Factors that influence choice of travel mode in major urban areas

The attractiveness of Park & Ride

Anna-Lena Lindström Olsson

Division of Transportation and Logistics
2003
Abstract

Problems associated with traffic, such as traffic congestion and pollution, have occurred in major urban areas in particular due to the increased use of cars. One possible way to reduce the use of cars is to replace commuter trips by car with other modes of transport, such as a combination of car and public transport called Park & Ride. The aim of this thesis was to understand more about factors influencing the choice of mode and to find measures that could attract car drivers to Park & Ride. A stated preference survey has been conducted in order to quantify some standard factors. The factors used in this stated choice experiment were: security at the lot, availability of spaces at the parking lot, costs at the parking lot and walking distances between the parking space and the station. The results indicate that security at the Park & Ride facility is important. Both sexes assign a high value to secure parking, but women are more willing to pay for lights at an unguarded parking lot. The results reveal that parking facilities, such as free parking and short distance between parking place and work at work, influence people’s choice of mode. A general conclusion is that there is potential for increasing the use of Park & Ride facilities, especially among women and respondents over 30 years.

Key words:
Mode choice, valuation, traffic reduction, stated preference, factors, Park & Ride
Acknowledgements

VINNOVA, Banverket and the Swedish National Road Administration have financially supported this work with one third each. Within the project “Analysis of transfer of car trips to other modes of transport in major urban areas” studies of mode choice have been done. The research has been done at the Department of Infrastructure and Planning and division of Transportation and Logistics at the Royal Institute of Technology. My formal supervisor and examiner has been professor Karl-Lennart Bång to whom I am grateful for comments and advice on my work.

I would like to thank my colleagues in the research group of public transport, my supervisor Karl Kottenhoff and Katrin Dziekan for inspiring discussions and for valuable comments on drafts of the text. Oskar, Karin and Christer have also contributed with valuable comments on my work. Many thanks to all colleagues at the division of Transport and Logistics for just being around and making life enjoyable.

In addition to all my colleagues I would also like to thank Camilla, Muriel and Johanna for their valuable help during difficult parts of my thesis and for their encouragement on the way to this day. Johanna helped also with the Stated Preference questionnaire and analysis. I am also thankful to the help from Tommy Jungeryd at Protoma Research and his team for their help with the interviews.

I am very grateful to my dearest family, Lasse and our children Anna, Alexander and Patrik for letting me spend so much time working on my thesis over the years.

Anna-Lena Lindström Olsson

Stockholm, juni 2003
# TABLE OF CONTENTS

**PART I: Overview of the thesis**

1 **INTRODUCTION** ........................................................................................................3
   1.1 **BACKGROUND** .................................................................................................3
   1.2 **STUDIES WITHIN THIS THESIS** .................................................................4
   1.2.1 **PART II: Literature review** .........................................................................4
   1.2.2 **PART III: Attracting car drivers to Park & Ride – interviews with users and non-users of Park & Ride facilities** .........................................................4
   1.2.3 **PART IV: Commuters’ monetary valuation of Park & Ride attributes** ....4
   1.3 **DEFINITIONS** ...................................................................................................5

2 **MAIN RESULTS AND CONCLUSIONS** .................................................................6
   2.1 **RESULTS** ..........................................................................................................6
      2.1.1 **Introduction** ...............................................................................................6
      2.1.2 **Measures** ....................................................................................................7
   2.2 **CONCLUSIONS** .................................................................................................8
      2.2.1 **Monetary valuation of quality factors at Park & Ride facilities** .............8
      2.2.2 **Internal validation** ....................................................................................9

3 **FURTHER RESEARCH** ............................................................................................10
   3.1.1 **Competition between Park & Ride and public transport** .......................10
   3.1.2 **Travelling with children easier** .....................................................................10
   3.1.3 **Parking conditions at home** .........................................................................10
   3.1.4 **The effects of measures on mode split** .....................................................10
   3.1.5 **Developing models** ......................................................................................11
   3.1.6 **Influencing individuals** .................................................................................11

**PART II: Mode choice from an individual perspective – transferring car trips to other modes of travel - a literature review**

**PART III: Attracting car drivers to Park & Ride – interviews with users and non-users of Park & Ride facilities**

**PART IV: Commuters’ monetary valuation of Park & Ride attributes**
1 INTRODUCTION

1.1 BACKGROUND

The growth in car traffic is increasing the environmental impacts such as noise and exhaust emissions. Physical intrusion, barrier effects and congestion are other examples of the effects of these developments. These problems have led to growing interest from politicians, planners and the general public in finding acceptable methods to restrain individual car traffic in central urban areas in large cities.

Measures to shift car trips to other modes of transport, such as public transport and bicycles, have been studied in many cities. A number of fundamental problems become obvious in this context, as the choice of transport mode is influenced by many factors.

One problem when it comes to shifting from car to other modes is that many people believe they do not have any realistic alternatives to using the car. Another general problem is that car trips are perceived as being cheap for those that already have a car. Once the car has been purchased, little consideration is taken of its cost or the number of taxi journeys that could be made for the same amount of money. The car therefore usually appears to be an economical alternative compared with public transport.

The car has also many advantages such as high comfort and flexibility. The car also satisfies other needs such as status, prestige and feeling of control of one’s journey. Therefore it is hard for the public transport to compete with the car.

In many major cities where there is a public transport system the system is built up by a few major lines, which are reached by feeder buses. In order to reach a station a person has to walk, bike, take the feeder bus or the car etc. A person might have errands on the way and/or a long waiting time at the station. The person might consider these to be barriers making him/her choose to travel by car for the whole trip.

One proposed solution to some of the transport problems discussed could be to replace long car trips with a combination of car and public transport, consisting of one short car trip and one longer trip by public transport (hereinafter called Park & Ride). Park & Ride could be an alternative for those having errands on the way or where the local bus is not frequent enough. Park & Ride could be either used in less densely-populated areas, where public transport is not profitable because of the lower demand, or it could be located closer to the city centre on the main routes where congestion starts.

Looked on objectively Park & Ride seems to be a good alternative to the car however very few commuters use Park & Ride. Then the question arises: how can frequently private car users be transferred to Park & Ride?
Therefore the overall aim of this licentiate thesis is to:

- understand more about factors influencing the choice of mode and
- to find measures that could attract car drivers to Park & Ride.

1.2 STUDIES WITHIN THIS THESIS

From the literature review, some factors were identified as playing an important part in the choice of Park & Ride. In the first Park & Ride study, the interviewees were asked to grade these factors. In the second Park & Ride study, the willingness to pay for the four factors, security at the lot, availability of spaces at the parking lot, costs at the parking lot and walking distances between parking space and station, was determined.

1.2.1 PART II: Literature review

The literature review deals with factors that influence the choice of mode and different methods and theories for studying the choice of mode. Methods for collecting and analysing data are also discussed. Three quality factors in particular were found to be of interest for further investigation. These factors were walking distances to station or platform, parking conditions at home and work and security at the Park & Ride lot.

1.2.2 PART III: Attracting car drivers to Park & Ride – interviews with users and non-users of Park & Ride facilities

The purpose of this study was to investigate and understand some underlying factors influencing car drivers to use Park & Ride. The aim was to find out how to attract more private car drivers to Park & Ride facilities. The study describes both users' of these facilities and frequent car drivers' reasons for using or not using Park & Ride lots. Telephone interviews targeting the two kinds of groups, users and non-users of Park & Ride, were carried out. The non-users live in what is called the influence area of the studied lots.

