful information and capable of being traded. The attribute levels in this study are based on literature and own selection. For example, the attribute 'parking tariff' is classified into the following three attribute levels: € 0.50, € 2.50, and € 4.50. The author has chosen for an equally proportional growth of €2 in between the attribute levels. Also the attribute levels are plausible in regards to parking tariff level in the Netherlands (see *Figure 17*).

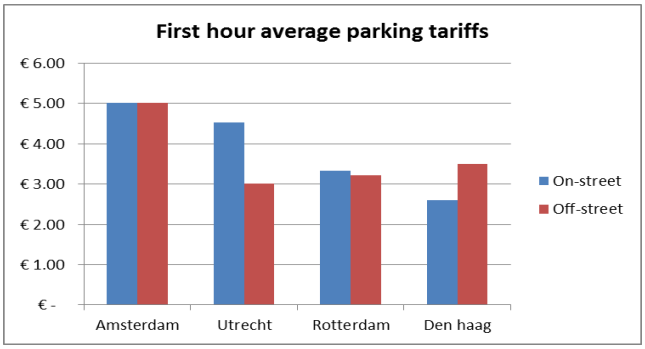


Figure 17 (Detailhandel Nederland, 2015; centrumparkeren, 2016)

Another example, the attribute 'Width parking space' is classified into the following three attribute levels: small width parking space (2.20 meter), medium width parking space (2.35 meter), and very wide parking space (2.50 meter). These attribute levels are based on literature and own selection. For instance, Rinsma & Koens (2007) suggest that a car park visited by shoppers should have a very wide parking spaces of at least 2.45 meter. On the other hand, the ESPA checklist point out that a parking space should at least have a width of 2.25 meter. Based on this knowledge, the author made a logical decision and has chosen for an equally proportional growth of 0.15 meter in between the attribute levels.

Constructs

However, as mention earlier an important practical limitation in DCE is the ability to handle large numbers of potentially relevant attributes. Hence, to deal with this problem and to avoid the risk of a high number of dropouts when conducting the questionnaire, the integrated HII method is used. In addition, several researchers suggest that an analysist should only include a small number of attributes in a single DCE otherwise both the required sample size increases exponentially and the choice tasks become overly complex for the respondent *(Molin & Timmermans, 2009; Breidert, Hahsler, & Reutterer, 2006; Gate, 2010)*. Although there are not strict rules with regard to the number of attributes in a single DCE, Ortuzar and Willumsen (in *Gate, 2010*) argue that a single DCE should have no more than 8 attributes/factors. In the context of this study, factors that will be included in the DCEs are considered as decision constructs consisting of several attributes. Before the attributes to be analyzed in this study are selected, first the list of attributes need to be categorized and clustered into decision constructs. By looking at the ESPA checklist, ten main categories could be identified for assessing the internal design (quality) of car parks (see *APPENDIX C*: ESPA checklist categories). For this study, it is meaningful to use those categories. According to the researchers recommendations on the number attributes/factors to be included in a single DCE, the number of categories is reduced from ten to five categories. In a new context, redesigning the categories resulted into five decision constructs.

Construct 1: Parking area

Attributes belonging to this constructs focus on the layout of the car park e.g. the way the columns are placed, visibility of other car drivers and pedestrians (dead corners), driving and parking comfort (sizes road and parking spaces) and the orientation within the car park.

Construct 2: Pedestrians environment

Attributes belonging to this constructs focus on specific facilities for pedestrians e.g. attributes related to pedestrians doors, exits and elevator points, and walking route within the car park.

Construct 3: Accessibility

Attributes belonging to this constructs focus on the speed, in means of amount of time necessary to enter- and leave the car park e.g. advanced parking systems such as license plate recognition and touch-free payments system providing more speed to car visitors. This construct should also include attributes that focus on special target group e.g. parking spaces for families with children and/or on those with disabilities.

Construct 4: Service

Attributes belonging to this constructs focus on car park customers convenience and indoor navigation e.g. a pleasant sound and perfume creating more ambiance, payment provisions, additional places in the car park such as toilets and storage spaces, and parking guidance systems. This construct should also include attributes related to services for electric cars and mobile phone (Wi-Fi and phone coverage).

Construct 5: Safety

Attributes belonging to this constructs focus on the safety of car park customers e.g. security, surveillance (e.g. placement of CCTV and the presence of staff), overall maintenance, and lighting in the car park.

Now, for clarity and in order to conduct an accessible survey it is meaningful to downsize the number of attributes. Moreover, in order to carry out a stated preference experiment, without the result that people have to process too many attributes at once, the choice has been made to fill in each construct with a maximum of five attributes. Thus, the list of 49 attributes is reconsidered leading to 25 attributes that are selected and will incorporated in the SP experiment and the statistical analyses. First, the author roughly divided the 49 attributes into the five constructs and selected for each construct, from his point of view, the five most relevant attributes. This first selection was based on the results of literature review and on the author's expertise. Furthermore, the author has several years of work experience as administrator of much-frequented car parks and has gained extensive experience meeting and greeting car park visitors (e.g. Transferium P1) Amsterdam ArenA, car park Villa ArenA P4/P4 in Amsterdam, car park Markenhoven in Amsterdam, and car park Stopera in Amsterdam). These car parks differs in design and partly because of this the author also gained awareness of the everyday problems of car park visitors. Next, as supervisors of this study, two experts in the field of parking are asked to make the same selection of the (in their opinion) most important attributes (see *APPENDIX D*: Selecting attributes for research). It is important to note that the supervisors of this study also provided the list of attributes and attributes levels (*APPENDIX B*: Attributes and attribute levels), in order to be better able to interpret the attributes. Finally, 25 design related attributes are selected for this study. *Table 2* shows the selected attributes which are further classified into three attribute levels.

Constructs	Attributes	Attribute levels
1. Parking area	Width parking space	1 *Small (2.20 m)* 2 *Medium (2.35m)* 3 *Very wide (2.50 m)*
	Width road lane	1 *Small (<3.50 m)* 2 *Average (3.50m)* 3 *Very wide (>3.50 m)*
	Clear signing car & pedestrian	1 *Barely visible* 2 *Visible* 3 *Clearly visible*
	Type of floor level identification	1 *None* 2 *Color-coding by level* 3 *Color coding and identification Theming*
	Presence of columns	1 *No columns present* 2 *Limited columns present* 3 *Large columns present*
2. Pedestrians environment	Pedestrians routes	1 *No separated walking route* 2 *Separated walking route* 3 *Separated and marked walking route*
	Entrance regime pedestrians	1 *Open passageways* 2 *Manual doors* 3 *Automatic doors*
	Width staircases	1 *Small (1.00 m)* 2 *Normal (1.50 m)* 3 *Very wide (2.00 m)*
	Type of elevator points	1 *Stairs* 2 *Elevator* 3 *Stairs and elevator*
	Walking distance parking space to the stairway	1 *15 meter* 2 *30 meter* 3 *30 meter*
3. Accessibility	Type access control system	1 *Licence plate recognition* 2 *Staff access* 3 *Entry ticket machine*
	Width entrance lanes	1 *Small (<3.00 m)* 2 *Normal (3.00m)* 3 *Very wide (>3.00 m)*
	Average waiting time at entrance	1 *Short (<30 second)* 2 *Average (30 second)* 3 *Long (>30 second)*
	Average waiting time at payment terminals	1 *Short (<1 minute)* 2 *Average (1 minute)* 3 *Long (>1 minute)*
	# special places reserved	1 *None* 2 *1 % of total spaces* 3 *5 % of total spaces*
4. Service	Presence of parking guidance systems	1 *Not present* 2 *At > to floor levels & rows* 3 *At parking space*
	Payment options	1 *Only cash* 2 *Cash and bank cards* 3 *Cash,bank cards and mobile*
	Presence music and/or fragrance system	1 *No music and parfume* 2 *Only background music* 3 *Music and relaxing scent (e.g. flowers)*
	# electrical charging points	1 *None* 2 *1 % of total spaces* 3 *5 % of total spaces*
	# toilets inside	1 *None* 2 *1 unisex toilet* 3 *Separate toilets*
5. Safety	Level of lighting	1 *No dark spaces* 2 *Minimal dark spaces* 3 *Much dark spaces*
	Security	1 *Video surveillance* 2 *Staff present* 3 *Staff and video surveillance*
	Presence of ramps	1 *None* 2 *Present in limited number* 3 *Present in high number*
	Marked escape routes	1 *Signposting* 2 *Illuminated signs* 3 *Illuminations and glow in the dark road lines*
	Cleanliness and maintenance	1 *No dirt and debris* 2 *Little dirt and debris* 3 *Much dirt and debris*

Table 2 Constructs, selected attributes and attribute levels

The list of attributes and attribute levels will come up in the questionnaire and may not yet be fully clear for the respondents. Therefore some design related attributes need some further clarification, in order to ensure that *Table 2* can be correctly interpreted by respondents. The first attribute that can be seen as vague is '#special places reserved' (see construct 3). This attribute referes to the number parking places available in the car park for specific target groups, for instance: for people with disabilities, for families with children, and for car sharing. Another aspect is that the attribute levels of the attribute 'Presence of parking guidance systems' (see construct 4) could be misinterpreted. This can be resolved by showing the respondents an image of the corresponding attribute levels, see *Figure 18*.

Figure 18 - At > to floor levels & rows

At parking space

The last attribute that need further clarification is 'marked escape routes'. Similarly, in order to avoid any misinterpretation about this attribute, in the questionnaire the attribute levels will be further clarified by *Figure 19*.

Figure 19 Illuminated signs

Illuminations and glow in the dark road lines

3.3.2 Choice task and Experimental design

The next step includes the selection of the experimental design. Five different sub-experiments need to be constructed, each for every decision construct. Moreover, each choice task is composed out of three parts and comprises a total of twelve attributes:

4. three basic attributes each with three attribute levels describing the hypothetical parking situation in terms of:
    - Capacity : *1. 300 parking spaces 2. 600 parking spaces 3. 900 parking spaces*;
    - Distance to final destination: *1. 50 meter 2. 250 meter 3. 450 meter;*
    - Hourly rate: *1. € 0.50 2. € 2.50 3. € 4.50.*
5. five attributes of one specific decision construct each with three attribute levels as described in *Table 2*; and
6. the four remaining decision constructs each with three general construct levels: *1. limited supply 2. medium supply 3. wide supply.*

Stelt u zich voor dat u met de auto een binnenstad bezoekt en dat u wilt gaan parkeren in een openbare parkeergarage. Welke van onderstaande parkeergarages heeft uw voorkeur?

	Parkeergarage A	Parkeergarage B
Basiskenmerken		
Capaciteit parkeergarage	*300 plaatsen*	*600 plaatsen*
Loopafstand tot eindbestemming	*50 meter*	*250 meter*
Uurtarief	*€ 0,50*	*€ 4,50*
Categorie: Ruimte in de parkeerplaats		
Breedte parkeervak	*Smal (2,20 m)*	*Smal (2,20 m)*
Breedte rijbaan	*Extra breed (> 3,50 m)*	*Smal (< 3,50 m)*
Bewegwijzering voor auto en voetganger	*Goed zichtbaar*	*Redelijk zichtbaar*
Aanduiding van parkeerplaats en/of vloerniveau	*Kleuren*	*Kleuren*
Aanwezigheid van kolommen	*Veel kolommen aanwezig*	*Weinig kolommen aanwezig*
Overige categorieën		
Ruimte voor voetgangers		
Toegankelijkheid		
Service		
Veiligheid		
Welke garage heeft uw voorkeur?		

Figure 20 Example of a choice task

As mentioned earlier, in DCEs the choice tasks are developed with two or more competing product alternatives (choice sets) in which individuals are asked to evaluate the hypothetical situation and select their preferred choice. The choice has been made to construct choice tasks with two different alternatives (car park **A** and car park **B**) due to the large amount af attributes in one sub-experiment and for the sake of simplicity. An example of one sub-experiment (choice task) is provided in *Figure 20* above. Supplementary, the layout of the choice task correspond approximately to several SP studies carried out which have proved to be successful (*e.g. Jansen, 2013; Couwenberg, 2014*).

In addition, if a full factorial design is used the total number of combinations of possible choice sets is equal to L^A where L is the number of levels and A the number of attributes *(Hensher, Rose, & Greene, 2005)*. This means that one sub-experiment that consisted of twelve attributes with three levels each has ($3 \text{ levels}^{12 \text{ attributes}}$) 531,441 possible combinations of attribute levels (profiles). This is a significantly large number of profiles and would be impractical to present as a whole (and even partially) to respondents. For meaningful research, it is necessary to downsize this number and, therefore, a fractional factorial design has to be used *(e.g., Richard T. Carson and Jordan J. Louviere 2010).* By the help of a statistical software program (e.g., SPSS, SAS or Ngene) this fractional factorial design can be generated. In this study SAS is used to generate a fractional factorial design that consist of 54 profiles for each sub-experiment. Moreover, the design is based on main-effects only, without any interaction-effects. If interaction effects were included, the amount of profiles would be higher.

Additionally, to ensure an orthogonal design the 54 profiles are randomized and categorized into choice sets consisting of two choice alternatives. This means that the 54 profiles are randomly subdivided into 27 choice sets for each sub-experiment. This is quite a lot because in total there are 135 choice tasks that has to be evaluated *(5 sub-experiments x 27 choice sets per sub-experiment)*. This again is an impractical number of choice taks to be handled by one respondent. And, also, if 27 choice task are submitted about ten times then at least 270 respondents are needed to produce reliable estimation results. In this case each respondent evaluates five choice tasks (one for each construct). Due to the limited time and resources to collect a large number of respondents, the respondents will have to evaluate ten choice tasks (two times five constructs). In this case, only 135 respondents are needed to get sufficient observations for the Stated Choice experiment.

3.3.3 Questionnaire

The next step is constructing and designing the questionnaire in which respondents can express their preferred choice among two hypothetical parking situations (car parks **A** or **B**). The choice has been made to construct the questionnaire using the BergSystem of the Eindhoven University of Technology as this is the most suitable program to include a SP research. After the questionnaire is developed, BergSystem makes it possible to generate a link to the questionnaire which then can be share on different ways to collect data. Furthermore, the questionnaire will be structured in such a way that respondents will first become familiar with the context of the study. Therefore, the questionnaire is composed out of one selection part and three main parts questionnaire in (see

APPENDIX E: *E*).

Target group

It is necessary to select the right target group for the data analyses. These are people with a car driving license and car park experience. To achieve this result, the respondents are asked two questions: (1) if they hold a driving license and (2) if they ever have visited a car park before. In order to participate in the questionnaire, both answers has to be 'YES'. If a respondent does not belong to the target group, then the respondent will be redirected to the end page where the questionnaire can be closed.

Parking experiences

This part is about respondents' familiarity with both on-street and off-street (car parks) parking. Furthemore, the respondents are asked how they experience parking in conjunction with the design related attributes. In this way the respondent is both becoming familiar with the study context and warming up for the stated preference part.

Stated preference

This part is the most important part of this study. This part concerns the users' willingness to pay for design related attributes of car parks. Each respondent is presented in total ten choice tasks (two times five constructs) and is asked to choose the preferred parking situation (car park **A** or car park **B**).

Respondents characteristics

This part is about the characteristics of the respondents, e.g. gender, residence, education, and date of birth. Also additional questions are asked about: whether or not the respondent is professionally involved (e.g. advisor, operator, supplier) in the parking, how long they hold a driving license, and if they have any disabilities. These additional questions are asked in regard with the representativeness of the sample. For example, assume that the sample includes an over-representation of particular groups of respondents e.g. people with disabilities or people that are holding a driving license for more than 30 years, it will be hard to generalize the findings. Then it would be better to know these facts when comparing the sample with the car park users' population next to the Dutch population.

3.3.4 Sample technique

The data collection is on the basis of different ways whereas the link to the questionnaire was shared:

1. through authors' social media networks;
2. through LinkedIn by two professionals in the field of parking with a large social network;
3. shared internally in two large companies through Yammer and Intranet;

4. questionnaire was published online via Vexpan website *(Vexpan, 2016)*. For details see *APPENDIX F*: Questionnaire on the Vexpan website.

This way of data collection results in a so-called convenience sampling. Due to the small budget and limited time for this study, the author has chosen for convenience sampling technique rather than field research; visit several car parks, and/or asking people directly if they would like to participate in the questionnaire. In field research the change of reaching the right target group for this study could be much higher. However, although convenience sampling is a more accessible sampling technique and very easy to carry out, it has some limitations *(Lærd Dissertation, 2012)*. First of all, it can lead to the under-representation or over-representation of particular groups of respondents within the sample. Also, since the sampling frame is not known, the sample is unlikely to be representative of the population being studied. This may undermines the authors ability to make generalisations from the sample to the studied population.

3.4 Conclusions

In this chapter the development of the questionnaire for the data collection is outlined. First, paragraph 3.1 presents which methods and techniques can be used for examining users' willingness to pay for design related attributes of car parks. This study used a combination of a SP choice experiment and integrated HII due the the high amount of attributes of car park. For analyzing SP data the multinomial logit modeling is used, as it is one of the most used methods for analyzing this kind of data.

Next, in paragraph 3.2 the attributes to be analyzed in this study are identified and selected. Moreover, the number of attributes is downsized from 49 to 25. Additionally, the 25 selected attributes are divided and categorized into five constructs whereas each construct consists of five attributes each with three attribute levels. Continued, the questionnaire is developed. Within this questionnaire data is gathered regarding the respondent parking experiences, preferences for design related attributes of car parks, and respondents characteristics. Additional questions were included in the respondents' part in order to have a better insight of the sample. Moreover, due to the small budget and limited time the convenience sampling technique was chosen rather than field research. This may lead to a sample that is not representative for the car park users' population. Last but not least, the results of the data collection will be analyzed and are outlined in the next Chapter 4.

4 Data analyses

In this chapter the analyses of the collected data are described. The analyses of the data are divided into two parts. First, the descriptive statistics summarize and describe the prominent features in terms of questionnaire response rate, sample description, and respondents' familiarity with the use of car parks. In the next part the analyses of the stated preference (SP) data is described, in order to gain insight into which design related attributes of publicly accessible car parks influences car drivers' willingness to pay.

4.1 Descriptive statistics

4.1.1 Questionnaire response rate

Figure 21 shows an overview of the total response of the questionnaire. In total, 326 respondents have started and completed the questionnaire successfully. In addition, the target group of this study are people who both hold a car driving license and have ever visited a car park. Almost all of the respondents (99%) were above 18 years old holding a driving license and also (93%) have visited a public car park. A small number of respondents (8%) does not belong to the target group of this study and therefore were redirected to the end page where the questionnaire can be closed. This group of 27 respondents where removed for the following analyses. From here onward, the analyses of the data focuses only on the 299 respondents who answerd all the questions in the questionnaire and both have visited a car park before and holding a driving license. On the other hand, there were 72 respondents who only looked at the front page of the questionnaire or have only answered a few questions. This group of respondents were eliminated for the following analyses.

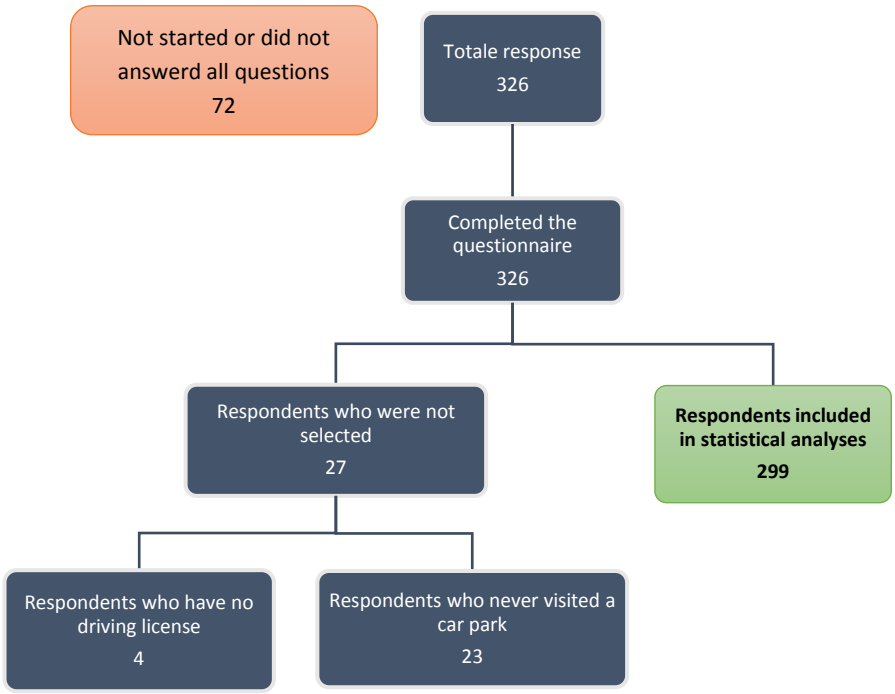


Figure 21 Overview of questionnaire response

4.1.2 Sample description

Table 3 presents the descriptive statistics on the study sample's demographic characteristics. For more details see *APPENDIX G*: Values analyzed.

Gender

Although the link of the questionnaire is distributed in various ways, the respondents were not evenly distributed according to gender. The proportion of male in the sample was much higher (69%) compared with female (31%). Although in the Netherlands the ratio between male and female is almost equal (CBS, 2016), the difference between the gender proportion in the sample may have several causes. Firstly, more male then female could have get the link to the questionnaire. Secondly, it could be a coincidence that the addressed females make less frequent use of a car than other females. For example, although car ownership among male is higher than female, nowadays more and more females obtaining their driving license as their employment rate has increased (CBS, 2015). However, several studies have shown that male travel more than female and that the car is the most dominant mode of transport for males *(e.g. CBS, 2015; Prashker, Shiftan, & Hershkovitch-Sarusi, 2008; Best & Lanzendorf, 2005; Polk, 2004)*. The author assumes that due to the fact that the car use is higher among male (driver) than female (more as co-driver) more males than females are interested in everything associated with parking *(CBS, 2015)*. This could also be a cause why more male than female have participated in this questionnaire.

Age

Additionally, the author made five different age categories based on CBS, in order to make a comparison of the age groups between the sample and the Dutch average (CBS, 2016). From all the respondents the majority (82%) is middle aged. Moreover, half of the respondents (50%) were between 40 and 65 years old, followed by respondens between 32 and 39 years. It turns out that the respondents in those middle aged groups were able to hold a driving license. An explanation for the small number of respondents in the <20 years age group may be due to the requirements that respondents are minimal 18 years old and are holding a driver license. But, overall, the distribution of respondents amongst the age groups is well distributed.

Education

Similarly, the author made five different education categories based on 'Onderwijs in Cijfers', in order to make a comparison of the education level between the respondents in the sample and the Dutch average *(Onderwijs in Cijfers, 2015)*. From all the respondents the majority (77%) is highly educated. Only a small number of respondents (3%) have a low level of education. The distribution of level of education is not well distributed in comparison to the Dutch average.

Driving Experience

Additionally, as shown in *APPENDIX G*: Values analyzed, the vast majority of the respondents do have a driver's license, with an exception of 1.0%. Moreover, half of the respondents (50%) are holding a driving license for more than 30 years. For now this fact may only suggest that the respondents are highly familiar with the car as a mode of transport and therefore may have several years of parking experience. In other words, the author assume that a respondents with many years of driving experience may have a the stronger view on parking as a whole.

Disabilities

Furthermore, the respondents could answer if they had one or more disabilities. The vast majority of the respondents (94%) have answered that they have no disabilities, whereas 2% has a visual disability, 1% has an auditory disability, and 2% has a physical disability. Although the the group of respondents with disabilities is very small, the author suggests that, in the stated preference part of the questionnaire, this group of respondents will pay more attention to facilities suitable and accessible for people with a disability (e.g. stair railing, and disabled parking spaces). For more detailes about the different types of disability see *Table 17* in *APPENDIX G*: Values analyzed.

Professionally

Althoug all respondents are approached in the same way (as a car park user), only a small minority (12%) of the respondents answered that they are professionally involved in the parking. This may indicate that the majority (88%) of the respondents have a different view (in a less detailled manner) on car parks in comparison to the experts in the field of parking. It is important to know this, because experts in the field of parking are not the (largest) target group of car park operators. However, due to the small group (12%) no further elaboration is done.

Sample characteristics	Level	Sample (%)	Dutch average (%)
Gender	Male	69.2%	49.7%
	Female	30.8%	50.3%
Age	<20 years	0.3%	22.5%
	20 - 39 years	32.1%	24.5%
	40 - 65 years	50.2%	34.8%
	65 - 80 years	15.8%	13.8%
	≥ 80 years	1.6%	4.4%
Education	Low education	3.0%	27.7%
	Middle education (Havo, vwo, mbo)	17.8%	39.4%
	High education (hbo, wo bachelor)	38.5%	20.1%
	Scientific education (hbo, wo master, doctor)	38.5%	11.6%
	Other	2.3%	1.2%
Driving Experience	<10 years	15%	-%
	10 - 19 years	16%	-%
	20 - 30 years	19%	-%
	>30 years	50%	-%
Disability	No restriction	94%	-%
	Visual	2%	-%
	Auditory	1%	-%
	Physical	2%	-%
	*Others	1%	-%
Professionally involved in parking	Yes	12%	-%
	No	88%	-%

Table 3 Characteristics of respondents (N=299)

In summary, although the sample can not be considered as representative for the Dutch population, the data can be used for further investigation. It would have been better the compare the sample with the available information about car park users. This is because in reality, it may be true that more males than females are visiting a car park, or that the population of car park users consists for the most part of highly educated people. However, this data was much more difficult to obtain because the author has opted for a convenience sample technique. Therefore it is not fully clear if the sample is representative compared to the population of the car park users. No further statements about the sample description are made.

4.1.3 Parking experiences of respondents

The next part of the questionnaire was about the parking experiences of respondents and their familiarity with the use of car parks in terms of parking frequency, parking motive, parking tariff, and the experience with parking on-street and off-street.

Parking frequency

Firstly, the respondents were asked to indicate how often they have visited a car park over the past year. The respondents were divided into three groups. The largest group (78%) was the low frequent visitors (about 1/year or 2-3/month), followed by the group (15%) occasionally visitors (about 1-3/week), and the smallest group (6%) was high frequent visitors (almost daily). For more details see *APPENDIX F*.

Parking motive

Secondly, the respondents were asked to indicate how often they visit a car park for four different motives (see *Figure 22*). The analysis shows that the most common reason to visit a car park is related to the motives shopping, recreation and leisure. Furthermore, more than half of the respondents (58%) answered that they never visit a car park when they drive on their own from home to work and vice versa. Although this fact does not necessarily suggest that this large group of respondents avoid parking in a car park, it could indicate that there is no car park nearby and thus they choose to park their car on-street next to their houses. And also, at work there could be parking spaces provided for employees. This same logic applies for respondents that pick up or drop off someone from/at e.g. the train station. For this motive, a majority (49%) of the respondents rarely make use of a car park, followed by respondents (29%) that never make use of a car park. One reason for this might be that the majority of the respondents do not necessary need to park their car in a car park, in order to pick up or drop off a certain person; sometimes picking up- or drop off someone could take place within a limited period of time.

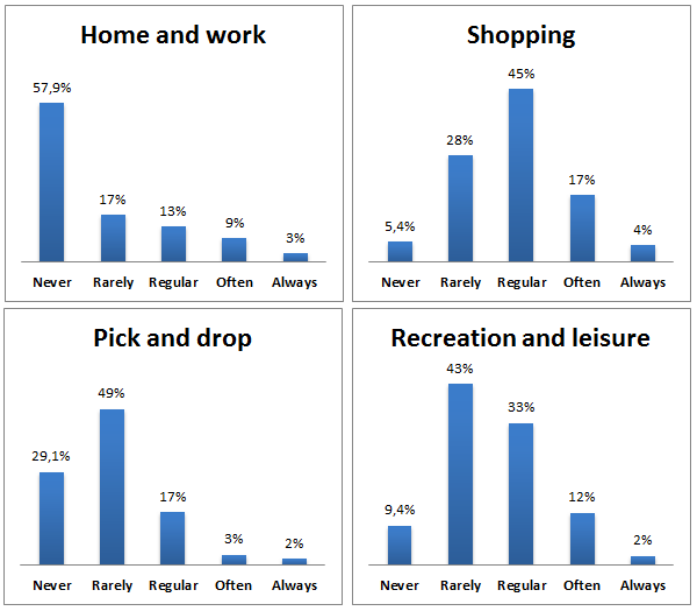


Figure 22 Parking frequency per travel motive(N=299)

Parking tariff

Thirdly, the respondents were asked about the their highest paid parking tariff in the past year. This data provides a general impression about what people have paid, whether on-street or off-street and irrespective of location, for a parking space (see *Figure 23*). The respondents were divided into three groups, namely who paid: a relatively cheap parking ticket price (between €<0.50 and 3.00/hour), an average parking ticket price (between €3.01 and 5.50/hour), and a relatively expensive parking price (between €5.51 and >€8/hour). The largest group (38%) paid an average parking tariff that corresponds to the Dutch average *(Detailhandel Nederland, 2015)*, followed by the group (26%) who paid a cheap parking tariff, and the smallest group (6%) have paid expensive parking ticket price. Noteworthy, there was nobody found (n=299) who indicated that over the past year he or she has parked always for free (€0.00). Also, there is a large group (15%) who indicated that they do not know what the highest paid parking tariff was. This may be because car drivers are not always

aware of- or do not remember what they have paid for a parking space. Maybe knowing the highest paid parking tariff is not a high priority for some people.

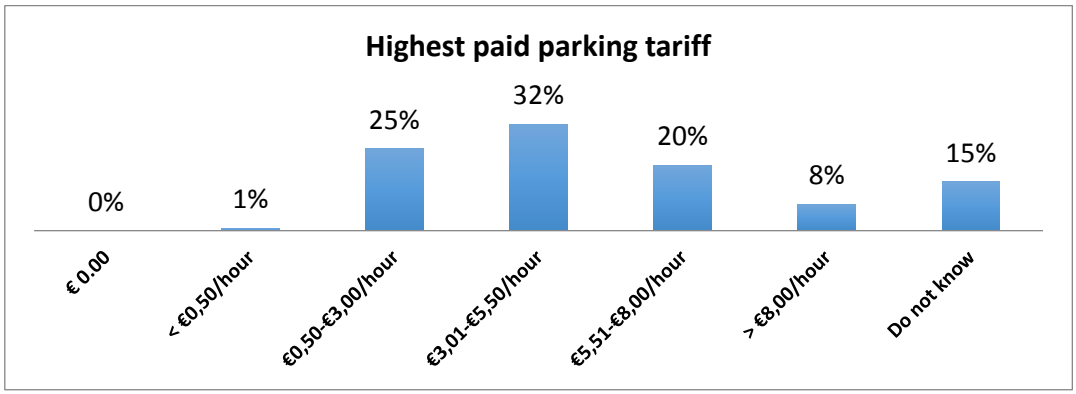


Figure 23 Highest paid parking tariff (N=299)

Experience of parking on-street and off-street

Lastly, the respondents were asked how they experienced parking on-street and parking off-street (see *Figure 24*). Furthermore, the respondents could rank several factors between two extremes on a scale ranging from one to five. To describe the result of the analysis, the mean score of each factor is calculated and used for comparison, as visualized in *Figure 24*. First, the parking tariff for off-street parking is experienced more expensive than on-street parking. Second, parking on-street is experienced as more nearby the final destination than parking off-street. This indicates that car drivers find the distance from a parking space on-street to the final destination more nearby than off-street. Third, as the author expected, it is experienced more difficult to find a free parking space on the streets than off-street. Fourth, car drivers find that for parking off-street there are more payment options available than for parking on-street. Fifth, the safety perception is experienced for off-street parking as more secure than on-street. In addition, the following factors only concerns off-street parking: the parking space is experienced as more narrow than broad, the waiting time in general is experienced more as short period than long period, and last but not least, the facilities for pedestrians in off-street car parks are experienced as more few than many. For more details see *APPENDIX G*: Values analyzed.