1.2.3 PART IV: Commuters’ monetary valuation of Park & Ride attributes

The purpose of this study was to determine commuters’ willingness to pay for different factors describing the quality of Park & Ride facilities. The aim of the study was also to investigate how some background factors influence the choice of mode and how parking at the destination and home influence the choice of mode. A postal study using a stated preference approach was carried out and, in addition to hypothetical questions, personal characteristics were collected, together with the commuters’ travel information relating to all their travel opportunities and their usual mode for work trips. This study presents the survey design, general descriptive statistics about the commuters, commuters’ willingness to pay and, to some extent, the influence these factors have on the choice of mode.
1.3 DEFINITIONS

This section defines some of the terms used in the thesis.

**Attitudes** are a term used in psychology to refer to people’s views or thoughts about a particular thing or object. Attitudes contain an emotion dimension and an attitude may be positive, negative or neutral. Attitudes are results of previous experiences and what we have heard others say, and they are relatively stable.

**Attribute** is a distinguishing characteristic of something, e.g. a mode of transport.

**Benefit** is also a term used by economists. It has approximately the same meaning as value, and can be said to represent the total effect of different values. A benefit is often dimensionless, but a benefit to the public economy is usually expressed in monetary terms.

**Factor** is here synonymous with attribute and variable.

**Measure** belongs to the group of factors. Measures are here defined as factors that can affect the individual, such as physical measures, behavioural measures and policy measures.

**Park & Ride** is a mode where the person takes the car to a specific car park close to a station and travels from there to his or her destination by public transport.

**Preferences** are what people like most or better than something else.

**Quality** is the difference between the traveller’s expectations and what he or she perceives that they receive from the transport system. Quality factors are factors that have to do with the individual’s perception of the journey in relation to the pre-planned standard of the transport system.

**Values** can be used generally about many phenomena, e.g. if something is positive or negative from a particular individual’s point of view. More specifically, economists use it as a concept in connection with consumption. A person will choose what he or she values highly. Economists therefore normally quantify individuals’ or groups’ values. Valuations of different factors related to travelling remain relatively stable over time.

**Variable** is a mathematical representation of a factor or attribute that gives varying numerical values. In this thesis, a variable is defined as a characteristic of the individual, the transport system or the surrounding environment.
2 MAIN RESULTS AND CONCLUSIONS

2.1 RESULTS

2.1.1 Introduction

Many societies have been built around the car, which has made choosing other travel modes difficult. Men, to a greater extent than women, value and choose modes of transport that are individual, for example cars, bicycles and motorcycles. Women’s mobility is less car-oriented than men’s. Women still take greater responsibility for children and the home. The car is implemented at an early stage in children’s lives and they learn that the car is a status symbol.

According to a study, 20% of car journeys are unavoidable; 60% can be influenced in some way and are dependent on the standard of public transport, working hours and the location of services; 20 % could be replaced by some other mode. Journeys to and from work are considered easiest to transfer from the car while journeys to leave and fetch children are hardest.

The literature review and the two Park & Ride studies have contributed with:

- An overview and knowledge of factors influencing the choice of mode
- Showing potential for increasing Park & Ride
- Estimating willingness to pay for quality factors at the Park & Ride lot
- Pointing at measures that could attract car drivers to Park & Ride
- Further research

The main aim of the literature review was to explore factors that influence the choice of mode and different methods for explaining the choice of mode. There are many factors that determine the choice of travel mode. Several of them are strongly correlated, as shown in other studies. Previous studies of factors influencing the choice of mode have led to the factors that have been studied in the two Park & Ride studies in this thesis.

The age at which a person starts to drive a car influences the choice of mode. If a person starts at an early age, this appears to be a habit that is firmly established and is difficult to change.

Parking conditions at work influence the choice of mode. In overall terms, the majority of the commuters who use a car as the main mode do not have any monthly parking costs at work while about half the Park & Ride users have parking costs. Overall private car drivers have shorter distances between parking place and work. A conclusion is that if a commuter has good parking conditions at work he/she is more likely to use car as the usual mode. Other studies support this finding.
These two studies show that there is potential for increasing the use of Park & Ride. Many non-users say they are prepared to use Park & Ride at least once a week. In overall terms, when commuters are guaranteed a parking space at a lot, they become more willing to use Park & Ride than before. Even those that already use Park & Ride frequently are willing to use it more. However, it must be remembered that people do not always act as they say they will.

If the Park & Ride lot had not existed, 9% of the users say that they would drive all the way to work. This indicates a change in modes. However, almost half the Park & Ride users would choose public transport for the whole trip if the Park & Ride lot were not available.

As 20% of the users of Park & Ride leave children at day care on their way to work, there are probably also non-users that leave children at day care on their way to work and would consider using Park & Ride if a Park & Ride lot were better located for them.

2.1.2 Measures

A high travel standard is the single most important factor when it comes to increasing the market share of public transport. However, measures of different kinds are needed to attract car drivers to other modes of transport. They include a combination of restrictions on the car, such as road tolls, car-free zones, parking fees, improved conditions for pedestrians, cyclists and public transport, communication in the form of campaigns and information, not to mention incentives. Badly implemented measures can both be ineffective and create opposition to public transport measures.

It appears that the individuals who are easiest to influence are already using public transport and the above-mentioned measures would not therefore have such a major impact on this group. It might be more worthwhile to focus resources on influencing the group comprising middle-aged people with high salaries, as they are the ones with the least sustainable travelling patterns in terms of energy consumption.

If car users are to be attracted to Park & Ride, it is necessary to ensure a smooth transition to public transport. The lot should not be something you have to spend time looking for. The distances between the Park & Ride lot and platform should be short. Finding and reaching the lots must not be overly complicated and the payment system, if one exists, must be straightforward. At the same time, Park & Ride must not compete for the people who use public transport for the whole of their journey or bicycle to the station. One solution would be to improve the conditions for bus passengers and cyclists, at the same time as a Park & Ride lot is built.

In addition to good marketing and publicity, effective road signs to the facilities and clear signs at the lots are highly recommended. It is also desirable to have signs with the next departure time of buses and trains.

As free Park & Ride lots are the most frequently selected option of measures among both users and non-users of Park & Ride, this appears to be an important measure in order to transfer car drivers to Park & Ride. However, the studies in this thesis have
shown that there is a willingness to pay for guarded lots and guaranteed availability of parking spaces. So a fee could be recommended at lots that are over parked or have rectified their security problems. Security is mentioned several times by the respondents throughout the questionnaires as being an important factor and it is also assigned a high value in the studies.

The studies have shown that the availability of space at the Park & Ride lot is important when it comes to determining whether or not people are going to use Park & Ride. More spaces at the lot or charging a fee to park at the lot are possible solutions.

Another important measure is more knowledge about Park & Ride. People have limited knowledge and information about the public transport system and Park & Ride. In order to get more car drivers to use Park & Ride, it is essential to show figures relating to time and cost savings when using public transport. In general, non-users and users both mention the importance of saving time and money.

The suggestions put forward by the two target groups differ slightly. The users’ ideas for increasing the use of Park & Ride are more closely associated with improving their specific parking lot. The non-users suggest more general, wider solutions, such as tolls, banning cars in the city centre and raising the parking fees in the city. Non-users select a congestion charge of SEK 30 as a good way of making car drivers use Park & Ride more frequently than users.

2.2 CONCLUSIONS

2.2.1 Monetary valuation of quality factors at Park & Ride facilities

Commuters value a guarded lot more highly than being guaranteed a parking space, as can be seen in Table 2.1. The willingness to pay for an unguarded lot with lights is half the willingness to pay for a guarded lot. Lights could be an economical measure in order to make the lot more secure. It is probably less expensive to put lights on an unguarded lot than making the lot guarded.

<table>
<thead>
<tr>
<th>The factors at the Park &amp; Ride lot</th>
<th>Willingness to pay (SEK/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guarded lot with lights and roof</td>
<td>SEK 11</td>
</tr>
<tr>
<td>Guaranteed a parking space</td>
<td>SEK 7</td>
</tr>
<tr>
<td>Lights on an unguarded lot</td>
<td>SEK 6</td>
</tr>
</tbody>
</table>

Table 2.1 Willingness to pay for some of the factors.