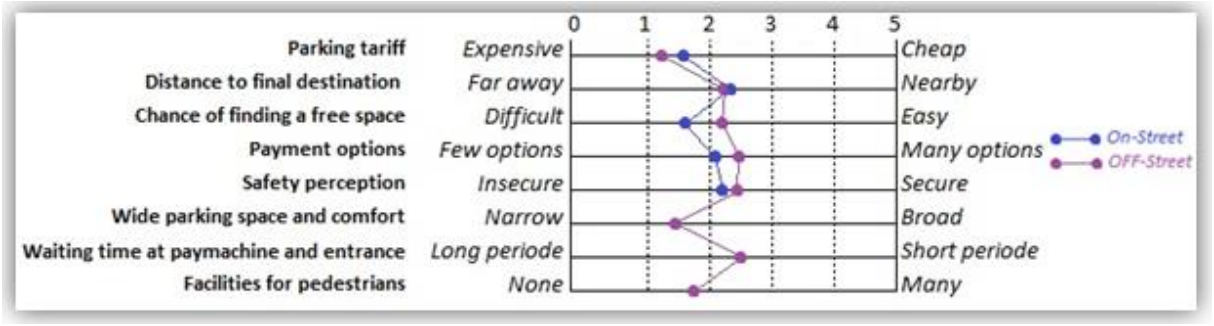


Figure 24 Parking experience On-street and Off-street (n=299)

4.2 Results

The Stated Choice data of the five sub-experiments are analyzed using multinomial logit model as implemented in the NLOGIT software (version 5). Before going into the results details, the applied model and output of this model will be described. First, the overall model performance will be explained. Next, the parameters of the model will be described in which the focus is put on the statistical significance of the used attributes. Hereby the part-worth utilities of the attributes and constructs will be calculated and described.

4.2.1 Model evaluation

Table 4 shows the outcomes of the overall model performances. For the log-likelihood estimation, the log-likelihood ratio statistic is 1245.56 with 65 degrees of freedom (66 included parameters minus 1). By comparing this value with the found value of the LRS with the value of critical chi-square (from Chi-square table) which is 84.82 (df =65, $\alpha = 0.05$), the conclusion can be made that the optimal model performs significantly better than the constant only model. This means that the optimal model including the different attributes fits the data better than a model without these attributes. As mentioned earlier, rho-squares value between 0.2 and 0.4 represents a decent fit *(Hensher et al., 2005)*. The rho-square value of the optimal model is equal to 0.29, and therefore, the conclusion can be made that the model has a decent fit. Furthermore, the adjusted rho-square of the optimal model is equal to 0.28. This means that, when the optimal model is adjusted by the number of parameters it has still a decent fit.

Output Nlogit	
Observations	3061
Estimated parameters	66
Iterations	6
Log likelihood Optimal model	-1498.87
Log likelihood Constant only model	-2121.65
Degree of freedom (DF)	65
Log likelihood ratio statistic (LRS)	1245.56
Rho-square	0.29
Adjusted rho-square	0.28
Critical Chi² ratio	84.82

Table 4 The overall model performance

4.2.2 Attributes evaluation

To use the model, all parameters have to be estimated. This part of the model description consists of three important issues; the significance level, the influence, and the range of all constructs and attributes.

Significance level

By looking at the output of NLOGIT three levels of significance can be distinguished: parameters with three stars (***) meaning a significance level of 99% or higher, identification with two stars (**) means a significance level between 95% and 99%, and one star (*) means a significance level between the 90% and 95%. Last but not least, parameters without any stars (significance less than 90%) are considered as statistically not significant. As elaborated earlier, for this study there were five constructs, twenty-five design related attributes, and three basic attributes (see *Paragraph 3.2*). Furthermore, *Figure 25* shows the coefficients and corresponding siginficance levels of the three basic attributes that are used to describe a car park in terms of size, location and parking tariff, the coefficients and corresponding significance of the five constructs, and the coefficients and corresponding significance of the twenty-five design related attributes.

In addition, each attribute and construct has two parameters (parameter β_1 and parameter β_2). One the one hand, if an attribute has two parameters that are not statistically significant at the 10% confidence level, it means that the corresponding attribute is considered as not significant and considered as coincidence. For

example, as shown in *Figure 25*, both parameters (β_1 and β_2) of the attribute 'capacity' were found not to be significant. Therefore this attribute can be excluded for further research. On the other hand, if an attribute has only one significant parameter then the value zero will be filled in when calculating the part-worth utility of the attribute. For example, as shown in *Figure 25* for the location parameter 1 the β value is 0.2386 (*** = significant) and parameter 2 the β value is 0.0496 (= not significant). Therefore when calculating the part-worth utility of the attribute 'location' the parameter 1 value stays the same and for the parameter 2 the value zero (0.0) will be filled in.

Basic attributes	Coefficient	Sign.
Capacity1	0.0197	NS
Capacity2	-0.0267	
Location1	0.2386	***
Location2	0.0496	
Parking tariff1	0.9841	***
Parking tariff2	0.0865	*

Attributes of Parking area	Coefficient	Sign.
Width parking space1	-0.4771	***
Width parking space2	0.0218	
Width road lane1	-0.3376	***
Width road lane2	0.0640	
Clear signing car & pedestrian1	-0.1526	NS
Clear signing car & pedestrian2	-0.1034	
Type of floor level identification1	-0.0405	NS
Type of floor level identification2	-0.0266	
Presence of columns1	0.0661	NS
Presence of columns2	0.1442	

Attributes of Pedestrians environment	Coefficient	Sign.
Pedestrians routes1	-0.0268	
Pedestrians routes2	0.2970	**
Entrance regime pedestrians1	-0.0024	NS
Entrance regime pedestrians2	0.0328	
Width staircases1	-0.1486	NS
Width staircases2	-0.0048	
Type of elevator points1	-0.3631	***
Type of elevator points2	-0.0110	
Walking distance parking space to the stairway1	0.1109	NS
Walking distance parking space to the stairway2	-0.1174	

Attributes of Accessibility	Coefficient	Sign.
Type access control system1	-0.1797	
Type access control system2	-0.2168	*
Width entrance lanes1	-0.2104	**
Width entrance lanes2	0.1361	
Average waiting time at entrance1	0.0782	NS
Average waiting time at entrance2	0.1228	
Average waiting time at payment terminals1	0.0728	NS
Average waiting time at payment terminals2	-0.0187	
# special places reserved1	0.1007	
# special places reserved2	-0.1977	*

Attributes of Service	Coefficient	Sign.
Presence of parking guidance systems1	-0.2958	***
Presence of parking guidance systems2	0.2949	***
Payment options1	-0.9337	***
Payment options2	0.3829	***
Presence music and/or fragrance system1	0.1877	NS
Presence music and/or fragrance system2	0.0471	
# electrical charing points1	-0.1806	NS
# electrical charing points2	-0.0636	
# toilets inside1	-0.2807	**
# toilets inside2	0.0289	

Attributes of Safety	Coefficient	Sign.
Level of lighting1	0.3599	***
Level of lighting2	0.1447	
Security1	-0.0212	
Security2	-0.2133	*
Presence of ramps1	0.2580	**
Presence of ramps2	0.0805	
Marked escape routes1	-0.2063	NS
Marked escape routes2	0.2068	
Cleanliness and maintanance1	0.4506	***
Cleanliness and maintanance2	0.4192	***

Constructs	Coefficient	Sign.
Parking area1	-0.4347	***
Parking area2	0.0837	
Pedestrians environment1	-0.1421	***
Pedestrians environment2	0.0093	
Accessibility1	-0.1556	***
Accessibility2	-0.0187	
Service1	-0.0293	NS
Service2	-0.0332	
Safety1	-0.3511	***
Safety2	0.0248	

*Figure 25 NLOGIT Parameters (Note: ***, **, * → Significance at 1%, 5%, and 10%)*

The influence attribute

Effect coding is used to represent the effects of the attribute levels. This coding can be used to calculate the part-worth utilities of all construct levels and attribute levels. Furthermore, it provides a manner of using categorical predictor variable in several kinds of estimation models. To this end, all the construct levels and attributes levels can be addressed in a coherent way. An example is provided in *Figure 26* below.

Attribute level	Capacity (# places)	Distance to final destination (meters)	Parking tariff (euros)	Parking area (Construct)	Width road lane (meters)	Type of elevator points	Effect code	
							X1	X2
1	300	50	0.50	Limited supply	Small <3.50	Stairs	**1**	**0**
2	600	250	2.50	Medium supply	Avarage 3.50	Elevator	**0**	**1**
3	900	450	4.50	Wide supply	Very wide >3.50	Stairs and elevator	**-1**	**-1**

E.g Parking tariff

Vparkingtariff1 (€0.50) = (1 x β1= 0.9841) + (0 x β2 = 0.0865) = 0.984

Vparkingtariff2 (€2.50) = (0 x β1= 0.9841) + (1 x β2 = 0.0865) = 0.087

Vparkingtariff3 (€4.50) = (-1 x β1= 0.9841) + (-1 x β2= 0.0865) = -1.071

Change attribute levels into

Figure 26 Example effect coding on attributes

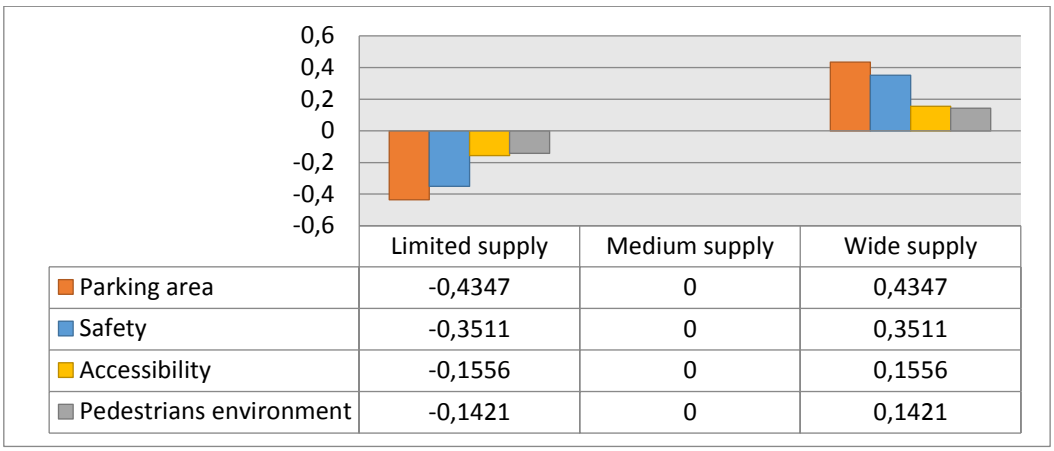
Based on the calculation in the example, the outcome of these equations will give the path-worth utilities of the attribute levels of the attribute 'Parking tariff', namely: parking tariff of €0.50 has a path-worth utility of 0.984, parking tariff €2.50 a path-worth utility of 0.087, and parking tariff €4.50 has a path-worth utility of -1.071. Furthermore, with the values of *Figure 25,* a graph of the part worth utility can be generated. This part-worth utility graph can be generated for all statistically significant attributes and constructs.

As described earlier, in each choice task there were five attributes of one specified construct each with three attribute levels, and four remaining constructs each with three not detailed attribute levels. Before the design related attributes will be handled, first the path-worth utilities of the attribute levels of the constructs are explained. The attribute levels of the constructs are not detailed and are: limited supply, medium supply, and wide supply. In here, it is possible to see what the results are when a car park is provided with more supply in means of design features of a certain construct. For example, if the construct 'safety' was presented as 'wide supply' (displayed as:), it should be interpreted as a car park with very high protection level: presence of security staff and security cameras, well illuminated, etc.. And if it was presented as 'limited supply' (displayed as:), it should be interpreted as a car park with few safety provisions: no security, much dark places, much dirt and debris, etc.. In this way, it will become clear what happens with the utility when the amount of supply changes. As an aside, in the questionnaire, the choice was made to provide clarification of only two constructs (safety and accessibility) regarding the interpretation of the not detailed values (attribute levels).

The influence of constructs

Figure 27 visualizes the change in part-worth utility for all constructs, except for the construct 'Service' (was not found significant). This means that when the values of the construct 'Service' are not presented at the detailed level in comparison to other constructs it is considered not significant. In addition, the first conclusion that can be made is that all the four constructs are positively increasing in a straight line when the amount of supply also increases (from limited to wide). Another matter is the range (difference between highest and lowest part-worth utility) of all the constructs. The larger the range the more influence the construct has on the total utility of an alternative and the higher the probability that car drivers will choose for that alternative car park. The conclusion based on this data can be made that 'Parking area' is the highest ranked construct. This means that when a certain car park has limited supply of design features of this construct and this will be changed into wide supply, this will have the highest influence on the choice of car park by car drivers. On the other hand, the construct 'Pedestrians environment' has the least influence on car drivers' preferences. In summary, from one the highest ranked construct to four the lowest ranked construct are:

1. *Parking area;*
2. *Safety;*
3. *Accessibility;*
4. *Pedestrians environment.*
5. ~~*Service*~~



	Limited supply	Medium supply	Wide supply
Parking area	-0,4347	0	0,4347
Safety	-0,3511	0	0,3511
Accessibility	-0,1556	0	0,1556
Pedestrians environment	-0,1421	0	0,1421

Figure 27 Path-worth utility- and range per construct

Basic attributes

Before starting with the design related attributes, first the basic attributes will be described. *Figure 28* visualizes the change in part-worth utility for the basic attribute 'parking tariff' and the basic attribute 'distance to the final destination'. The basic attribute 'Capacity' was not found significant and therefore not included in the analysis. Furthemore, the attributes 'parking tariff' and 'distance to the final destination' are both continuous attributes which means that the attribute levels have continuous values and an equally proportional growth. These two attributes are therefore visualized in a 2D line chart. For instance, the attribute 'parking tariff' has different levels : € 0.50, € 2.50, and € 4.50. And the difference between the levels is constantly an amount of €2.00. Now that the part-worth utility of the attributes are visualized in a line chart also more information is provided into the continuous values.

As to the location of the car park, it can be concluded that an alternative becomes less attractive when the distance to the final destination becomes larger. As the author expected, a car park close to the final destination is more preffered by car drivers than a car park situated further away. Another remarkable observation is the wide variety in the utility of the parking tariff; the change in utility for the attribute parking tariff is very strong (from €0.50 to €4.50). Firstly, it can be stated that a car park will be less attractive for car drivers when the requested parking tariff is high. In other words, the lower the parking fee, the higher the probability that a car driver will choose a car park. Overall, with regards to the basic attributes, there can be concluded that the parking tariff has the highest influence on the total utility of an alternative, and therefore has the highest influence on the respondents' choice behavior. As an aside, although the basic attributes did produce some interesting facts, however, the primary objective for this study was to gain more insights into the willingness to pay for design related attributes of car parks.

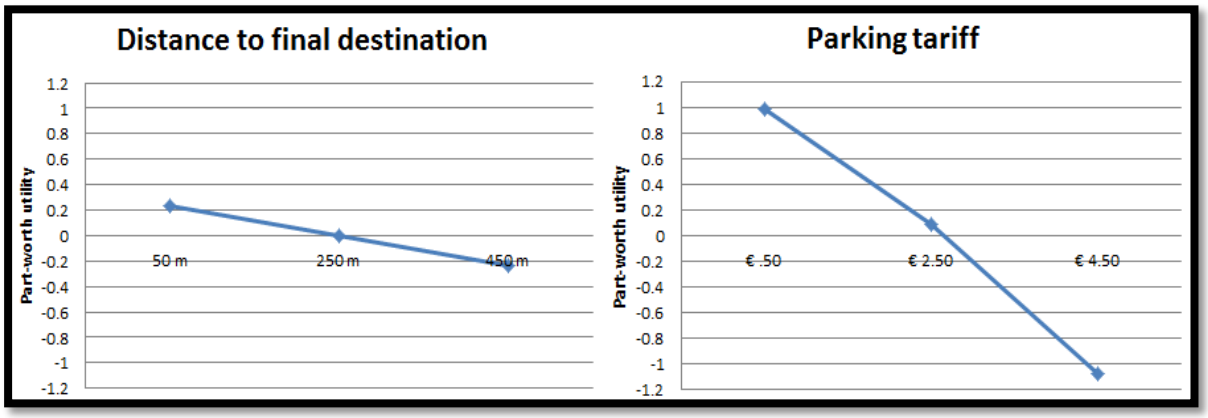


Figure 28 Part-worth utility change per basic attribute

Design related attribute

Figure 28.1 up to *Figure 28.14* visualize the change in part-worth utility for fourteen design related attributes. It is important to note that there are both continuous attributes and discrete attributes. The discrete attributes have one no natural order between the levels and therefore the part-worth utility is shown in a column chart.

As shown above in *Figure 25* in red, there were eleven design related attributes not significant which indicates that these attributes do not influence the respondents´ choice for a car park. Another matter is the range (difference between highest and lowest part-worth utility) of all the design related attributes. *Table 5* shows an overview of the different ranges per attribute in a structured way. Attribute number one (=payment options) has the highest influence and number fourteen (number of special places reserved) the lowest influence on the respondents' parking choice behavior. In other words, the model estimated the weight of different design related attributes whereby the higher the weight of an attribute, the more relevant it is considered. What amazes the author is that precisely ´payment options´ is considered as the most important attribute. The author did not expect that 'payment options' would have the highest influence on the respondents' parking choice behavior. This is because no such link was apparent on the basis of a thorough study of the literature.

NR	Attribute	Range
1	Payment options	1.4845
2	Cleanliness and maintenance	1.3204
3	Width parking space	0.9542
4	Type of elevator points	0.7262
5	Level of lighting	0.7198
6	Width road lane	0.6752
7	Pedestrians' routes	0.5940
8	Presence of parking guidance systems	0.5907
9	Number toilets inside	0.5614
10	Presence of ramps	0.5160
11	Type access control system	0.4336
12	Security	0.4266
13	Width entrance lanes	0.4208
14	Number special places reserved	0.3954

Table 5 Overview range per attribute

However, the conclusion based on this data can be made that in overall the top 5 most important design related attributes are: 'Payment options' (construct Service), followed by 'Cleanliness and maintenance'(construct Safety), 'Width parking space' (construct Parking area), 'Type of elevator points' (construct Accessibility), and 'Level of lighting' (construct Safety), see also *Table 5*. Remarkable, although the construct 'Service' was not significant', however, within the construct there were attributes that are considered as important. For instance, the attribute 'Payment options' has the highest coefficient (β=-0.9337) and change in utility (range=1.4845). This means that if a car park has all the fourteen design related attributes, then the attribute 'payment options' (which indicate a car park that accepts: cash, bank cards and mobile payments) would have the strongest positive influence on the respondents´ choice for a car park. A possible explanation is that when the construct ´service´ is not presented with its design related attributes and attribute levels, it is not well understood. Thus, when the construct 'service' was presented as: 'limited supply' (displayed as:), or 'wide supply' (displayed as:), the respondents may have misinterpreted the construct and did not link the attributes 'payment options', 'presence of parking guidance systems', and 'number toilets inside' to 'service'.

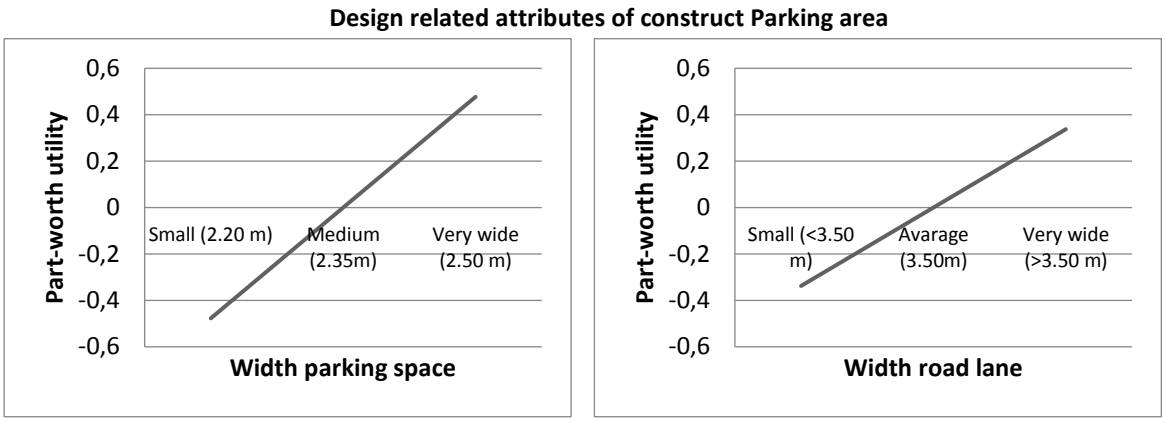


Figure 28. 1

Figure 28. 2

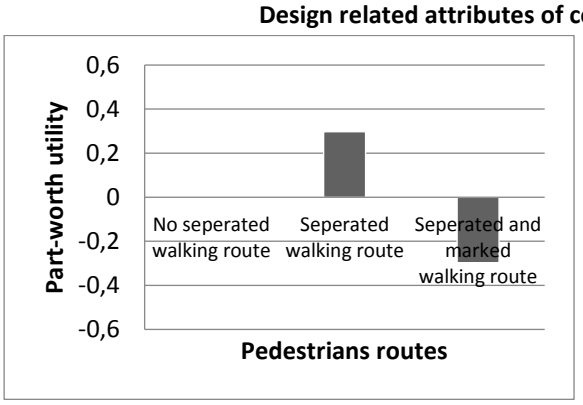


Figure 28. 3

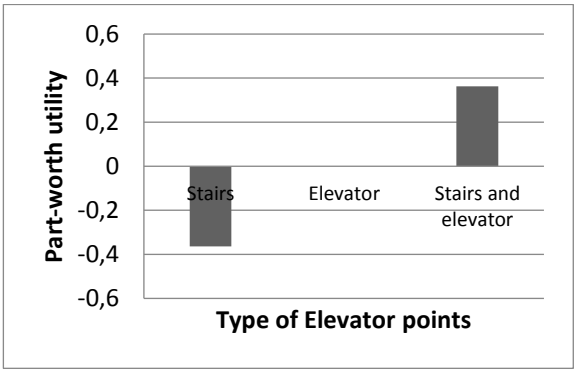


Figure 28. 4

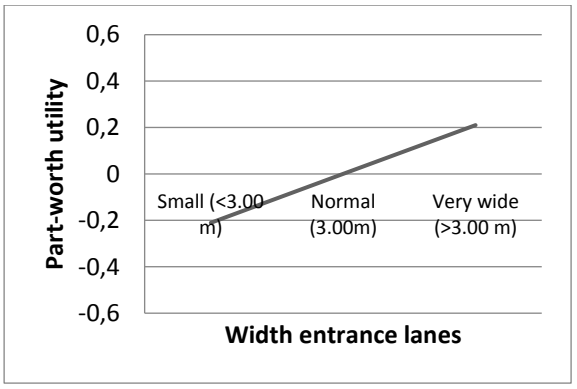


Figure 28. 5

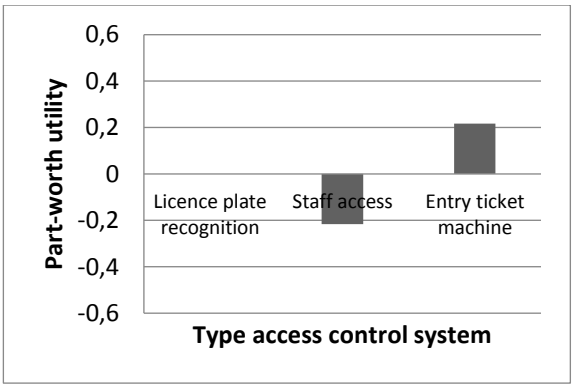


Figure 28. 6

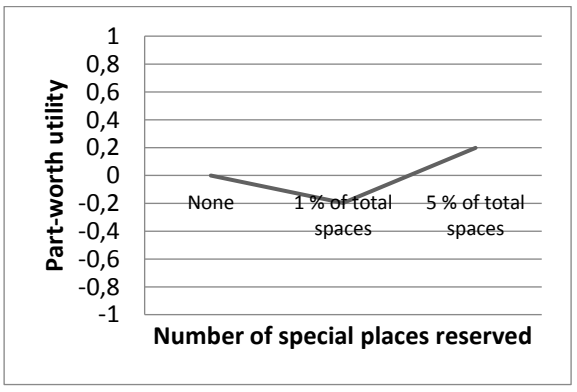


Figure 28. 7

Design related attributes of construct Service

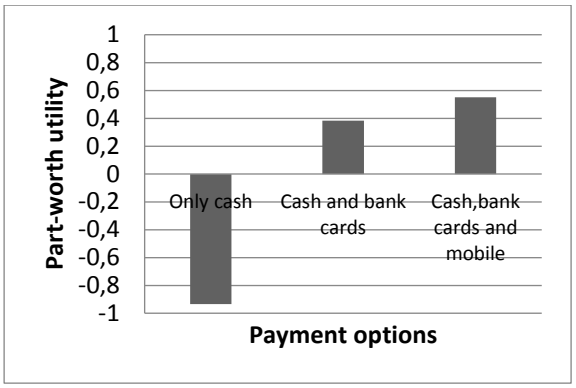


Figure 28. 8

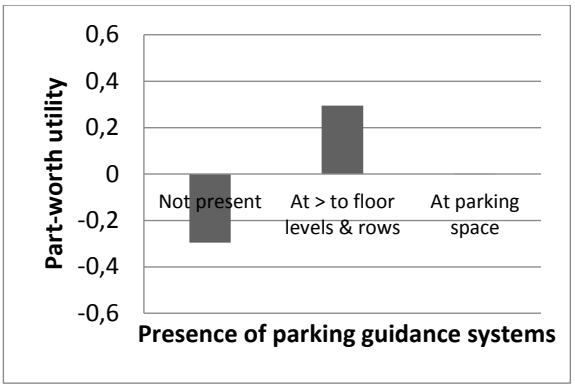


Figure 28. 9

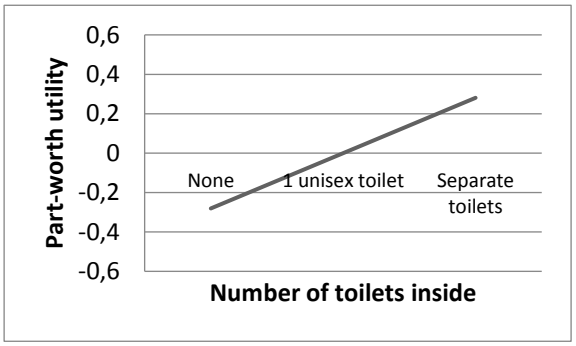


Figure 28. 10

Design related attributes of construct Safety

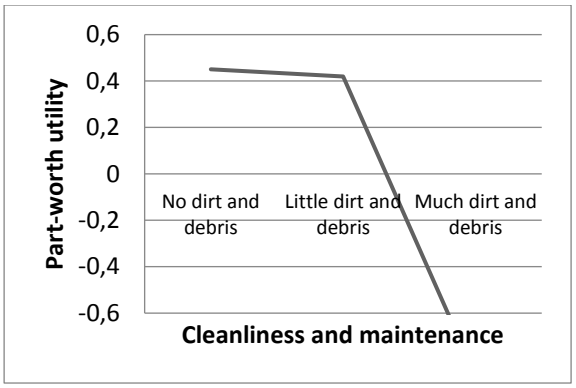


Figure 28. 11

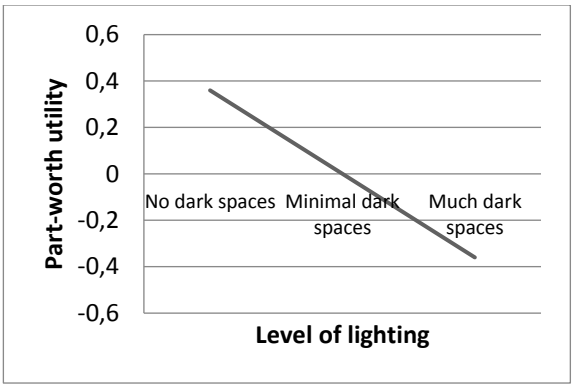


Figure 28. 12

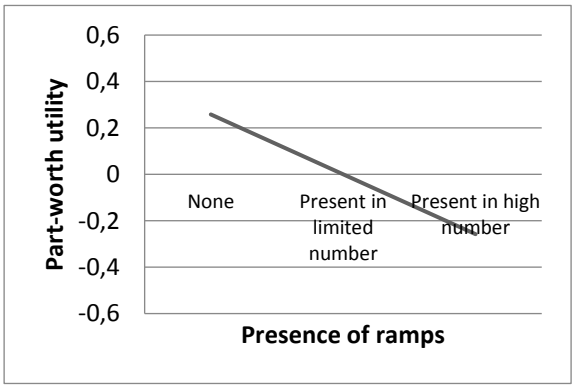


Figure 28. 13

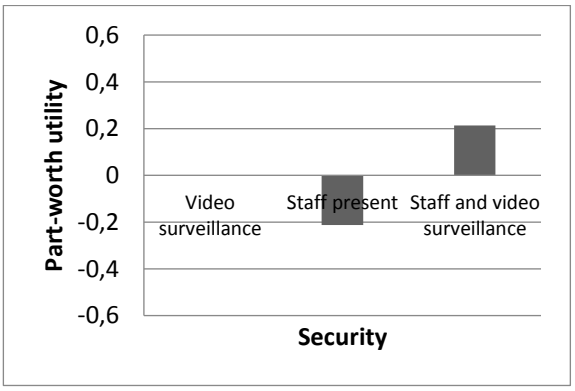


Figure 28. 14

In summary, the following design related attribute have a **positive influence** on respondents' willingness to choose for a certain car park, namely a car park:

- that accepts different payment options: cash, bank card, and mobile;
- that have no dirt and debris;
- that have very wide parking space (2.50m);
- that have both a stairs and elevator (in case of multilevel car park);
- that is very well lit and therefore no dark spaces in the parking area;
- that have very wide road line (>3.50m);
- that have a parking guidance system directing car drivers to the most suitable floor level & parking row;
- that have separate toilets;
- without ramps that are to reduce the speed of the traffic;
- that have an entry ticket machine;
- that have both staff- and video surveillance;
- that have very wide entrance lanes (>3.00m);
- that have 5% special places reserved of the total parking spaces (e.g. for people with disabilities, families with children, car sharing places etc.).

As an aside, the results of the attributes 'pedestrians routes' and 'presence of ramps' which both have influence on respondents´ choice for a car park are not as expected. First of all, it was expected that a car park with separated and marked walking route for pedestrians is more preferred by respondents than a car park with only a separate walking for pedestrians. A possible explanation could be that respondents have misinterpret the levels of the attribute, and therefore, had a false impression. Second of all, it was also expected that a car park with many ramps for controlling speed traffic in the parking area is more preferred by respondents than a car park with no ramps at all. The review of the existing literature reveals that car drivers attach great value on safety. Thus, the author assumed that the use of ramps in car park improves the safety of car drivers and therefore considered as more important by respondents. Instead, respondents may be disturbed by ramps in a car park.

4.2.3 Willingness to pay for design related attributes

In this section car drivers' willingness to pay (WTP) for each design related attribute will be described. To come to a conclusion about respondents' willingness to pay, the outcomes described above must be translated and expressed in euros. Furthermore, the WTP for design related attribute j is calculated as the derivative of the measured design related attribute's utility parameter (β_j) with respect to cost attribute's utility parameter (β_c), *see Paragraph 3.1.2 Formula 1*. In addition, *Table 6* shows the cost attribute's utility parameter (β_c = 2.0547) which is considered as the range of the attribute 'parking tariff', and is hence, equivalent to an amount of €4.00 (difference between €0.50 to €4.50). Therefore after β_j is divided by the β_c this outcome will be multiplied by € 4.00. *Table 7* shows car drivers' WTP for each design related attribute and the changes in the different attributes' levels.

Cost attribute	Utility Estimate	Utility parameter (β_{Ci})
Parking tariff per hour		**2.0547**
€ 0.50	*0.9841*	
€ 2.50	*0.0865*	
€ 4.50	*-1.0706*	

Table 6 Cost attribute's utility parameter

As an example, take the WTP of the attribute 'Payment options' and the changes in the different attributes' levels. *Figure 29* shows how the WTP has been calculated. It is important to note that although the estimation of the 'payment options' parameters are significant at the 5 % level, the WTP amount of €2.89 appear to be on the high side. The author do not consider this amount as plausible. Although the WTP is based on observed

trade-off preferences for different attributes and attribute levels, an explanation could be that respondents were not willing to trade-off between combination of 'payment option'. In other words, in the questionnaire (SP part) the respondents could express their preferred choice among two hypothetical parking situations (car parks **A** or **B**). The hypothetical situations are described by a series of attributes and attribute levels. The author assume that if a car park only accepts cash payment it will not be chosen. It is also important to note that the respondents were forced to choose one of the two alternatives; 'choose none' option was not included.