Women and men have the same willingness to pay for a guarded lot, but women value an unguarded lot with lights more highly than men. One explanation of this result could be that women place a higher value on their individual security than men. Lights would make women feel safer, while guards make both men and women feel security for the car.
2.2.2 Internal validation

Both Park & Ride studies reveal that individual security and security for cars are very important criteria when it comes to determining what makes a Park & Ride lot attractive. However, the three methods that have been used produce slightly different results. The method used in Study 2, stated preferences, shows that a guarded lot has a higher value than being guaranteed a parking space, see Table 2.2.

When asking about the measures that would make commuters start to use Park & Ride (ranking of 14 measures), a guarded lot comes much further down the list of suggested measures. In addition to the measure free to park at the lot, being guaranteed parking space and easy to find and park at the lot are suggested measures.

In Study 1, the respondents grade security more highly than free parking. One explanation of the slightly different results could be that the question was asked in different ways. For example, in Study 2, the respondents were asked to choose three measures from 14 available on a list of measures that would make them use Park & Ride more frequently or start to use it. However, in Study 1, the respondents were asked to grade five factors, one at a time. In this question, being guaranteed a parking space was not one of the factors. One explanation of why the fee received lower scores than security could be that the ratings were made independent of each other.

<table>
<thead>
<tr>
<th>Method</th>
<th>Stated-preference method used in Study 2</th>
<th>Ranking of 14 measures that would make commuters start to use Park &amp; Ride</th>
<th>Grading of five factors that make Park &amp; Ride lots attractive, Study 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No fee at the lot</td>
<td>No fee at the lot</td>
<td>Security at the lot</td>
</tr>
<tr>
<td>2</td>
<td>Guarded lot (security at the lot)</td>
<td>Guaranteed a parking space</td>
<td>High frequency of buses</td>
</tr>
<tr>
<td>3</td>
<td>Guaranteed a parking place</td>
<td>Easy to find and park at the lot</td>
<td>No fee at the lot</td>
</tr>
</tbody>
</table>

Table 2.2 The two most important factors using three different methods.

That the probability of choosing car depends on the parking conditions at work is common knowledge. The result about parking conditions at home should be looked at with care due to the imperfection in the questionnaires, see next chapter. Factors that make Park & Ride attractive, the potential for increasing Park & Ride and valuation of quality factors of the Park & Ride lot are other results from the studies. Another result is the choice model created in study 2 that describes the choices between Park & Ride facilities. Another main finding is the knowledge about how Park & Ride can be a solution to families with children that have to leave their children at day care or school.
3 FURTHER RESEARCH

In this chapter some topics for further research are identified.

3.1.1 Competition between Park & Ride and public transport

The results show that the majority of users of Park & Ride would travel by public transport if the Park & Ride lot had not existed. There could be a problem if many public users switch to Park & Ride resulting in less demand for a feeder bus. To minimise the flow from public transport to Park & Ride there has to be more research about where the lot actually should be located and what could be done in order to make feeder bus or bicycle attractive enough to retain the people who are already using the bus or bicycle. There should be more research about what additional measures are needed to promote transferring from car to Park & Ride.

3.1.2 Travelling with children easier

Car trips between home and work are regarded as being most easy to transfer, except when the trip includes leaving or fetching children. Some 20% of the users use Park & Ride after leaving children at day care. There is perhaps some potential for using Park & Ride if parents have a greater opportunity to park after leaving their children at day care centres. It would be interesting to investigate ways of making the work trip easier when the trip involves leaving and fetching children.

3.1.3 Parking conditions at home

The majority of the respondents park outside their homes. The aim of the question of parking conditions at home was to find out how convenient it is to park and how this influences the choice of mode. However, this aim was not realised by the question. In order to find out how much the parking conditions at home influence the choice of mode, it would be interesting, in addition to the question asked in Study 2, to ask a question relating to the distances or walking time between home and the parked car. This may be a better way of finding out the inconvenience of collecting the car and how this influence the choice of mode.

3.1.4 The effects of measures on mode split

As the studies clearly indicate that better and more numerous signs are an important measure, it would be interesting to determine the effects better signs would have on the mode split. Other measures, such as the lights at a lot, could also be further investigated. The effects of marketing on mode split would also be interesting to study in
more detail. Information about the cost and time of travelling by car and Park & Ride should then be presented to car users.

### 3.1.5 Developing models

In this thesis, four quality aspects have been quantified using stated preference technique. These quantified factors should be quantified together with the usual cost and price factors for the trip in order to obtain a more balanced picture of willingness to pay for the quality factors.

The model created in this research describes the choice between Park & Ride lots. However, it is more interesting to study the choices between Park & Ride and other modes. The data from this study could be used for studying mode choices. It would also be interesting to use the parameters estimated in this thesis in a forecast model to see how these factors influence the choice of mode.

### 3.1.6 Influencing individuals

Studies have revealed that individuals consume varying levels of resources in their way of travelling. Attempts should be made to find instruments to influence individuals to travel in a more environmentally compatible manner. The conclusion is that more research is needed in this area when it comes to ways of influencing travellers of different kinds.

For example at the age of around 25, many young people abandon public transport and start travelling by car. To encourage more young people to continue using public transport, studies should be conducted to identify measures for achieving this.

The reviewed studies have shown that the car satisfies needs such as identity, status and prestige, whereas public transport generally does not. These needs seem to be an important factor in making car an attractive mode and therefore more studies of how these needs can be met by public transport or Park & Ride are needed.
PART II: Literature Review

Mode choice from an individual perspective – transferring car trips to other modes of travel
# TABLE OF CONTENTS

## 1 INTRODUCTION

1.1 BACKGROUND ........................................................................................................ 5  
1.2 AIM, SCOPE AND DELIMITATION ...................................................................... 7  
1.3 METHOD .............................................................................................................. 7  

## 2 TRANSFER FROM CAR TO OTHER MODES OF TRAVEL

2.1 INTRODUCTION.................................................................................................... 8  
2.2 DIFFICULTIES IN TRANSFERRING CAR DRIVERS TO OTHER TRAVEL MODES... 8  
2.2.1 The popularity of the car............................................................................... 9  
2.2.2 Dependence on the car.................................................................................. 9  
2.3 THE POTENTIAL FOR TRANSFER TO OTHER MODES OF TRAVEL ............... 10  
2.3.1 The potential for transferring car drivers to other modes............................. 10  
2.3.2 The potential for greater use of bicycles...................................................... 10  
2.3.3 The potential for greater use of public transport........................................... 10  

## 3 THEORIES OF HOW PEOPLE CHOOSE MODE OF TRAVEL

3.1 INTRODUCTION............................................................................................... 11  
3.2 ATTITUDE-BASED THEORIES ......................................................................... 11  
3.2.1 Theory of Planned Behaviour....................................................................... 11  
3.2.2 TPB with the ‘habit’ variable ...................................................................... 13  
3.2.3 Criticism of attitude based theories............................................................. 13  
3.3 METHODS BASED ON UTILITY MAXIMISATION............................................ 13  
3.3.1 The logit model .......................................................................................... 14  
3.3.2 Criticism of the maximum benefit models ................................................... 15  

## 4 DATA COLLECTION

4.1 INTRODUCTION ............................................................................................... 16  
4.2 QUESTIONNAIRES ......................................................................................... 16  
4.3 QUALITATIVE METHODS ............................................................................... 16  
4.3.1 Focus groups ............................................................................................. 17  
4.3.2 In-depth interviews ................................................................................... 17  
4.4 QUANTITATIVE METHODS ............................................................................. 17  
4.4.1 Revealed preference data ........................................................................... 17  
4.4.2 Stated preferences – hypothetical values and choices ................................... 17  