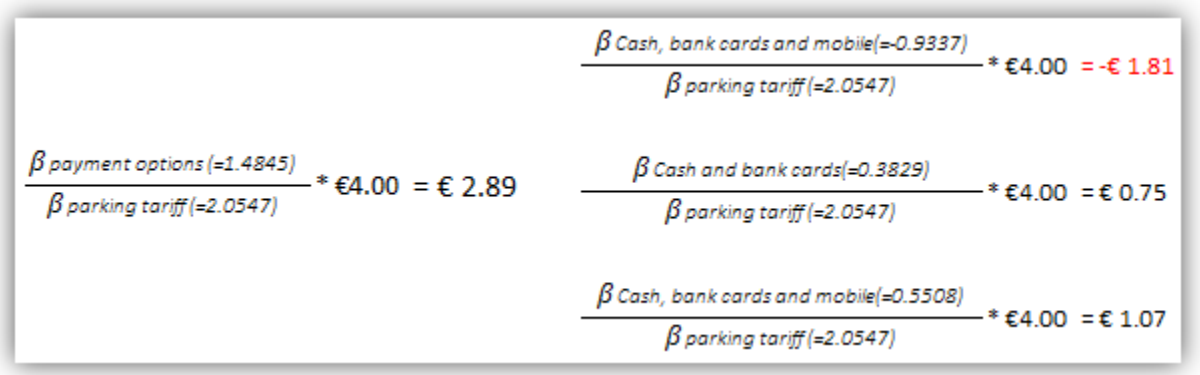


Figure 29 WTP calculation of attribute Payment options

However, based on the collected data, the conclusion can be made that car drivers are willing to pay more (€ 1.07) for a car park that accepts several payment options (Cash, bank cards, and mobile) and willing to pay far less (- €1.81) when cash is the only payment option. Thus, when we assume the situation that a certain inner city car park only accept cash payments and this would be improved so that other payment options will also be available (cash, bank cards and mobile), than the amount of € 2.89 can be charged above the current parking tariff in which it will not negatively influence car drivers parking choice behavoir. Furthermore, this amount can also be seen as a reasonable return on invested capital for the operator. All the other design related attributes in *Table 7* are addressed in the same way.

Design related attribute	Part-worth utility	Utility parameter (βx_i)	WTP
1 Payment options		**1.4845**	**€ 2.89**
Only cash	*-0.9337*		*€ -1.82*
Cash and bank cards	*0.3829*		*€ 0.75*
Cash, bank cards and mobile	*0.5508*		*€ 1.07*
2 Cleanliness and maintenance		**1.3204**	**€ 2.57**
No dirt and debris	*0.4506*		*€ 0.88*
Little dirt and debris	*0.4192*		*€ 0.82*
Much dirt and debris	*-0.8698*		*€ -1.69*
3 Width parking space		**0.9542**	**€ 1.86**
Small (2.20 m)	*-0.4771*		*€ -0.93*
Medium (2.35m)	*0*		*€ 0.00*
Very wide (2.50 m)	*0.4771*		*€ 0.93*
4 Type of elevator points		**0.7262**	**€ 1.41**
Stairs	*-0.3631*		*€ -0.71*
Elevator	*0*		*€ 0.00*
Stairs and elevator	*0.3631*		*€ 0.71*
5 Level of lighting		**0.7198**	**€ 1.40**
No dark spaces	*0.3599*		*€ 0.70*
Minimal dark spaces	*0*		*€ 0.00*
Much dark spaces	*-0.3599*		*€ -0.70*
6 Width road lane		**0.6752**	**€ 1.31**
Small (<3.50 m)	*-0.3376*		*€ -0.66*
Average (3.50m)	*0*		*€ 0.00*
Very wide (>3.50 m)	*0.3376*		*€ 0.66*
7 Pedestrians routes		**0.594**	**€ 1.16**

No separated walking route	*0*		*€ 0.00*
Separated walking route	*0.297*		*€ 0.58*
Separated and marked walking route	*-0.297*		*€ -0.58*
8 Presence of parking guidance systems		**0.5907**	**€ 1.15**
Not present	*-0.2958*		*€ -0.58*
At > to floor levels & rows	*0.2949*		*€ 0.57*
At parking space	*0.0009*		*€ 0.00*
9 Number of toilets inside		**0.5614**	**€ 1.09**
None	*-0.2807*		*€ -0.55*
1 unisex toilet	*0*		*€ 0.00*
Separate toilets	*0.2807*		*€ 0.55*
10 Presence of ramps		**0.516**	**€ 1.00**
None	*0.258*		*€ 0.50*
Present in limited number	*0*		*€ 0.00*
Present in high number	*-0.258*		*€ -0.50*
11 Type access control system		**0.4336**	**€ 0.84**
Licence plate recognition	*0*		*€ 0.00*
Staff access	*-0.2168*		*€ -0.42*
Entry ticket machine	*0.2168*		*€ 0.42*
12 Security		**0.4266**	**€ 0.83**
Video surveillance	*0*		*€ 0.00*
Staff present	*-0.2133*		*€ -0.42*
Staff and video surveillance	*0.2133*		*€ 0.42*
13 Width entrance lanes		**0.4208**	**€ 0.82**
Small (<3.00 m)	*-0.2104*		*€ -0.41*
Normal (3.00m)	*0*		*€ 0.00*
Very wide (>3.00 m)	*0.2104*		*€ 0.41*
14 Number of special places reserved		**0.3954**	**€ 0.77**
None	*0*		*€ 0.00*
1 % of total spaces	*-0.1977*		*€ -0.38*
5 % of total spaces	*0.1977*		*€ 0.38*

Table 7 car drivers' willingness to pay for specific design related attribute

4.3 Conclusion

Analyses of the data have revealed a number of interesting findings about respondents' experiences (analyses part 1) and their willingness to pay (analyses part 2).

In the first part of the analyses, it became clear that although the sample was not representative for the Dutch population, it is not fully clear if the sample is representative for the car park parkers' population. What is important, however, is that due to the pre-selection questions all respondents included in the statistical analyses are part of the target group. In addition, from the respondents' experiences interesting results are obtained. Firstly, the largest group of the respondents were low frequent car park visitors. Secondly, car parks are mainly visited by car drivers with travel purposes shopping and leisure/recreation. Another interesting point in this context is that there is potential for increasing parkers' experiences in a positive way. For example, the respondents could rank several parking factors between two extremes on a scale ranging from one to five. Overall, when looking at the mean score then the parking factors are, in general, ranked on the more less positive extreme e.g. the factor 'wide parking space and comfort' is experienced as more narrow than broad.

The second part of the analyses was the most important part for this study. This part helped to provide a better understanding of the most important design related attributes and respondents' willingness to pay for these attributes. The multinomial logit model was used to analyze the obtained choice data. The model was tested using the log-likelihood ratio statistic and the rho-squares value. It was found that the model has a decent fit. In order to use the model, the parameters of three basic attributes, twenty-five design related attributes, and five constructs with general construct levels were estimated. In this regard, the significance levels, the influences, and the ranges of all constructs and attributes were examined.

First of all, the results showed that not all used constructs and attributes affects the respondents' choice of car park. The following constructs and attributes had no significant coefficients, and therefore, were excluded for further analyses: the construct 'service', the basic attribute 'capacity', and the design related attributes: 'clear signing car & pedestrian', 'type of floor level identification', 'presence of columns', 'entrance regime pedestrians', 'width staircases', 'walking distance parking space to the stairway', 'average waiting time at entrance', 'average waiting time at payment terminals', 'presence music and/or fragrance system', 'number electrical charging points', and 'marked escape routes'. According to Kjaer (in Gate, 2010), an insignificant coefficient could also mean that it: ''*is not possible to demonstrate a significant relationship between the given level and the choice*''. Thus, it does not necessarily mean that the above attributes and construct are unimportant to respondents.

Second of all, the results showed that respondents are willing to pay for fourteen design related attributes, namely: 'payment options', 'cleanliness and maintenance', 'width parking space', 'type of elevator points', 'level of lighting', 'width road lane', 'pedestrians routes', 'presence of parking guidance systems', 'number toilets inside', 'presence of ramps', 'type access control system', 'security', 'width entrance lanes', and the 'number of special places reserved'. Furthermore, the relative importance weight of each attribute is translated and expressed in euros. It turns out that respondents are willing to pay the most for 'payment options' (an amount of €2.89). As described earlier, although payment options may be considered as the most important attribute, however, the author assumed that the WTP amount is on the high side and sees as not plausible. The explanation for this finding has been given and is mainly because the respondents were not willing to trade-off between combination of 'payment option'.

5 Conclusion and discussion

In this chapter the overall conclusion and discussion of the study will be described. This chapter also describes the relevance and limitations of the study. Finally, some recommendations for further scientific research and recommendations towards parking companies will be provided.

5.1 Overall conclusion

This study investigates the importance of design related attributes of publicly accessible car parks and how much car drivers are willing to pay for each design related attribute. The purpose of this study is to provide organizations involved in parking more insight into the relationship between the parking tariff and design related attributes. In order to answer the main question first five sub-questions are answered.

How is the parking stock built up?

The author gained more insight and knowledge about the parking phenomenon. There is a large amount of parking supply offered in which car drivers can choose where to park their car. Depending on the trip purpose car drivers make a decision where to park their car an consider several factors. The most important factors are the 'parking tariff' and the 'location' of the parking facility. Furthermore, there are different types of parking facilities that differ regarding size and price at different locations. Parking facilities in suburbs (e.g. Park and Ride facilities) are mostly accessible to the public, larger in size, cheaper in price and less attention is paid to the quality. In addition, many large cities suffer from the lack of parking spaces and therefore introduced paid parking in order to maintain a better balance between supply and demand. Therefore, parking facilities in city centers are often multi-level car parks (above or underground car parks) and more expensive. There are also commercial parking companies providing paid parking spaces. Their pricing strategy mainly concerns the 'willingness to pay' principle and can only work efficiently if it is within the frameworks of the municipal parking policy. This is because urban planners could use the pricing mechanism and stimulate off-streets parking by making on-street parking more expensive than off-street. The literature review carried out for this report shows that the parking tariff is considered as one of the most successful parking measure to discourage car drivers to park in a certain area.

What could be considered as design factors of a car park?

The identification and selection of attributes to be analyzed in this study are based on literature and experts opinions. By looking at different sources forty-seven potential attributes are identified. It was not possible to investigate all attributes and only twenty-five design related attributes are selected for this study. First of all, the choice was made to assign three levels to each attribute in order to identify both linear and non-linear utility relationships. If an attribute has only two attribute levels, then the utility function can only be linear. Second of all, a list was compiled of forty-seven attributes that are divided and categorized into five constructs. Based on the author expertise, for each construct five attributes are selected. Additionally, two experts in the field of parking have expressed their views on this list and have indicated twenty-five attributes that are important to them. Similarly, they are instructed to select only five attributes per construct. Thus, an attribute could be selected three times by the author, and the two experts. The attributes that are selected the most are also used for this study.

How are car parks being evaluated?

Three different stakeholders are identified each with different perception on the use of car park, namely: parking companies/operators, parking associations, and car park users. First of all, parking companies provide (paid) parking spaces to the car driver. Many large parking companies (e.g. Q-park, Apcoa, and Interparking) having a policy aimed on establishing a recognizable name and brand identity by providing parkers a high-quality parking product. The aim of commercial parking companies is to attract as many car drivers as possible to their parking facilities in order to increase their occupancy rates and yield the maximum revenues. In contrast, there are several municipalities that own many car parks, but their aim is based on providing parking spaces to its residents and visitors rather than yield the maximum revenues. Second of all, the parking association keeps an eye on the offered parking supply and attaches great importance to the way parking

consumers (users of car parks) perceive the image of car parks. The European Parking Association (EPA) is the umbrella organization of 22 European parking associations. The EPA developed an ESPA checklist in order to assess the internal-quality of car parks. A car park can be assessed by an expert of the parking association (e.g. Vexpan). And if the requirements of the ESPA checklist are met, then a quality award can be granted. Last but not least, the literature review carried out for this report shows that parkers place a lot of emphasis on the price level (parking tariff should be extra low), size of the parking space (parking spaces should be wide), different payment options, high visibility (good lighting and no blind corners), personal safety, and a clean car park.

How should users' willingness to pay be measured?
In order to identify the car park users' preferences regarding the relationship between parking tariffs and design related attributes, a Stated Preference experiment is set up. Due to the large amount of attributes the integrated Hierarchical Information Integration approach is used in order to reduce the risk on information overload and respondent burden. Additionally, a questionnaire instrument is developed in which drivers can valuate several parking alternatives each described by several design related attributes and tariff schedule. The WTP is calculated as the derivative of the measured design related attribute's utility parameter with respect to cost attribute's utility parameter.

How much are users of inner-city car parks willing to pay (extra) for design related attributes?
After the data were obtained first the respondents' characteristics were analyzed. The sample was not representative for the Dutch population. However, it is not fully clear if the sample is representative compared to the population of car park users because this data was not available. The multinomial logit modeling (MNL) is used to analyze the stated choices. The results showed that there are fourteen design related attributes that have an influence on respondent's willingness to pay. For each attribute the WTP amount is calculated. The highest WTP amount is for the attribute 'payment options' (€2.89): from cash only to cash, bank card, and mobile. This is followed by an amount €2.57 for a 'clean parking area': from much- to no dirt, and followed by an amount €1.86 for 'wider parking spaces': from small- to very wide.

5.2 Overall discussion

5.2.1 Scientific relevance

This study does add valuable knowledge about car park users' parking choice behavior to the already existing knowledge. Literature shows that there is little knowledge about which internal design attributes triggers car drivers to visit a certain car park. Also little is known about how much car drivers are willing to pay for design related attributes. The integrated HII approach with the Stated preference experiment proves to be a highly useful, efficient methodology for understanding car drivers' parking choice behavior. The outcome of this study adds valuable knowledge about car park users' willingness to pay for design attributes of car parks. This study is a first attempt to provide more insight into the connection between parking tariffs and design related attributes.

5.2.2 Practical Relevance

Information concerning the influence of design related attribute on car drivers' car parking choice behavior can help parking companies and parking operators to optimize the design of the car parks. To attract car drivers to specific car parks, parking companies could use the following recommendations.

Description
Allow different payment possibilities
Make sure that the car park is regularly cleaned and maintained
Ensure that the inside of the car park is well illuminated
Ensure that the parking spaces are at least 2.35 meter wide
Ensure that there are separate toilets and are kept clean
Ensure that car drivers are directed to the most the most suitable floor level & parking row
Ensure a good and safe parking environment by use of staff- and video surveillance
Do not use ramps or at the very least only a limited number to control or manage vehicular traffic
Ensure that the entrance of the car park is at least 2.30 meter wide and is equipped with an entry ticket machine
In case of a multilevel car park ensure that there is both stairs and an elevator

Table 8 Recommendations for car park design

This study also shows how much car drivers are willing to pay a additional design features. One of the recommendations for the design is ensure that the inside of the car park is well illuminated. For instance, assume that a car park operator want to invest in beter lighting because there are some dark places whitin the car park. On the one hand, this would improve the visibility and increase the safety of car park visitors. On the other hand, this also means an additional investment. To this end, the outcome of this study provide information about how much the car park operator can increase the parking tariff. In this case with €0.70. Furthermore, the findings of willingness to pay can serve as a reference for determining parking tariffs. In the current literature there is little known about the justification of parking tariffs and many municipalities and also car park companies are looking elsewhere (e.g. competitors).

5.2.3 Study limitations

In this study there were some limitations that could have influence the outcome of this study. One limitation concerns the way how the data is collected. Due to the limited budget and time for this research the convenience sampling technique is used. Based on the response rates, it is not fully clear if the sample is representative of the target population (car park visitors), and therefore, the results cannot be generalized. It is more useful to collect data by visiting car parks and ask visitors if they would like to participate in the study. Also the way the attributes and attribute levels were selected and categorized and clustered into decision constructs could have influenced the outcome of this study. The author has identified forty-seven interesting attributes based on (limited) literature and own knowledge. It is more useful to explorer the importance of the attributes and attribute levels before selecting the attributes for the study.