## 5 FACTORS THAT INFLUENCE CHOICE OF TRAVEL MODE

5.1 INTRODUCTION ............................................................................................... 20  
5.2 SOME WAYS OF CLASSIFYING FACTORS THAT AFFECT THE CHOICE OF TRAVEL MODE ........................................................................................................ 20  
5.2.1 Hard and soft factors .................................................................................. 20  
5.2.2 Internal and external factors ....................................................................... 21  
5.2.3 Subjective and objective factors .................................................................. 21  
5.2.4 Classification of trip standard factors.......................................................... 21  
5.3 CLASSIFICATION OF FACTORS .................................................................... 22  
5.3.1 Transport-specific factors ........................................................................... 23  
5.3.2 Environment-specific factors ...................................................................... 23  
5.3.3 Individual-specific factors .......................................................................... 23  

3
5.3.4 Trip-specific factors ................................................................. 23
5.3.5 Policy factors ........................................................................ 23
5.3.6 Quality factors ....................................................................... 23
5.4 Descriptions of Some Factors ................................................... 24
  5.4.1 Transport-specific factors ..................................................... 24
  5.4.2 Environment-specific factors ................................................. 25
  5.4.3 Individual-related factors ...................................................... 25
  5.4.4 Journey-specific factors ....................................................... 28
  5.4.5 Policy factors ....................................................................... 28
  5.4.6 Quality factors ..................................................................... 28
5.5 Particular Factors Influencing the Choice to Cycle ..................... 29

6 Measures Influencing Choice of Travel Mode ......................... 30
  6.1 Introduction ............................................................................. 30
  6.2 Measures to Reduce Car Use .................................................. 30
  6.3 Policy Measures ..................................................................... 30
  6.4 Individual-specific Measures ................................................... 31
    6.4.1 Security measures ............................................................. 31
    6.4.2 Influencing attitudes .......................................................... 31
    6.4.3 Incentives ......................................................................... 32
  6.5 Transport-related Measures ................................................... 33
    6.5.1 Measures for the infrequent traveller ................................. 33
    6.5.2 Measures for the habitual traveller .................................... 33
    6.5.3 Examples of railway initiatives ........................................... 33
    6.5.4 Examples of combined trips ............................................... 33
    6.5.5 Standard-raising measures ................................................ 34
    6.5.6 Measures in the infrastructure .......................................... 34
    6.5.7 Measures at stations and stops .......................................... 34
  6.6 Special Walking/Cycling Measures to Attract Motorists .......... 35
  6.7 Combinations of Measures ..................................................... 36

7 Conclusions and Further Research ............................................. 37
  7.1 Summary and Conclusions ....................................................... 37
  7.2 The Need for Continued Research ......................................... 39
    7.2.1 Factors and models that explain the choice of travel mode  39
    7.2.2 Knowledge of how different individuals are influenced ...... 39
    7.2.3 Study of how different factors affect the proportion of cycling 40

8 References: .............................................................................. 41
1 INTRODUCTION

1.1 BACKGROUND

Car ownership is increasing and more and more people are continuing to use their cars later in life. Our journeys are tending to become longer and longer. Today we travel more than 40 km per adult and day (SIKA 1998). A third of all trips we make are pleasure trips. Journeys to and from work/school and service trips each account for about a quarter of the total number of journeys. The car is the predominant means of transport and accounts for 6 of 10 passenger journeys. Viewed in terms of transport performance, this is equivalent to 66% of journeys being made by car. Almost 3 trips of every 10 are made on foot or by bicycle, but since these trips are short ones, in terms of transport performance they account for only 3% (SIKA 2000).

In the county of Stockholm the proportion of journeys made by public transport is 18%, compare to 7% for the whole country, see Figures 1.1 and 1.2. At peak periods, during the peak hour approximately 55% of journeys are made by public transport (RUF S 2001). People in Stockholm also spend most time travelling, 64 minutes a day, whereas the average is 59 minutes per day and passenger. People walk and bicycle more than they do in other major cities such as Gothenburg, and also when compared to the country as a whole (SIKA 1998). The proportion of people who have a driving licence and access to a car is lower in the Stockholm area, which may be explained by the public transport supply and the age structure of the population (SIKA 2000).

![Chart showing the share of modes in the Stockholm area](chart.png)

**Figure 1.1** *Share of modes in the Stockholm area*
As car traffic increases so also does its effect on the environment in the form of noise and exhaust emissions. The transport sector accounts for 40% of carbon dioxide emissions in Sweden and 78% is from the car traffic (SIKA 2000).

In addition to the impact on the global climate in the form of carbon dioxide emissions and fossil fuel consumption, many large towns and cities experience local problems such as congestion, shortage of parking spaces and exhaust emissions. The roads and car parks that cars require take up large amounts of space. Larger towns and cities have problems with congestion, especially during the morning and afternoon rush hour. This congestion also causes problems for types of transport other than passenger transport. The whole goods transport system is influenced, making deliveries difficult, and accessibility for emergency vehicles is also restricted.

Children’s freedom of movement has decreased with the general increase in car driving. Parents drive their children to school and other activities to an increasing extent, which has resulted in an unsafe traffic environment for children walking and bicycling, the consequence of which is that more parents drive their children to different activities. Studies have shown that children’s mental and motoric development is impeded when they get less exercise. Children develop by exploring their immediate environment and want to be in the same surroundings as adults (Björklid 1999).

It is against this background that planners, politicians and large sections of society are being to take an interest in different ways of limiting car traffic in big towns and cities.

One way is to transfer car traffic to public modes of transport, walking and cycling. Ways of transferring car journeys to other modes of transport have been studied in several towns and cities. The choice of mode is influenced by many factors, not just the quality and supply of the alternative modes, but also by such factors as status and habit (Forward 1998b). There is a need to be able to predict mode choice based on...
individuals’ background factors such as gender, age, education and family structure for example, but also based on people’s habits, experience and attitudes (Steg et al 2000, Ben-Akiva et al 1999). One problem in this respect is the difficulty in quantifying travellers’ attitudes and values. In order to be able to persuade individuals to choose modes other than the car, we need knowledge about the individuals’ attitudes, values and resources (Nilsson 1998).

1.2 AIM, SCOPE AND DELIMITATION

The major aim of this literature review is to identify factors that determine people’s choice of travel mode.

The literature review also describes a number of different theories and models dealing with how mode choice can be predicted on the basis of different factors. To a certain extent, the literature review also describes data collection methods for ascertaining and assigning values to underlying factors. Models that can be used to analyse the data collected are also reviewed.

1.3 METHOD

Searches have been made in several transportation databases, such as VTI’s RoadLine database, the Swedish National Road Administration (SNRA), TRIS, NTL (the transportation library in the United States), CORDIS, DanDok and TRB. Search engines have also been used, for example Nordic Light and Infoseek. The search words were modal split, mode choice, modelling bicycle, life style, attitude, behaviour, tdm, traffic reduction, stated preference, factors, habit, usage and practice. The literature comes for the most part from Scandinavia, Australia, Western Europe and the United States.

Other literature reference lists were also used in the literature search.
2 TRANSFER FROM CAR TO OTHER MODES OF TRAVEL

2.1 INTRODUCTION

Car journeys can be transferred to walking, cycling or public transport. Car journeys can also be transferred to journeys where the car is combined with public transport or to cycle in combination with public transport. The possibility to transfer car drivers to public transport is not dependent solely on making public transport more attractive but also on restricting the amount of space available to the car. However several studies indicate that a better public transport supply has only a limited effect on car use (RAC 1995). Gärling argues that an important difficulty for families in reducing car trips is the lack of other modes that can fulfil their needs of transport (Gärling 1997).