Another limitation of the study is the way the questionnaire is constructed and presented to the respondents. In the Stated Preference part the respondents are asked to choose between two hypothetical parking situation (car park **A** or car park **B**). By doing this, the respondents were forced to choose one of the two alternatives because there was no 'no-choice' alternative provided. Although this study is based on the assumption that respondents are willing to trade-off between combination of attributes and attribute levels, now they could not indicate that they would not choose any of the presented product profiles. The consequence of this has been that respondents did not trade-off between attribute levels of 'payment option'. It turned out that, when a hypothetical car park only accept cash, no one will choose this alternative. Therefore, it is useful to include a no-choice alternative in the choice task. Last but not least, the respondents could have misinterpret the values of the constructs and attributes. In the questionnaire, more clarification is provided of only two constructs (safety and accessibility) regarding the interpretation of the not detailed values (construct levels). Maybe it was more useful to provide more clarification to the respondents. However, this would increases the length and

completion time of the questionnaire. Also the respondents would then have to handle much more information.

5.2.3 Recommendation for further scientific research

The following suggestions are purposed for further scientific research

Re-examine the importance the attributes.

The outcome of this study showed that respondents are willing to pay most for payment options. As mentioned earlier, this outcome has amazed the author because it was not as expected. Further research must reveal whether different payment options in a car park is considered as most important by car drivers. The issue does need further exploration.

Use of data

In this study the data is analyzed using a standard multinomial logit model. For further research it could be interesting to analyses these data with a more advanced choice modeling technique (e.g. mixed multinomial logit modeling). On the other hand, although the sample cannot be considered as representative for the Dutch population, the data can be used for further investigation. It can be complemented with more detailed information about other attributes that could also have an influence on car park users' willingness to choose for a certain car park.

Occupancy

The outcome of this study showed which value is placed upon different design related attributes. Therefore it could be interesting to launched several case studies to analyse the willingness to pay of car drivers for similar car parks that only differ from design. For example, in Den Bosch the car pars St-Jan Den Bosh and Wolvenhoek Den Bosch are both located in the city center and have the same parking tariff (€2.20 per hour). The study showed that car drivers are willing to pay a higher tariff for several design related attributes. These two car parks are a good example for a case study. It is also interesting to know if the car park St-Jan Den Bosh attract more visitors than Wolvenhoek because of it's internal design (higher occupancy rate).

Travel motive

The focus of this study was on the design of inner-city car parks. In the stated choice experiments the respondents were asked to choose between two hypothetical car park alternatives (choice tasks). They had to assume that they are visiting a town by car and wanted to parking their a car park. They were asekd to stated their choice by 'choosing' their most preferred alternative. Therefore it is interesting to look whether car drivers are willing to pay more for design related attributes of other then inner-city car parks.

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APPENDIX A: Car park attributes from different sources

Attributes	Literature					
	ESPA (2015)	*Louter, F. & Van Savooyen, E. (2005)*	*Rinsma, J. & Koens, B. (2007)*	*CROW (2011)*	*Jim Hill (2005)*	*Swarco (2014)*
Capacity						
Width parking space						
Lenght parking space						
Type mark parking space						
Width road lane						
Traffic flow						
Road pavement						
Ramps						
Columns presence/distance						
Clear signing car & pedestrian						
Pedestrians routes						
Entrance regime pedestrians						
Headroom for pedestrian						
# staircases						
Width staircases						
Feature staircases						
Type of embellishment (art, decoration)						
# elevators						
# payment terminals						
Walking distance parking space to the stairway						
Width entrance lanes						
Average waiting time at entrance						
Clear height for vehicles						
Type access control system						
# disable parking spaces						
# disable toilets						
Type of parking guidance systems						
Presence of parking guidance systems						
Payment options						
Presence music and/or fragrance system						
Type of charging points						
# electrical charging points						
# toilets inside						
Storage and pick up points						
Type of floor level identification						
Cleanliness and maintenance						
Marked escape routes						
Security						
Presence of staff and/or CCTV						
Room for staff/operator						
Level of lighting						
Operation and terms signage						
Tariff structure						
Tariff level						
Distance between car park and final destination						
Design type						
Sustainability						

APPENDIX B: Attributes and attribute levels

Attributes	Attributes levels			Based on
Capacity	*Small (300 spaces)*	*Medium (600 spaces)*	*Large (900 spaces)*	own selection
Width parking space	*Small (2.20 m)*	*Medium (2.35m)*	*Very wide (2.50 m)*	Literature
Lenght parking space	-	-	-	
Type mark parking space	*Letters*	*Number*	*Colour*	Literature and own selection
Width road lane	*Small (<3.50 m)*	*Average (3.50m)*	*Very wide (>3.50 m)*	Literature
Traffic flow	*One way traffic*	*Two way traffic*	-	Literature
Road pavement	*Asfalt*	*Concrete*	*Coating*	Literature and own selection
Ramps	*None*	*Present in limited number*	*Present in high number*	Literature and own selection
Columns presence/distance	*No columns present*	*Limited columns present*	*Large columns present*	Literature and own selection
Clear signing car & pedestrian	*Barely visible*	*Visible*	*Clearly visible*	Literature and own selection
Pedestrians routes	*No separated walking route*	*Separated walking route*	*Separated and marked walking route*	Literature
Entrance regime pedestrians	*Open passageways*	*Manual doors*	*Automatic doors*	Literature
Headroom for pedestrian	*Low (<2 m)*	*Standard (2- 2,1 m)*	*High (> 2 m)*	Literature
Type of elevator points	*Stairs*	*Elevator*	*Stairs and elevator*	Literature and own selection
Width staircases	*Small (1.00 m)*	*Normal (1.50 m)*	*Very wide (2.00 m)*	Literature and own selection
Feature staircases	*Hand rails*	*Anti-slip surface*	-	Literature and own selection
Type of embellishment (art, decoration)	*None*	*Artwork*	*Planters*	own selection
# elevators	*Single level car park (0)*	*2*	*>3*	own selection
Average waiting time at payment terminals	*Short (<1 minute)*	*Average (1 minute)*	*Long (>1 minute)*	own selection
Walking distance parking space to the stairway	*15 meter*	*30 meter*	*30 meter*	own selection
Width entrance lanes	*Small (<3.00 m)*	*Normal (3.00m)*	*Very wide (>3.00 m)*	Literature
Average waiting time at entrance	*Short (<30 second)*	*Average (30 second)*	*Long (>30 second)*	own selection
Clear height for vehicles	*Standard (1,9 m)*	*Medium (2,1 m)*	*High (2,3 m)*	Literature
Type access control system	*Licence plate recognition*	*Staff access*	*Entry ticket machine*	Literature and own selection
# disable parking spaces	*None*	*1 % of total spaces*	*5 % of total spaces*	Literature and own selection
# disable toilets	*None*	*1 or 2*	*>2*	Literature and own selection
Type of parking guidance systems	*Static aisle signage*	*Multicolor LED Space Lights (ultrasonic sensor)*	*Dynamic sign system*	Literature and own selection
Presence of parking guidance systems	*Not present*	*At > to floor levels & rows*	*At parking space*	Literature and own selection
Payment options	*Only cash*	*Cash and bank cards*	*Cash,bank cards and mobile*	Literature and own selection
Presence music and/or fragrance system	*No music and parfume*	*Only background music*	*Music and relaxing scent (e.g. flowers)*	Literature and own selection
Type of charging points	*Electric cars*	*Mobile phone*	*Laptop or other electric systems*	Literature
# electrical charging points	*None*	*1 % of total spaces*	*5 % of total spaces*	own selection
# toilets inside	*None*	*1 unisex toilet*	*Separate toilets*	own selection
Storage and pick up point	*None*	*Lockers*	*Shopping pick up point*	Literature and own selection
Type of floor level identification	*None*	*Color-coding by level*	*Color coding and identification Theming*	Literature and own selection
Cleanliness and maintenance	*No dirt and debris*	*Little dirt and debris*	*Much dirt and debris*	Literature and own selection
Marked escape routes	*Signposting*	*Illuminated signs*	*Illuminations and glow in the dark road lines*	Literature and own selection
Security	*Video surveillance*	*Staff present*	*Staff and video surveillance*	Literature and own selection

Presence of staff and CCTV	*Staff on remote and 1 CCTV*	*Staff present and 1-2 CCTV*	*Staff present and 2> CCTV*	Literature and own selection
Room for staff/operator	*None*	*At entrance easy to find*	*Hard to find*	Literature and own selection
Level of lighting	*No dark spaces*	*Minimal dark spaces*	*Much dark spaces*	Literature and own selection
Operation and terms signage	*No signs*	*Tariff structure & opening hours*	*#spaces available*	Literature and own selection
Tariff structure	*Pay per minute*	*Pay per hour*	*Pay per day*	Literature
Tariff level	*0.50 €*	*2.50 €*	*4.50 €*	Literature and own selection
Distance car park to final destination	*50 meter*	*250 meter*	*450 meter*	Literature and own selection
Design type	*Above ground*	*Under ground*	*Both*	Literature and own selection
Sustainability	*Solar panels*	*Energy saving lighting system*	-	Literature

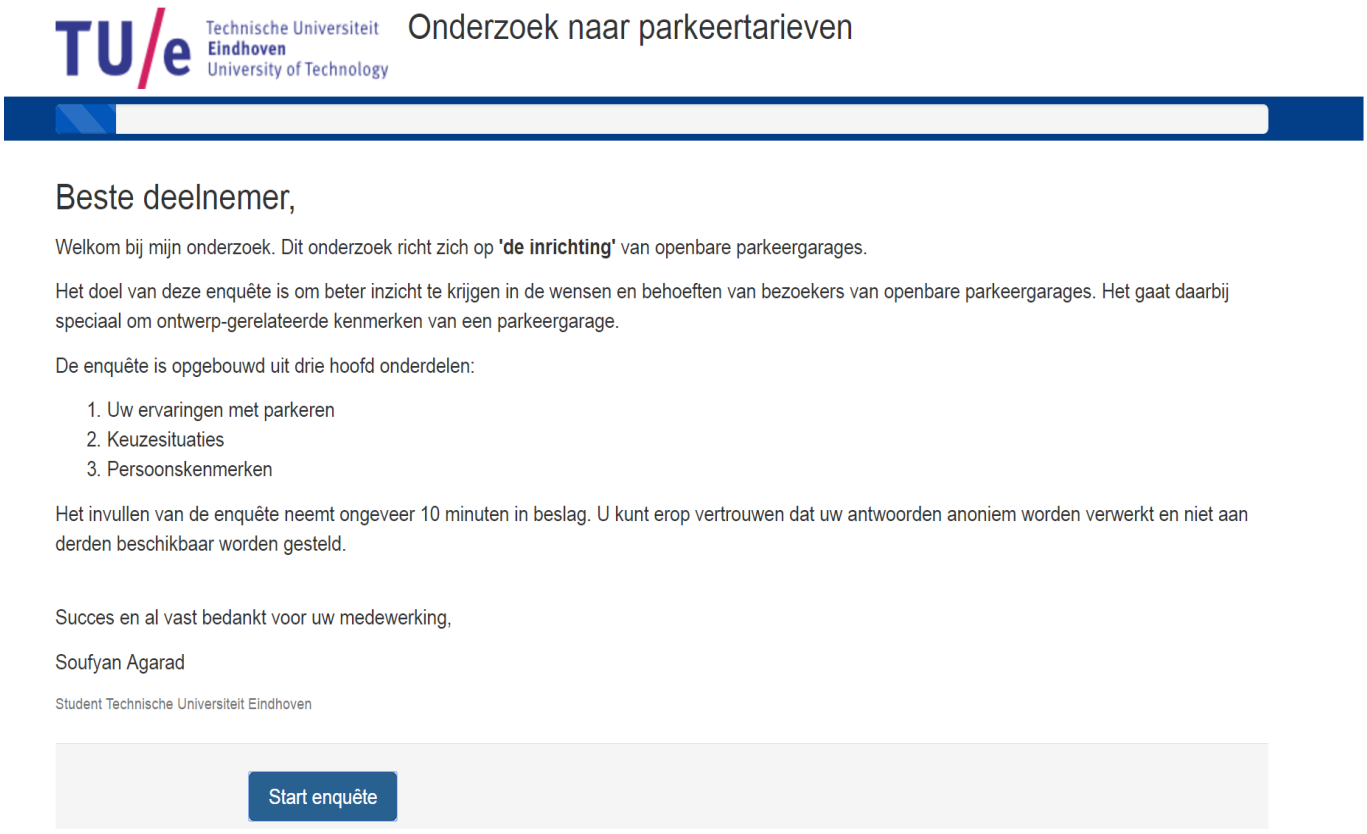
APPENDIX C: ESPA checklist categories

Category	Category points	Aspects	Explanation
1 Mandatory minimum conditions	-	*Car park characteristics	To be eligible for an award, the car park must first meet various mandatory minimum conditions. For instance, it must be a publicly accessible car park with generally an overhead clearance of at least 1.90 metres. Additionally, at least 70% of bays must be at least 2.30m wide and the average light levels in parking area is at minimum 20 Lux.
2 Lighting	16	*Placement of lamps *Lighting level (lux) and uniformity	This section specifies the internal lighting level in the car park. The expert measures the light levels (in Lux) on different places in the car park (e.g. on parking area, at pay-machine, cashier, in elevation points etc.). Also the lighting uniformity is measured. - *This category can have a maximum score of 46 points.*
3 Car Entry / Car Exit	8	*Traffic signs *Information signs *Ticket machines *Access security	Points are scored in the recognisability of traffic signs and legibility of information signs (e.g. prices & opening hours). A modest amount of attention is also paid to the ease of use for entering the car park. For instance, is their enough room for cars waiting at the entrance and can they easily take a ticket from the ticket machines. Additionally the items of the access security are also scored, such as intercom, CCTV, licence plate recognition. - *This category can have a maximum score of 29 points.*
4 Parking area	20	*Columns *Visibility *Signs and marks *Sizes and angles *Accessibility for disabled persons	In this section the expert is assessing the way the columns are placed compared to the parking bays which is key to the safety and comfort in the parking garage. This category also examines other aspects, such as the visibility (dead corners), recognisability of signs and width of parking spaces and lanes and the parking angle. Last but not least, also attention is paid to handicap facilities (e.g. location and wide of the parking bay). - *This category can have a maximum score of 43 points.*
5 Vehicle ramps	8	*Floors *Sizes and radius *Surface	This section is based on the assumption that a single level car park without a vehicular ramp have a higher standards of customer friendliness. The suggestion is that sloping slabs decreases the users comfort and it may increase the risk of damage. On the other hand, in case of a multilevel car park with a ramp, the very minor parts (e.g. wide and radius of the ramp and the surface whether it is smooth or with an anti-slip material) are also addressed by the expert. - *This category can have a maximum score of 13 points.*
6 Pedestrians Access	16	*Elevation points and their sizes *Head clearance height *Visibility	This section addresses the public staircases and lifts and pedestrian entrances to the parking garage. Also scores are given to the visibility of elevation points to parking area, the visibility of doors/walls (e.g. glass) and stair steps and of people with poor eyesight. - *This category can have a maximum score of 43 points.*
7 Security Equipment	8	*Surveillance *Security equipment	This section addresses the type of surveillance (e.g. placement of CCTV and the presence of staff) in the parking garage. Extra points are provided for a high staff identification. - *This category can have a maximum score of 35 points.*
8 Wayfinding	8	*Parking spot identification *Guiding systems *Signs and marks	This section looks at the orientation within the car park. For instance, the experts examine the way vacant spots are designated. Also the use of colors, marks or signs for wayfinding are taken into account and scored by the expert. - *This category can have a maximum score of 31 points.*
9 Comfort and miscellaneous	8	*Control systems *Wall, painting and decoration	Several control systems are examined such as pay & display system allowing different payment options, sound system for music in the parking garage, and internet (Wi-Fi) and mobile coverage. Also points are provided when there are customer toilets available and to the use of decoration (e.g. planters artwork). - *This category can have a maximum score of 34 points.*
10 Energy and environment	8	*Lighting system and lamps *Sustainable water (re)use *Service facilities	This section looks at the type of lamps (e.g. LED, TL) used in the parking garage. Additionally points are provided when the parking garage is equipped with energy saving lighting systems, solar panels and movement detection. Also attention is paid services such as charging points for electric cars and car sharing initiatives. - *This category can have a maximum score of 20 points.*
Minus points	-15	*Social safety *Maintenance *Scent	In this category deduction of points are given to aspects such as presence of graffiti, presence of dirt, poor quality of paintwork, poor quality/lack of maintenance and also in the case of bad smells. - *This category can have a maximum score of -60 points.*
Bonus points	15	*Extra provision in car park *Other extra positive services	Bonus points are given when for example there are extra services available such as lockers, bicycle rent, vending machines etc. Also it is appreciated if there is an first aid trained staff in the parking garage. Real time traffic data Escalators. - *This category can have a maximum score of 33 points.*
Total points	**100**		

APPENDIX D: Selecting attributes for research

Constructs	Attributes	Author	Expert1	Expert2	*Attributes selected*
Parking area	Width parking space				Width parking space
	Lenght parking space				
	Type mark parking space				
	Width road lane				Width road lane
	Traffic flow				
	Road pavement				
	Type of floor level identification				*Type of floor level identification*
	Clear signing car & pedestrian				*Clear signing car & pedestrian*
	Presence of columns				*Presence of columns*
Pedestrians environment	Size pedestrians doors				
	Pedestrians routes				*Pedestrians routes*
	Entrance regime pedestrians				*Entrance regime pedestrians*
	Headroom for pedestrian				
	Width staircases				
	Feature staircases				
	Type of embellishment (art, decoration)				
	Walking distance parking space to the stairway				*Walking distance parking space to the stairway*
	Type of elevator points				*Type of elevator points*
Accessibility	Width entrance lanes				*Width entrance lanes*
	Average waiting time at entrance				*Average waiting time at entrance*
	Average waiting time at payment terminals				*Average waiting time at payment terminals*
	Clear height for vehicles				
	Type access control system				*Type access control system*
	# special places reserved				*# special places reserved*
Service	# disable toilets				
	Type of parking guidance systems				
	Quality of mobile network coverage				
	Presence of parking guidance systems				*Presence of parking guidance systems*
	Payment options				*Payment options*
	Presence music and/or fragrance system				*Presence music and/or fragrance system*
	Type of charging points				
	# electrical charging points				*# electrical charging points*
	# toilets inside				*# toilets inside*
	Storage and pick up point				
Safety	Presence of ramps				*Presence of ramps*
	Cleanliness and maintenance				*Cleanliness and maintenance*
	Marked escape routes				*Marked escape routes*
	Security				*Security*
	Presence of staff and/or CCTV				
	Room for staff/operator				
	Level of lighting				*Level of lighting*
Basic attributes	Capacity				Capacity
	Tariff level				Tariff level
	Distance				Distance

APPENDIX E: Questionnaire



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Onderzoek naar parkeertarieven

Nu willen we te weten komen wat uw ervaringen zijn met openbare parkeergarages.

Hoe vaak bezoekt u een openbare parkeergarage?

- Ongeveer 1 keer per jaar
- Ongeveer 1 keer per maand
- Ongeveer 2 á 3 keer per maand
- Ongeveer 1 keer per week
- Ongeveer 2 á 3 keer per week
- Bijna dagelijks
- Weet ik niet

Hoe vaak bezoekt u gemiddeld een openbare parkeergarage voor de onderstaande reismotieven?

Op een schaal van 1 *(nooit)* tot 5 *(altijd)*

Motief	Nooit	Zelden	Regelmatig	Vaak	Altijd
Woon-werk					
Winkelen					
Recreatie en vrije tijd					
Halen of brengen *(bijvoorbeeld naar station, vliegveld)*					

Vorige Volgende

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Onderzoek naar parkeertarieven

Wat was het hoogste uurtarief dat u in het afgelopen jaar hebt betaald?

- € 0,00
- < € 0,50 per uur
- € 0,50 - € 3,00 per uur
- € 3,01 - € 5,50 per uur
- € 5,51 - € 8,00 per uur
- > € 8,00 per uur
- Weet ik niet

Hoe ervaart u in het algemeen parkeren op straat?

Geef per aspect uw ervaring aan.

Aspecten	Zeer negatief	Negatief	Neutraal	Positief	Zeer positief
Parkeertarief *(duur <—> goedkoop)*					
Afstand tot eindbestemming *(ver <—> dichtbij)*					
Afstand tot betaalautomaat *(ver <—> dichtbij)*					
Vinden van een vrije parkeerplaats *(moeilijk <—> makkelijk)*					
Betaalopties *(weinig opties<—> veel opties)*					
Veiligheid *(onveilig <—> veilig)*					

Hoe ervaart u in het algemeen parkeren in een parkeergarage?

Geef per aspect uw ervaring aan.

Aspecten	Zeer negatief	Negatief	Neutraal	Positief	Zeer postief
Parkeertarief *(duur <—> goedkoop)*					
Afstand tot eindbestemming *(ver <—> dichtbij)*					
Breedte en inparkeer-comfort *(krap <—> heel ruim)*					
Voorzieningen voor voetgangers *(geen <—> veel)*					
Wachttijd bij het inrijden en/of betalen *(lang <—> heel kort)*					
Vinden van een vrije parkeerplaats *(moeilijk <—> makkelijk)*					
Betaalopties *(weinig opties <—> veel opties)*					
Veiligheid *(onveilig <—> veilig)*					

Vorige Volgende

2. Keuzesituaties

In dit onderdeel van de enquête wordt onderzocht welke *ontwerp-gerelateerde kenmerken* van een parkeergarage u belangrijk vindt en of u bereid bent om hiervoor meer te betalen. U krijgt **verschillende keuzesituaties** voorgelegd, waarbij u telkens kunt kiezen uit twee parkeergarages (**A** of **B**). U wordt gevraagd aan te geven welke van deze twee garages uw voorkeur heeft.

Deze twee alternatieve parkeergarages worden aan de hand van twee groepen van kenmerken beschreven, namelijk:

1. Aan de hand van **algemene kenmerken** welke gaan over de parkeersituatie en hebben betrekking op: de grootte, locatie en het uurtarief van een parkeergarage.
2. Aan de hand van **ontwerpkenmerken** welke gaan over wat u ziet en ervaart binnen in een parkeergarage en hebben betrekking op hoe een parkeergarage er van binnen uitziet.

Voor het gemak hebben we de ontwerpkenmerken ingedeeld in categorieën. Op de volgende pagina wordt dit verder kort toegelicht.

Vorige | Volgende

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Onderzoek naar parkeertarieven
Keuzesituaties

UITLEG

Met een oefenvraag willen we u kennis laten maken met de keuzesituaties in deze enquête. U krijgt steeds een tabel te zien met twee alternatieve parkeergarages (**A** en **B**). Elk alternatief is opgebouwd uit verschillende categorieën en kenmerken.

We hebben **vijf categorieën** samengesteld. De categorieën hebben betrekking op de inrichting (binnenkant) van een parkeergarage:

1. **Ruimte in de parkeergarage**
2. **Ruimte voor voetgangers**
3. **Toegankelijkheid**
4. **Faciliteiten**
5. **Veiligheid**

Elke categorie bestaat uit **vijf kenmerken**. Deze kenmerken kunnen verschillende waarden aannemen. Bijvoorbeeld de categorie **'Ruimte voor voetgangers'** heeft de volgende kenmerken met de bijbehorende waarden:

a. **Looproute voor voetgangers:** geen eigen looproute -- eigen looproute -- eigen- en gemarkeerde looproute
b. **Toegang voor voetgangers:** open doorgangen -- handmatige deuren -- automatische deuren
c. **Breedte trappen:** smal (1,00 m) -- normaal (1,50 m) -- extra breed (2,00 m)
d. **Type stijgpunten:** trap -- lift -- trap en lift
e. **Loopafstand parkeerplaats tot trappenhuis (exit):**15 meter -- 30 meter -- 45 meter

In elke tabel wordt telkens **één categorie** gedetailleerd aangeduid (zoals hierboven). Daaronder staan de **overige 4 categorieën** met een globale aanduiding. Hiermee wordt het aanbod aan voorzieningen per categorie bedoeld:

- (Ruim aanbod)
- (Gemiddeld aanbod)
- (Beperkt aanbod)

Als bijvoorbeeld bij de categorie **'Veiligheid'** aangeduid wordt met *'Ruim aanbod'* (weergegeven door:), dan betekent dit dat het veiligheidsniveau zeer hoog is: *camera's en beveliging aanwezig, zeer goed verlicht, etc.*. En een aanduiding met *'Beperkt aanbod'* (weergegeven door:) betekent dat er weinig veiligheidsvoorzieningen aanwezig zijn:*veel donkere plekken, geen beveliging, veel rommel en vuil etc.*

U krijgt meerdere tabellen te zien. Elke categorie zal gedetailleerd aan bod komen. Op de volgende pagina vindt u eerst nog een oefenvraag.

Vorige | Volgende

OEFENVRAAG

In onderstaande tabel ziet u een voorbeeld van een keuzesituatie waarin 2 alternatieve parkeergarages worden getoond (**A** en **B**). Bekijk en vergelijk de kenmerken van beide parkeergarages goed zodat u een onderbouwde keuze kunt maken. Onder aan de tabel kunt u de parkeergarage die uw voorkeur heeft aanvinken.

Stelt u zich voor dat u met de auto een binnenstad bezoekt en dat u wilt gaan parkeren in een openbare parkeergarage. Welke van onderstaande parkeergarages heeft uw voorkeur?

	Parkeergarage A	Parkeergarage B
Basiskenmerken		
Capaciteit parkeergarage	*300 plaatsen*	*900 plaatsen*
Loopafstand tot eindbestemming	*50 meter*	*250 meter*
Uurtarief	*€ 2,50*	*€ 4,50*
Categorie: Ruimte voor voetgangers		
Looproute voor voetgangers	*Geen eigen looproute*	*Eigen- en gemarkeerde looproute*
Toegang voor voetgangers	*Open doorgangen*	*Automatische deuren*
Breedte trappen	*Normaal (1,50 m)*	*Smal (1,00 m)*
Type stijgpunten	*Trap*	*Trap en lift*
Loopafstand tot trappenhuis	*15 meter*	*45 meter*
Overige categorieën		
Ruimte in de parkeerplaats		
Toegankelijkheid		
Service		
Veiligheid		
Welke garage heeft uw voorkeur?	○	○

Dit was een oefenvraag. We hopen dat u met de uitleg die u hebt gekregen nu de **volgende 10 gelijksoortige keuzesituaties** kunt beoordelen.

Vorige Volgende

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Onderzoek naar parkeertarieven

De eerste twee keuzesituaties gaan over de categorie **Ruimte in de parkeergarage**.

Hierbij horen de volgende kenmerken en waarden bij:

a. **Breedte parkeervak**: Smal (2,20 m) -- Gemiddeld (2,35 m) -- Extra breed (2,50 m)
b. **Breedte rijbaan** : Smal (<3,50 m) -- Gemiddeld (3,50 m) -- Extra breed (>3,50 m)
c. **Bewegwijzering voor auto en voetganger** : Beperkt zichtbaar -- Redelijk zichtbaar -- Goed zichtbaar
d. **Aanduiding van parkeerplaats en/of vloerniveau** : Geen, Kleuren -- Kleuren en thematische symbolen
e. **Aanwezigheid van kolommen** : Geen kolommen -- Weinig kolommen aanwezig -- Veel kolommen aanwezig

Ter herinnering

De **overige 4 categorieën** hebben een globale aanduiding. Hiermee wordt het aanbod aan voorzieningen per categorie bedoeld:

- (Ruim aanbod)
- (Gemiddeld aanbod)
- (Beperkt aanbod)

Als bijvoorbeeld bij de categorie **'Toegankelijkheid'** aangeduid wordt met *'Ruim aanbod'* (weergegeven door:), dan betekent dit een zeer toegankelijke parkeergarage: *brede inrit(ten), snel in- en uitrijden, speciale parkeerplaatsen gereserveerd etc.* En een aanduiding met *'Beperkt aabod'* (weergegeven door:) betekent een slechte toegankelijkheid: *lange wachttijden bij betaalautomaten en in- en uitritten, smalle in- en uitritten, etc.*

Vorige Volgende

Technische Universiteit Eindhoven University of Technology

Onderzoek naar parkeertarieven

Keuzesituatie: Ruimte in de parkeerplaats

Stelt u zich voor dat u met de auto een binnenstad bezoekt en dat u wilt gaan parkeren in een openbare parkeergarage. Welke van onderstaande parkeergarages heeft uw voorkeur?

	Parkeergarage A	Parkeergarage B
Basiskenmerken		
Capaciteit parkeergarage	*600 plaatsen*	*300 plaatsen*
Loopafstand tot eindbestemming	*50 meter*	*250 meter*
Uurtarief	*€ 2,50*	*€ 2,50*
Categorie: Ruimte in de parkeerplaats		
Breedte parkeervak	*Gemiddeld (2,35 m)*	*Extra breed (2,50 m)*
Breedte rijbaan	*Extra breed (> 3,50 m)*	*Gemiddeld (3,50 m)*
Bewegwijzering voor auto en voetganger	*Beperkt zichtbaar*	*Redelijk zichtbaar*
Aanduiding van parkeerplaats en/of vloerniveau	*Kleuren en thematische symbolen*	*Kleuren en thematische symbolen*
Aanwezigheid van kolommen	*Veel kolommen aanwezig*	*Veel kolommen aanwezig*
Overige categorieën		
Ruimte voor voetgangers		
Toegankelijkheid		
Service		
Veiligheid		
Welke garage heeft uw voorkeur?	○	○

Vorige | Volgende

Technische Universiteit Eindhoven University of Technology

Onderzoek naar parkeertarieven

De volgende twee keuzesituaties gaan over de categorie **Ruimte voor de voetganger**.

Hierbij horen de volgende kenmerken en waarden bij:

a. **Looproute voor voetgangers**: geen eigen looproute -- eigen looproute -- eigen- en gemarkeerde looproute
b. **Toegang voor voetgangers**: open doorgangen -- handmatige deuren -- automatische deuren
c. **Breedte trappen**: smal (1,00 m) -- normaal (1,50 m) -- extra breed (2,00 m)
d. **Type stijgpunten**: trap -- lift -- trap en lift
e. **Loopafstand parkeerplaats tot trappenhuis (exit)**: 15 meter -- 30 meter -- 45 meter

Vorige | Volgende

Keuzesituatie: Ruimte voor voetgangers

Stelt u zich voor dat u met de auto een binnenstad bezoekt en dat u wilt gaan parkeren in een openbare parkeergarage. Welke van onderstaande parkeergarages heeft uw voorkeur?

	Parkeergarage A	Parkeergarage B
Basiskenmerken		
Capaciteit parkeergarage	*900 plaatsen*	*300 plaatsen*
Loopafstand tot eindbestemming	*450 meter*	*50 meter*
Uurtarief	*€ 2,50*	*€ 2,50*
Categorie: Ruimte voor voetgangers		
Looproute voor voetgangers	*Geen eigen looproute*	*Eigen- en gemarkeerde looproute*
Toegang voor voetgangers	*Automatische deuren*	*Open doorgangen*
Breedte trappen	*Normaal (1,50 m)*	*Normaal (1,50 m)*
Type stijgpunten	*Trap*	*Trap en lift*
Loopafstand tot trappenhuis	*30 meter*	*30 meter*
Overige categorieën		
Ruimte in de parkeerplaats		
Toegankelijkheid		
Service		
Veiligheid		
Welke garage heeft uw voorkeur?	○	○

Vorige Volgende

Technische Universiteit Eindhoven University of Technology
Onderzoek naar parkeertarieven

De volgende twee keuzesituaties gaan over de categorie **Toegankelijkheid**.