Several studies have been conducted that deal with transferring car drivers to other modes of transport but these have mostly been of a qualitative nature (RAC 1995, Jensen 1997). The studies address the problems of car ownership, congestion and health aspects related to too little exercise.

This chapter discusses the difficulties involved in transferring motorists to other modes of travel and the potential for increasing the proportion of other modes.

2.2 DIFFICULTIES IN TRANSFERRING CAR DRIVERS TO OTHER TRAVEL MODES

A general problem in transferring travellers from car to other modes of travel is that the car is perceived as cheap. Once a car has been obtained, it is there and the owner does not consider what it really costs and how many trips by taxi for example it would be possible to make for the same amount of money. Several studies show that as soon as a car has been obtained, people choose the car for all trips without considering other alternatives every time (RAC 1995).

Another contributory cause of difficulties in transferring car drivers to other modes of travel is the forces behind the automotive industry and its preservation with large amounts of money being spent, for example on car advertising. Car driving has characterised the development of conurbations to a very great extent and has built in a greater dependence on the car. Traffic solutions have given priority to cars at the expense of other types of transport (Jensen 1995).

Yet another contributory cause may be that there has been no strong lobbying that can represent the interests of cyclists and pedestrians. Cycling also has an image problem due to the high accident risk in traffic. Nor are there any satisfactory planning instruments for cycling and integrating the bicycle into the transport system. Work and re-
sponsibility for bicycle traffic is currently divided over several sectors and even several
different people, which may make coordination difficult (Nilsson 1998). The bicycle
leads an obscure life in research even if it has been discussed more in recent years, but
efforts are in fact being made in certain quarters to get more people to cycle (Eriksson
and Lindvall 1999).

2.2.1 The popularity of the car

There are several reasons why the car is so popular. It is a convenient and comfortable
way to travel. The driver and passengers can travel undisturbed and feel secure, and a
car journey saves time. The car also has cultural and symbolic values (Hjorthol 1999,
Forward 1998b).

Jensen (1997) arrives at the conclusion that the car is not only a convenient mode of
transport but also satisfies other needs, for example feeling that one is in control of
one’s journey. Normal transport-economic models assume that people are rational be-
ings and choose the mode of travel that gives the most benefit. Many researchers,
however, consider that people choose their mode of transport according to feelings
and habits. This manifests itself in the fact that we do not change our behaviour just
because conditions change, for example improved public transport, since we weigh in
more values than time and cost when we choose our mode of transport.

The car is an important part of people’s lives from an early age. Even when they are
very young, children learn that the car is a status symbol. Taking one’s driving licence
is an important ritual. The car is spotlighted in films and made to symbolise freedom
and strength. The car is implemented early in children’s lives and becomes part of their
everyday life together with feed bottles, comforters, and mom and dad. This is why
methods of persuasion and other measures in the form of incentives and threats have
largely proved ineffectual other than in just a few per cent of cases (Goodwin 1991).

The symbolic value of motoring, however, has declined since the 1950s. In a qualita-
tive study of young individuals carried out in Gothenburg, it was found that their in-
terest is more focused on computers (TV games) than tinkering with a car (Andréasson
and Sjöberg 1996). In the 1950s a car of one’s own was the only thing that mattered
and in those days young people often took their driving test as soon as they were 18.
Also Krantz (1999) concludes that young people are not as interested in tinkering with
cars as they were 20 years ago. Computers have become part of young people’s lives
and they view the car as a utility.

2.2.2 Dependence on the car

An English study (RAC 1995), based on a number of different surveys including qual-
itative studies, taped interviews, attitude surveys, questionnaires, and daily records,
showed how people’s dependence on the car varies with the number of journeys they
make, and that different people have widely divergent views of dependence on the car.
An analysis of the interviews also shows that dependence on the car varies greatly from
individual to individual. The conclusion is that efforts should be focused on groups of
individuals instead of on the average individual (RAC 1995).
2.3 THE POTENTIAL FOR TRANSFER TO OTHER MODES OF TRAVEL

2.3.1 The potential for transferring car drivers to other modes

According to a study, 20% of car journeys are unavoidable; 60% can be influenced and are dependent on the standard of public transport, working hours and the location of services; and 20% of the journeys could be replaced by some other mode, such as walking (RAC 1995).

Journeys to and from work are considered easiest to transfer from the car, while journeys to drive and fetch children are hardest (WALCYING 1998, Grue and Hoelsaeter 2000).

2.3.2 The potential for greater use of bicycles

Many people have a different relationship to the car than they have to public transport or the bicycle. The bicycle has nowhere near the same strength or status as the car. However due to the fact that the bicycle is an individual mode of transport it ought to be an alternative to the car to a greater extent. For this reason, Jensen (1997) considers that there is a potential for more cycling if it were more attractive. Since many car journeys are short, some of them could be made by bicycle (Nilsson 1995).

2.3.3 The potential for greater use of public transport

The potential exists to increase travelling by public transport in the Stockholm area from today’s peak hour 52% to 55% if services are expanded in the peripheral areas of the city. The increase is based on more activities, in addition to housing, being located to these areas. If nothing is done, the proportion will instead decrease to 49% (RUFS 2001).

If the city’s population grows and public transport is not developed the proportion will increase by 2% (RUFS 2001). On the other hand, an economic development of +2% will reduce the proportion of public transport from 52% to 42%.
3 THEORIES OF HOW PEOPLE CHOOSE MODE OF TRAVEL

3.1 INTRODUCTION

This section deals with differences between psychological and economic theory, and qualitative and quantitative methods and different theories of how people choose their mode of travel. The section concludes with a review of methods based on utility maximisation.

The economic theories are often based on the assumption that people act and choose between alternatives according to rational principles. The basic assumption is partly that people endeavour to maximise their utility and partly that they act completely rationally.

3.2 ATTITUDE-BASED THEORIES

Earlier research around commuters’ choice of travel mode employed microeconomic theories and methods to map the individual’s decision process. There are other theories or explanatory models, for example the attitude-based theories described below.

3.2.1 Theory of Planned Behaviour

One attitude-based theory is the Theory of Reasoned Action formulated by Ajzen and Fishbein (1975) which tries to predict and explain human behaviour. The theory deals with possible linkages between attitudes and behaviour and it is assumed that people have a free choice. Ajzen later developed the theory to include the variable perceived behavioural control. This theory, the Theory of Planned Behaviour (TPB), assumes that the choice is also dependent on the individual’s perception of his or her ability to execute a certain behaviour (Ajzen 1985). TPB has made it possible to explain the choice of travel mode (Forward 1998a, Forward 1998b).

According to TPB, people act rationally and decisions are considered consciously. The intention behind a certain behaviour is dependent on three factors:

- the attitude toward the behaviour
- the social norm
- the perceived behavioural control
**Figure 3.1** Theory of Planned Behaviour (Source: Dzikan, Kottenhoff and Lindström Olsson 2003).

*Attitude* includes all important convictions related to the personal consequences of a certain behaviour (e.g. travel by bus).

*Social norms* are the product of normative convictions, which the individual's environment expects of him or her, and the individual's motivation to adapt to these expectations.

*Perceived behavioural control* is a function of control convictions, which in turn arise partly out of one's own experiences and partly indirectly, as a consequence of information given by other people (e.g. how difficult someone believes it is to travel by train). The importance of the perceived behavioural control component itself and its value for predicting behaviour have been confirmed by empirical studies (Gärling & Fujii; Gillholm & Gärling 1997).

The variables are assumed to be independent of each other and the degree of explanation (their influence) varies between travel modes. According to TPB the effect of other factors such as gender, age, and personality will influence behaviour, but indirectly, which means that the explanatory value of the model would not be greater if more variables were included.

If we want to predict a specific behaviour we must measure the attitude to just that specific behaviour. An example: If we want to know whether a person will take the car or travel by public transport for their next journey to work, we have to ask about that person's attitude to that particular journey and not about public transport in general.
TBP shows that it is possible to change a person’s behaviour by influencing their attitudes, the subjective norm and their perceived behavioural control. If we want more people to travel by public transport, we can influence attitude, for example by offering free test trips. This gives people personal experience. The subjective norm can be influenced by good examples such as celebrities and politicians showing that they travel by train and public transport.

3.2.2 TPB with the ‘habit’ variable

Regarding means of transport, studies have shown that habit has a high degree of explanation (Forward, 1994). Forward (1998b) tested an extended variant of TPB where the factor habit was added to the model.

A study was made in Gothenburg (Forward 1998b) with the aim of evaluating how well the theory can increase understanding of the motive behind the choice of travel mode. The results of the study show that perceived control and habit have the highest degree of explanation for travel mode choice and that there are strong linkages between intention and behaviour, which means that the intention can be measured by measuring actual behaviour instead. The results of the study show that the variables help to explain the travel mode choice by between 42 and 69% of the intention to walk, cycle and drive short distances (Forward 1998b). The conclusion in the study is that together with habit the theory can be used to advantage to increase our knowledge of what factors control people’s choice of travel mode.

3.2.3 Criticism of attitude based theories

A certain amount of criticism has been raised against attitude-based theories, partly because it is difficult to know whether attitudes control travel mode choice or vice versa. People do not always act as they say they will. Rystam’s (1998) qualitative studies of travel mode choice indicate that changes in behaviour lead to changes in attitudes. The respondents felt that it was their changed behaviour that caused them to change their attitudes, not the other way around. According to Nilsson (1998) attitudes’ value for predicting actual behaviour is poor, because they are collected through interviews or questionnaires. The same complex of problems also applies to Stated Preference interviews, see below. It is important when asking attitude questions to base them as far as possible on the individual’s experience. Another shortcoming is that attitude-based theories are not easy to use to predict what happens when the standard of the service, for example travelling time, changes.

3.3 METHODS BASED ON UTILITY MAXIMISATION

Travellers choose their mode of travel, car, bus, train or bicycle, depending on how great they perceive the benefit for travelling to be – how they value the travel modes and their supply. The mode of travel with the smallest sacrifice is chosen most frequently and by most people. Economists often assume that individuals make the choices that will give them the greatest possible personal benefit.
The benefit of journeys is influenced by for example the travelling time, the fare, the level of comfort and quality offered in connection with making the journey. The choice of travel mode is regarded as an individual, rational choice from a number of alternatives. The standard of the supply, e.g. travelling times and proximity to stops and stations, can be expressed relatively easily in measures of advantage. The basic assumption is that the individual can weigh the personal benefit derived from the alternatives’ different characteristics against each other. Even where individuals do not do so, the importance of the different characteristics can be estimated, i.e. calculated statistically. The benefit derived from different characteristics is perceived differently by different individuals. All people will not therefore choose the same products, way of living, or means of transport.

The quantitative analysis methods used in infrastructure planning mainly consider only hard factors such as travelling time, frequency of service and fares. The soft factors, such as attitudes, are often omitted, because they are more difficult to handle in quantitative analyses (Loncar-Lucassi, 1998). Attitudes are also difficult to quantify.

3.3.1 The logit model

The logit model is the most common economic method of describing how individuals choose between different alternatives. The model shows how strongly different factors influence the choice of travel mode and the linkages between the factors (Böse et al. 1996).

The description of the logit model below is for the most part taken from Ben Akiva (1985) or Algiers and Widlert (1992).

The logit model is also based on the assumption that individuals choose the alternative that provides the highest utility. The utility of the alternatives is dependent on the different characteristics of the alternatives, the design of the transport system, and the individual. The utility is described as a function of these factors (here referred to as variables).

The utility consists of a measurable part and a non-measurable part called a random term.

\[ U_i = V(X_i) + \varepsilon_i \]

where \[ V(X_i) = \beta_1 X_{i1} + \beta_2 X_{i2} + \ldots \]

and \[ U_i = \text{the utility of alternative } i \]

\[ \beta_i = \text{parameter that is estimated} \]

\[ X_{i1} = \text{the characteristic of alternative } i, \text{ e.g. travelling time and price} \]

\[ \varepsilon = \text{random term} \]

The expression \( V(X_i) \) is called the utility function and is a function where the characteristics of each travel mode are described by means of a number of variables (factors) that describe the individual, characteristics of the travel mode and the transport sys-
tem. The X variables are measurable and express travelling time, waiting time, cost, size of household, income etc. $\bar{\beta}$ is a weighted parameter that is estimated. Since not all characteristics (factors) can be measured or observed the function contains a random term $\varepsilon$. If we assume that the distribution of the random term is known, the probability of the individual choosing a certain alternative can be calculated. Depending on the distribution that the random term $\varepsilon$ is assumed to have, different models are obtained. If it is a Gumbel distribution, the probability $P_i$ of choosing travel mode $i$ is determined by the logit function where

$$P_i = \frac{e^{V(X_i)}}{\sum_j e^{V(X_j)}}$$

$P_i$ = the probability of choosing alternative $i$

$j$ = all the alternatives that the individual may choose between.

The logit model says that the probability that an individual will choose a certain alternative is dependent on its utility in relation to the utility of all the other alternatives.

The logit model is estimated using data that show how individuals have chosen between different alternatives. The data may come from studies of travel behaviour (RP data) with the actual choices individuals made, Stated Preference-data (SP) where individuals make hypothetical choices, or a compilation of both RP and SP data.

### 3.3.2 Criticism of the maximum benefit models

Transport economic models usually assume that people are rational beings and choose the mode of travel that gives the greatest benefit. This basic assumption has come in for some criticism; choices between travel modes are not made solely on the basis of rational economic decisions as to what is best.
4 DATA COLLECTION

4.1 INTRODUCTION

Data for analysis can be collected in different ways. Each method has its own strengths and weaknesses (Holme and Solvang 1997). Some of these methods are described below.

Travellers’ desires, attitudes, perceptions, and values can be studied in different ways. Using qualitative interviews and/or questionnaires we can get answers to, for example, what they value, and when and how.

The advantage of qualitative studies over quantitative studies is that they capture things that the interviewer did not think about at the beginning. Qualitative studies can be used to obtain a rough assessment of the attractiveness of different modes of travel. Qualitative studies on the other hand do not show the amount of resources that are needed to satisfy the traveller’s desires.

With quantitative studies it is possible to arrange factors with different degrees of accuracy on different scales, for example a ranking scale, an interval scale, or a ratio scale.

4.2 QUESTIONNAIRES

Written or oral questions are normally using questionnaires or interview guides respectively. It is relatively cheap to collect written data, but the response rate is often poor which may ultimately lead to a systematic skewing of the results.

Formulating written questions and getting people to write down their responses may also cause difficulties. It is often easier for the individual to answer orally and for the interviewer to note down what they say. This method requires extensive personnel resources, which makes it expensive. The length and content of the questionnaire varies with the aim of the study.

4.3 QUALITATIVE METHODS

Qualitative methods, e.g. focus groups or in-depth interviews, are suitable methods for study attitudes and motives explaining how people act (Banister et al 1994).
4.3.1 Focus groups

Focus groups is a qualitative method that allows attitudes and views of several people to be studied at the same time. Using focus group interviews we can find out what matters to people. The result might be a long list of factors or attributes. The factors that are stated by many people should be singled out and investigated further.

The method involves staging a group discussion of an issue that has been decided in advance by the people conducting the study. This method is presently used to a greater extent in traffic research (Megel 2002, Waara 2001). Focus group research is especially appropriate for more complex issues which little or no knowledge exists (e.g. why a particular mode of travel is less popular than others).