Hierbij horen de volgende kenmerken en waarden bij:

a. **Type toegangscontrolesysteem**: Kentekenherkenning -- Personeel bediening -- Toegangskaartje
b. **Breedte inrit**: Smal (<3,00 m) -- Normaal (3,00 m) -- Extra breed (>3,00 m)
c. **Gemiddelde wachttijd bij de inrit**: Kort (<30 seconden) -- Gemiddeld (30 seconden) -- Lang (>30 seconden)
d. **Gemiddelde wachttijd bij een betaalautomaat**: Kort (<1 minuut) -- Gemiddeld (1 minuut) -- Lang (>1 minuut)
e. **Aantal speciale parkeerplaatsen gereserveerd**: Geen -- 1% van het totale aantal parkeerplaatsen -- 5% van het totale aantal parkeerplaatse

***Ter verduidelijking**

Met het kenmerk *'Aantal speciale parkeerplaatsen gereserveerd'* wordt bedoeld: Het aantal parkeerplaatsen gereserveerd voor speciale doelgroepen, bijvoorbeeld:

- Voor mensen met een handicap;
- Car sharing standplaatsen;
- Voor gezinnen met kinderen.

Vorige Volgende

Technische Universiteit Eindhoven University of Technology

Onderzoek naar parkeertarieven

Keuzesituatie: Toegankelijkheid

Stelt u zich voor dat u met de auto een binnenstad bezoekt en dat u wilt gaan parkeren in een openbare parkeergarage. Welke van onderstaande parkeergarages heeft uw voorkeur?

	Parkeergarage A	Parkeergarage B
Basiskenmerken		
Capaciteit parkeergarage	*600 plaatsen*	*300 plaatsen*
Loopafstand tot eindbestemming	*450 meter*	*450 meter*
Uurtarief	*€ 0,50*	*€ 4,50*
Categorie: Toegankelijkhed		
Type toegangscontrolesysteem	*Toegangskaartje*	*Personeel bediening*
Breedte inrit	*Extra breed (>3,00 m)*	*Smal (<3,00 m)*
Gemiddelde wachttijd bij de inrit	*Kort (< 30 seconden)*	*Kort (< 30 seconden)*
Gemiddelde wachttijd bij een betaalautomaat	*Lang (> 1 minuut)*	*Kort (< 1 minuut)*
Aantal speciale parkeerplaatsen gereserveerd	*1%*	*5%*
Overige categorieën		
Ruimte in de parkeerplaats		
Ruimte voor voetgangers		
Service		
Veiligheid		
Welke garage heeft uw voorkeur?	○	○

Vorige Volgende

Technische Universiteit Eindhoven University of Technology

Onderzoek naar parkeertarieven

De volgende twee keuzesituaties gaan over de categorie **Service**.

Hierbij horen de volgende kenmerken en waarden bij:

a. **Aanwezigheid van parkeerverwijssysteem**: Geen -- Op vloer niveau -- Op parkeerplaats niveau
b. **Betaalopties**: Cash -- Cash en bankkaart -- Cash -- bankkaart en mobiel
c. **Muziek en parfum**: Geen -- Achtergrond muziek -- Muziek en geparfumeerd
d. **Laadpunten voor elektrische auto**: Geen -- 1% van het totale aantal parkeerplaatsen, 5% van het totale aantal parkeerplaatsen
e. **Aanwezigheid van toiletten**: Geen -- 1 gedeeld toilet -- Aparte toiletten man/vrouw

***Ter verduidelijking**

Met de waarden van het kenmerk *'Aanwezigheid van parkeerverwijssysteem'* wordt bedoeld, bijvoorbeeld:

- 

(Parkeerverwijssysteem op vloer niveau)

- 

(Parkeerverwijssysteem op parkeerplaats niveau)

Vorige Volgende

Keuzesituatie: Service

Stelt u zich voor dat u met de auto een binnenstad bezoekt en dat u wilt gaan parkeren in een openbare parkeergarage. Welke van onderstaande parkeergarages heeft uw voorkeur?

	Parkeergarage A	Parkeergarage B
Basiskenmerken		
Capaciteit parkeergarage	*300 plaatsen*	*600 plaatsen*
Loopafstand tot eindbestemming	*250 meter*	*450 meter*
Uurtarief	*€ 4,50*	*€ 0,50*
Categorie: Service		
Aanwezigheid van parkeerverwijssysteem	*Op vloer niveau*	*Op parkeerplaats niveau*
Betaalopties	*Cash en bankkaart*	*Cash*
Muziek en parfum	*Muziek en geparfumeerd*	*Achtergrond muziek*
Laadpunten voor elektrische auto	*1%*	*1%*
Aanwezigheid van toiletten	*Geen*	*Aparte toiletten man/vrouw*
Overige categorieën		
Ruimte in de parkeerplaats		
Ruimte voor voetgangers		
Toegankelijkheid		
Veiligheid		
Welke garage heeft uw voorkeur?	○	○

Vorige Volgende

TU/e Technische Universiteit Eindhoven University of Technology
Onderzoek naar parkeertarieven

De laatste twee keuzesituaties gaan over de categorie **Veiligheid**.

Hierbij horen de volgende kenmerken en waarden bij:

a. **Verlichtingsniveau**: Geen donkere plekken -- Beperkt donkere plekken -- Veel donkere plekken
b. **Beveiliging**: Videobewaking -- Personeel -- Personeel en videobewaking
c. **Aanwezigheid van drempels**: Geen -- Beperkt aantal -- Groot aantal
d. **Markering vluchtroute**: Borden -- Verlichting -- Verlichting en nalichtende belijning
e. **Schoon en onderhoud**: Geen rommel en vuil -- Beperkt hoeveelheid rommel en vuil -- Veel rommel en vuil

***Ter verduidelijking**

Met de waarden van het kenmerk *'Markering vluchtroute'* wordt bedoeld, bijvoorbeeld:

-  (Verlichting)
-  (Verlichting en nalichtende belijning)

Vorige Volgende

Keuzesituatie: Veiligheid

Stelt u zich voor dat u met de auto een binnenstad bezoekt en dat u wilt gaan parkeren in een openbare parkeergarage. Welke van onderstaande parkeergarages heeft uw voorkeur?

	Parkeergarage A	Parkeergarage B
Basiskenmerken		
Capaciteit parkeergarage	*600 plaatsen*	*300 plaatsen*
Loopafstand tot eindbestemming	*50 meter*	*50 meter*
Uurtarief	*€ 4,50*	*€ 2,50*
Categorie: Veiligheid		
Verlichtingsniveau	*Geen donkere plekken*	*Veel donkere plekken*
Beveiliging	*Videobewaking*	*Videobewaking*
Aanwezigheid van drempels	*Groot aantal*	*Beperkt aantal*
Markering vluchtroute	*Borden*	*Verlichting en nalichtende belijning*
Schoon en onderhoud	*Beperkt hoeveelheid rommel en vuil*	*Beperkt hoeveelheid rommel en vuil*
Overige categorieën		
Ruimte in de parkeerplaats		
Ruimte voor voetgangers		
Toegankelijkheid		
Service		
Welke garage heeft uw voorkeur?	○	○

Vorige Volgende

Technische Universiteit Eindhoven University of Technology
Onderzoek naar parkeertarieven

3. Persoonskenmerken

Tot slot willen we nog enkele persoonlijke gegevens van u weten om zodoende een duidelijke beeld te verkrijgen van de samenstelling van de onderzoeksgroep.

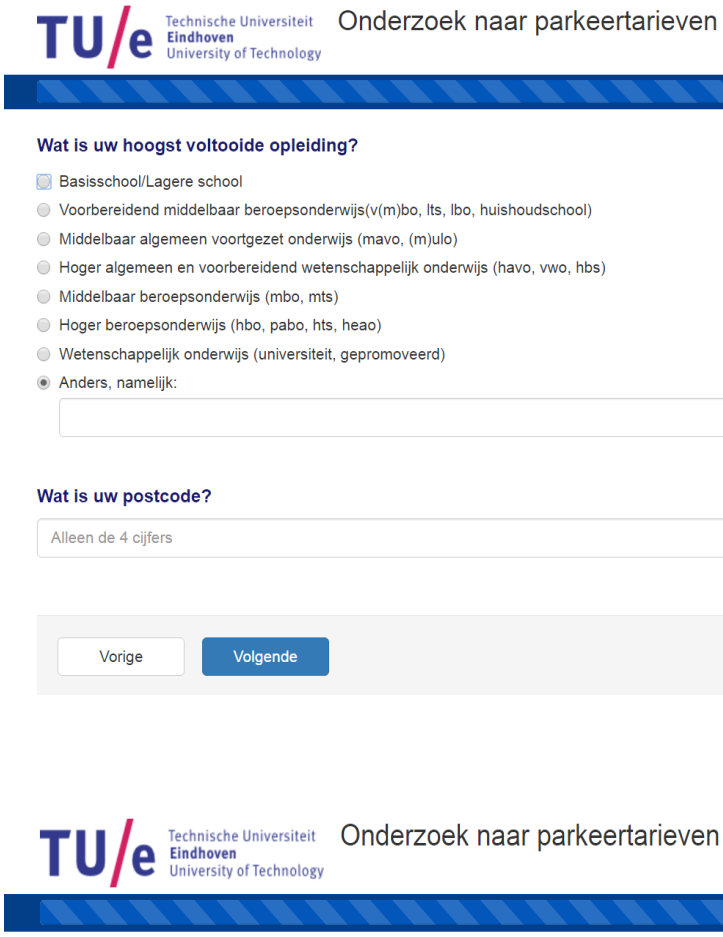
Wat is uw geslacht?

- ☐ Man
- ○ Vrouw

In welke jaar bent u geboren?

Bijvoorbeeld 1998

Vorige Volgende


Technische Universiteit Eindhoven University of Technology
Onderzoek naar parkeertarieven
Wat is uw hoogst voltooide opleiding?
Basisschool/Lagere school
Voorbereidend middelbaar beroepsonderwijs(v(m)bo, lts, lbo, huishoudschool)
Middelbaar algemeen voortgezet onderwijs (mavo, (m)ulo)
Hoger algemeen en voorbereidend wetenschappelijk onderwijs (havo, vwo, hbs)
Middelbaar beroepsonderwijs (mbo, mts)
Hoger beroepsonderwijs (hbo, pabo, hts, heao)
Wetenschappelijk onderwijs (universiteit, gepromoveerd)
Anders, namelijk:
Wat is uw postcode?
Alleen de 4 cijfers
Vorige
Volgende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Onderzoek naar parkeertarieven
Hoeveel jaren bent u in bezit van uw rijbewijs?
Kiest u het aantal jaren
Heeft u een beperking?
Meerdere antwoorden mogelijk
Geen beperking
Visuele beperking
Auditieve beperking
Fysieke beperking
Anders, namelijk:
Vorige
Volgende

APPENDIX F: Questionnaire on the Vexpan website

VEXPAN
PLATFORM PARKEREN NEDERLAND

18th EPA Congress and Exhibition

LOGIN NL EN

OVER VEXPAN KENNIS KWALITEIT EVENEMENTEN VEXPANSIE LEDENSERVICE CONTACT

ONDERZOEK RELATIE ONTWERP OPENBARE PARKEERGARAGE EN PARKEERTARIEVEN

Soufyan Agarad, masterstudent Real Estate Management & Development aan de Technische Universiteit Eindhoven doet in het kader van zijn masteropleiding onderzoek naar de relatie tussen het ontwerp van een openbare parkeergarage en parkeertarieven. Hieronder vindt u zijn verzoek aan u om aan dit onderzoek mee te werken.

Beste geïnteresseerde,

Mijn naam is Soufyan Agarad. Ik ben masterstudent Real Estate Management & Development aan de Technische Universiteit Eindhoven.

In het kader van mijn masteropleiding wil ik jullie medewerking vragen voor mijn onderzoek naar de relatie tussen het ontwerp van een openbare parkeergarage en parkeertarieven. Voor dit onderzoek wil ik weten welke ontwerp-

EVENEMENTEN

12 JAN — VEXPAN NIEUWJAARSRECEPTIE

25 JAN — VAKBEURS GEBOUWBEHEER & FACILITAIR UTRECHT

9 FEB — LUNCHBIJEENKOMST NIEUWEGEIN

20 SEP — EPA CONGRESS & EXHIBITION 2017 ROTTERDAM

LEDENSERVICE

APPENDIX G: Values analyzed

Table 9 The number of respondents (n=299) included in the analyses.

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Bezit van een rijbewijs * finished	299	100,0%	0	0,0%	299	100,0%
Gebruik van een openbare garage? * finished	299	100,0%	0	0,0%	299	100,0%

Table 10 Parking frequency in public car park

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Ongeveer 1 keer per jaar	36	12,0	12,0	12,0
	Ongeveer 1 keer per maand	107	35,8	35,8	47,8
	Ongeveer 2 Ã¡ 3 keer per maand	89	29,8	29,8	77,6
	Ongeveer 1 keer per week	28	9,4	9,4	87,0
	Ongeveer 2 Ã¡ 3 keer per week	18	6,0	6,0	93,0
	Bijna dagelijks	17	5,7	5,7	98,7
	Weet ik niet	4	1,3	1,3	100,0
	Total	299	100,0	100,0	

Table 11 Highest paid parking tariff over the past year

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	< â,¬ 0,50 per uur	2	,7	,7	,7
	â,¬ 0,50 - â,¬ 3,00 per uur	74	24,7	24,7	25,4
	â,¬ 3,01 - â,¬ 5,50 per uur	96	32,1	32,1	57,5
	â,¬ 5,51 - â,¬ 8,00 per uur	59	19,7	19,7	77,3
	> â,¬ 8,00 per uur	24	8,0	8,0	85,3
	Weet ik niet	44	14,7	14,7	100,0
	Total	299	100,0	100,0	

Table 12 Travel motive Home and work

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Nooit 1	173	57,9	57,9	57,9
	Zelden 2	51	17,1	17,1	74,9
	Regelmatig 3	39	13,0	13,0	88,0
	Vaak 4	26	8,7	8,7	96,7
	Altijd 5	10	3,3	3,3	100,0
	Total	299	100,0	100,0	

Table 13 Travel motive Shopping

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Nooit 1	16	5,4	5,4	5,4
	Zelden 2	83	27,8	27,8	33,1
	Regelmatig 3	135	45,2	45,2	78,3
	Vaak 4	52	17,4	17,4	95,7
	Altijd 5	13	4,3	4,3	100,0
	Total	299	100,0	100,0	

Table 14 Travel motive Recreation and leisure

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Nooit 1	28	9,4	9,4	9,4
	Zelden 2	127	42,5	42,5	51,8
	Regelmatig 3	100	33,4	33,4	85,3
	Vaak 4	37	12,4	12,4	97,7
	Altijd 5	7	2,3	2,3	100,0
	Total	299	100,0	100,0	

Table 15 Travel motive Pick and drop

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Nooit 1	87	29,1	29,1	29,1
	Zelden 2	146	48,8	48,8	77,9
	Regelmatig 3	50	16,7	16,7	94,6
	Vaak 4	10	3,3	3,3	98,0
	Altijd 5	6	2,0	2,0	100,0
	Total	299	100,0	100,0	

Table 16 Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Beoordeling tarief op straat	299	1	5	2,54	,920
Garage beoordeling hoogte tarief	299	1	5	2,16	,875
Beoordeling afstand tot eindbestemming op straat	299	1	5	3,30	,795
Garage beoordeling afstand tot eindbestemming	299	1	5	3,21	,798
Beoordeling vinden van een plek op straat	299	1	5	2,56	1,003
Garage beoordeling vinden van een plek	299	1	5	3,19	,915
Beoordeling betaalmogelijkheden op straat	299	1	5	3,03	1,052
Garage beoordeling betaalmogelijkheden	299	1	5	3,47	,876
Beoordeling veiligheid op straat	299	1	5	3,11	,830
Garage beoordeling veiligheid	299	1	5	3,45	,848
Garage beoordeling breedte en inparkeer-comfort	299	1	5	2,48	,924
Garage beoordeling wachttijden	299	1	5	3,49	,825
Garage beoordeling voorzieningen voor voetgangers	299	1	5	2,88	,823
Valid N (listwise)	299				

Table 17 Other kind of Disability

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		290	97,0	97,0	97,0
	-	1	,3	,3	97,3
	Asperger	1	,3	,3	97,7
	brildragend	1	,3	,3	98,0
	Echtgenote maakt gebruik van een rolstoel	1	,3	,3	98,3
	een hekel aan parkeergarages met slagbomen	1	,3	,3	98,7
	geen	1	,3	,3	99,0
	Ik zie met 1 oog geen diepte	1	,3	,3	99,3
	ptss	1	,3	,3	99,7
	Tijdelijke (hoop ik) - nieuwe heup nodig.	1	,3	,3	100,0
	Total	299	100,0	100,0	