4.3.2 In-depth interviews

The same applies to in-depth interviews. These, however, are conducted with one person at a time. Qualitative methods are relatively resource-consuming and the results can only be generalised using great discretion. Qualitative and quantitative methods (see below) should preferably be used in combination. The results of the qualitative studies can then be used to as the basis for the interview questions in the quantitative studies (Jensen 1997).

4.4 QUANTITATIVE METHODS

4.4.1 Revealed preference data

Data on how individuals choose their mode of travel may be of two types. The first type is data about how the individual acted, and is therefore based on actual behaviour, and is called Revealed Preferences (RP). Studies of travel habits in the form of diaries are one example. The other is based on what individuals say about how they will react and behave in imaginary situations (Stated Preferences, see also below).

Up until the 1990s RP was generally used to find out how important different factors were in people’s choices when travelling. The disadvantage of RP studies is that they require substantial amounts of basic data and it is difficult to separate, for example, travel cost and travelling time. Since the cost of journeys increases with distance travelled, with RP data it can be somewhat difficult to see how important the cost is in relation to the travelling time. One advantage, however, is that it is possible to study the effects of changes that have been introduced. Stated Preferences (SP) requires little data since one can choose the choice situations oneself according to certain statistical principles. To achieve the best possible agreement with reality, it is usual today to combine RP and SP data (Louviere et al. 2000).

4.4.2 Stated preferences – hypothetical values and choices

One way of measuring values is to use Stated Preference (SP) interviews. The respondents show their preferences by carrying out an SP experiment. In the SP interview the
respondent is confronted with a number of hypothetical choice situations. The SP interview thus consists of “games” that contain a number of alternatives. In these alternatives, factors are described that assume a number of levels within reasonable limits. Repeated choices that the respondent makes give a value in time or cost for the factors being studied (Ortúzar 2000).

SP is based on the assumption that individuals’ choices are controlled by maximisation of benefit. New choice situations can be handled provided travellers can enter into the situations so that they can give realistic responses. The advantage is that the sample is smaller and correlation can be avoided. However, the method produces problems of its own. Can we really trust what the respondent tells us? Some researchers are of the opinion that SP studies to find influencing factors are unreliable in cases where a choice between the car and the bicycle for example is being studied because it is difficult for the individual to imagine the situation realistically (Nilsson 1998). It is important that respondents do not feel that it is too troublesome to answer the questions.

There are different ways of designing the experiments or the interview, for example using ranking, scoring and choosing between alternatives where pair wise choices are most common. With pair wise choices, it is usual to have somewhere between 5 and 15 pairs of alternatives. The number of factors describing each alternative is dependent on the information that is being sought and how difficult the interview is. The factors normally have three levels. These levels may be continuous or discrete.

---

**Figure 4.1 An example of a stated choice experiment**

Pair wise choices are easy to understand, have a good frequency of response and the risk of systematic error is small. Scoring is an alternative to paired choices, as is ranking according to best, second best, third best and so on. Sjöstrand (1999) has tested these methods in the form of postal questionnaires. The study showed that pair wise choices were easiest to understand and frequency of response was high at the same time as the errors were not too serious (Sjöstrand 1999).
In SP studies it is assumed that people do not make their choices on the basis of single criteria but on a combination of factors. There are, however, a number of sources of error that need to be borne in mind:

- the absence of restrictions for the choice,
- rationalisation (exaggeration of the advantages of one’s actual behaviour)
- policy responses, i.e. attempts to influence decisions with one’s response.

Since each of the alternatives presented is described in the form of several factors, there is less risk of policy responses. The variables (factors) vary independently of each other, i.e. they are uncorrelated, which means that the data is eminently suitable for statistical analysis. The method uses pre-defined responses, which reduces the risk of getting rational responses.

The risk of error has proved to be greater when choosing between alternatives that are very different from each other, e.g. car and bicycle, than when choosing between very similar alternatives, e.g. different types of public transport. SP balances the factors against each other while at the same time exaggerating the effect of the factors since no restrictions exist (Lindqvist Dillén 1995). From this reasoning we can draw the conclusion that the SP method is better suited to having cyclists assess different cycling measures than to having habitual motorists choose between hypothetical questions about a car journey and a bicycle trip (Nilsson 1998).
5 FACTORS THAT INFLUENCE CHOICE OF TRAVEL MODE

5.1 INTRODUCTION

Factors are used in various types of transport models and attitude models. Magelund (1997), for example, studied how a number of factors affect people’s choice between car and public transport. In her model, Magelund does not include car ownership as an explanatory factor since it is considered to be based on the other factors. Her study shows that gender does not explain behaviour but correlates strongly to income and work-related factors. Income and work, on the other hand, have a direct impact on the choice of travel mode. The result shows that attitudes have a strong degree of explanation. People who choose public transport are characterised by low income and parking conditions at their place of work. For people who choose the car, their choice is explained by work-related factors.

When a model (logit model) was tested using only objective factors the degree of satisfaction was clearly not as good as when all factors were included in the model. A model that contains both objective and subjective factors thus best explains the choice between public transport and car (Magelund 1997).

This chapter describes some ways of classifying factors and how they affect the choice of travel mode.

5.2 SOME WAYS OF CLASSIFYING FACTORS THAT AFFECT THE CHOICE OF TRAVEL MODE

The choice of travel mode is affected by a great many factors, everything from transport-specific factors (describing the various components of the transport system) to individual-related factors such as a person’s attitudes and habits. These factors are classified in many different ways in the literature. Some of these are described below.

5.2.1 Hard and soft factors

Some researchers have chosen to divide the factors into hard and soft factors, where hard factors are easier to quantify than soft ones. Hard factors are normally found in the traditional travel mode choice models that are based on maximisation of utility. Examples of hard factors are travelling time, waiting time and ticket price (fare). Soft factors are things like comfort, service and information (Loncar-Lucassi 1998). Soft factors may also be psychological, for example flexibility, ease of orientation etc.
5.2.2 Internal and external factors

Factors that control choice of travel mode can also be divided into internal and external factors. Internal factors include attitudes, socio-economic and demographic factors, habits and perceived level of control. External factors include such things as travelling time and the cost of the journey (Bergström 1999, Nilsson 1998).

5.2.3 Subjective and objective factors

Another way, used by Rystam (1998) and Magelund (1997) is to divide the factors into subjective and objective factors. The objective factors are normally based on objective measures (Rystam 1998) and are easy to measure and quantify. Rystam counts the alternative’s so-called hard standard factors, travelling time, fare etc, and soft standard factors such as comfort, information etc, as objective factors. The objective factors also include socio-economic factors such as gender and age, and also trip-related factors such as purpose. Examples of other objective factors are weather, topography, security and environment. Subjective factors here include valuations of the alternative’s characteristics, attitudes and lifestyle. These factors are based on the individual’s perception and are often more difficult to quantify.

5.2.4 Classification of trip standard factors

For public transport, Kottenhoff (1999) divides the transport-related attributes that describe the travel standard into timetable, comfort and service factors, and quality satisfaction and safety, see Figure 5.1.

Classification of train related attributes

- **Timetable**
  - Travel time
  - Interchanges

- **Comfort**
  - Feeling
  - Sight
  - Hearing

- **On board service**
  - Entertainments
  - Catering

- **Safety**
  - Traffic safety
  - Personal security

- **Quality satisfaction**
  - Punctuality
  - Modern impression
  - Tidiness

Figure 5.1 *Classification of train-specific factors (adapted by author from Kottenhoff 1999)*
## 5.3 Classification of Factors

The literature shows that there are many different ways of structuring factors, according to how they affect the choice of travel mode, see the examples above. Measures are here defined as factors that can affect the individual, such as physical measures, behavioural measures and policy measures. There are factors that the individual can affect and factors that different actors can affect. There are also factors that are difficult to affect, e.g. the weather and topography. In this section, the factors are classified and described according to their affectability.

### Different types of factors

- **Environment-specific factors**
  - Topography, weather, access to shops

- **Trip-specific factors**
  - Reason for the trip, luggage, errands

- **Transport-specific factors**
  - Timetables, parking facilities, stations

- **Individual-specific factors**
  - Age, sex, income

- **Quality factors**
  - Safety, security, standard of the transport system

- **Measures affecting choice of travel mode**
  - Marketing-, Communication-, Mode-specific- and Policy measures

**Figure 5.2** Factors and measures.
5.3.1 Transport-specific factors

Transport specific factors are related to the various parts of the transport system, for example timetables, proximity to stops and stations, congestion charges, service level, proximity to the cycleway network and accessibility. In addition to travelling time, fare, comfort and information, transport-related factors also include station-related factors such as the general appearance of stations and stops. Bicycle parking and shower facilities at work are also included. These factors are mainly affected by the local authority, companies, operators, and the individual's home and work locations, and choice of travel mode.

5.3.2 Environment-specific factors

Environment-specific factors describe the environment of the route travelled, i.e. the things that are not part of the transport system; the topography, the weather access to shops and schools etc. Some of the factors have been predetermined for a long time and are thus difficult to influence. Others can be influenced in the long term, e.g. through physical planning.

5.3.3 Individual-specific factors

Individual-specific factors consist of factors that describe not only the individual and the individual’s characteristics, but also to a certain degree the whole household. Such factors include socio-economic factors such as age and gender, and also attitudes, status and habits. A person’s lifestyle is also an individual-related factor. Gender and age are predetermined, while attitudes and lifestyle can be influenced more easily.

5.3.4 Trip-specific factors

This category includes the factors that have to do with the trip itself. These can be the reason for the trip and the type of luggage the traveller is carrying on the trip. The individual can also affect these factors.

5.3.5 Policy factors

These are economic incentives, taxes and various restrictions on car traffic that local and central government can influence.

5.3.6 Quality factors

Quality factors are factors that have to do with the individual’s perception of the journey and the standard of the transport system. The safety and security factor is an example of a quality factor. Both the individual and central government can affect these factors.
5.4 DESCRIPTIONS OF SOME FACTORS

5.4.1 Transport-specific factors

Transport-specific factors are sometimes in the literature called standard factors, but in such cases the fare factor is not included.

Many studies show that travelling time and fare are crucial to the choice of travel mode and the decision to travel at all (Algers et al 1995). Kottenhoff (1999) showed that the level of comfort and service were also very important, at least for journeys by train.

Parking charges would have to be 30 NOK/per day. People with company cars were prepared to pay 18 NOK/per day to use their company car. One conclusion was that it might be possible to influence the choice of travel mode for the trip to work by restricting parking facilities for employees (WALCYNG 1998).

The findings in a study of punctuality, information, travelling time, timetable and frequency of service indicate a high willingness to pay for better punctuality (Kottenhoff and Lindh 1996). In particular, the risk of being delayed is perceived as very negative.

Fröidh (2003) found that the increase in travel on the Svealand line is explained partly by the fact that the trains travel fast and are very frequent, and partly by the high level of comfort. Many motorists have been attracted to the train in spite of the relatively high fares.

The conventional service supply at the stations is valued more highly than unconventional service elements, e.g. toilets are considerably more important than grocery shops (Prather Persson, 1998).

A study in Gothenburg of motorists’ choice of track-bound taxis as a hypothetical travel mode, the car drivers said that the following factors were important: ´low fare, maximum 300m walking distance, substantial time gain, enjoyable, comfortable, clean, tidy and hygienic. Motorists want short distances to public transport, 3 minutes, compared to public transport passengers who can accept up to 10 minutes’ walking distance (Loncar-Lucassi 1998).

The possibility to combine public transport with other travel modes is considered an important factor to persuade more people to use public transport. Passengers must be able to both get to the stop in an efficient manner and park nearby securely, or be able to reach the vehicle easily by bicycle.

To get motorists to use Park & Ride, the transfer to public transport must be smooth and walking distance must not be too long. Nor must it be too difficult to find and get to. If there is a payment system it must be simple to use. At the same time, the Park & Ride system must not compete for the passengers who make the whole journey by public transport or who bicycle to the station. One solution is to improve things for bus passengers and cyclists at the same time as the Park & Ride facility is built (Lindström Olsson 1999).
The rail factor between train and bus services

An empirical study conducted in Germany by Megel (2001) showed that when travelers have a free choice between bus and train, they prioritise the track-bound alternative. A so-called “rail factor” emerged. Both train and bus passengers gave emotional factors as the reasons for their choice of travel mode, e.g. more comfortable, more pleasant, better feeling or atmosphere.

In focus group discussions held with public transport users in Stockholm about their journeys to work (Loncar-Lucassi 1998), they stated a number of factors that motivated their choice. People who preferred track-bound transport felt that speed, reliability and the possibility to read while travelling were important factors. Convenience, security and general comfort attracted bus users more.

5.4.2 Environment-specific factors

Bergström (1999) studied how important winter road maintenance is for the choice of travel mode. She refers to a Norwegian study (Giæver et al 1998) where the most important factor affecting the choice of whether to cycle or not is if the roads are cleared of snow. Swedish studies show that temperature, snowfall and road conditions interact (Wretling 1996). A bicycle project in Århus (Eriksson and Lindvall 1999) shows that bad weather is not such a great obstacle as one might believe. The study also shows that better snow clearance and more room for transporting things on the bike are two solutions that can lessen the obstacles to cycling.

5.4.3 Individual-related factors

Attitude factors

Attitude is important when choosing a mode of travel. People’s attitude to cycling depends on their lifestyle, their personal circumstances, whether they have access to a car, and the social norm (Forward 1998). Attitudes differ between people who cycle and people who never cycle (Davies et al 1997).

The findings from Jensen’s (1997) qualitative interviews show that the car is not just a comfortable means of transport, but also satisfies other needs, for example feeling that one is in control of one’s journey. A car provides status, freedom and relaxation, since it permits people to be by themselves. The car can be seen as mobile territory or a private room where one can listen to music or be alone with one’s thoughts. It provides relaxation from an otherwise stressful life.

The car also satisfies a need of identity that public transport cannot satisfy. Jensen (1997) states that if we wish to try to influence people’s choice of travel mode we should include the identity need because identity for some groups is linked to the car.

Travel mode choice is also dependent on habit (Forward 1998, Jensen 1997). By habit or routine we mean that an action takes place without considering other alternatives. Road users have a resistance or inertia to change and prefer the travel mode they currently use. The resistance is greater if there is a previous habit. According to this argu-
ment, it is easier to introduce a new behaviour if the habit can be broken, for example when moving to a new house or job (Nilsson 1998).

A Norwegian study showed that people who were habitual motorists, who almost always drive and who had seldom cycled to work, showed the greatest unwillingness to change from car to bicycle.

Several studies show that people’s attitudes are important for the choice of travel mode. Others maintain that even if this is correct, attitudes are formed according to the actual choices travellers have made or have been forced to make due to the particular circumstances.

The age factor
Studies have shown that young people up to the age of 25 use public transport as their commuter trips (83%) After the age of 25 only 58 % travel daily by public transport (Widén 2002)

The lifestyle factor
Berge (1996) arrives at the conclusion that there are linkages between lifestyle and travel mode choice, access to a car, and attitudes. The analysis shows that there are differences between ages and gender, and if one lives in a rural area or in a town or city. The study also shows which groups it is most meaningful to concentrate resources on to get them to transfer from the car to other modes of travel. The group that is easiest to influence is found to already use public transport to a large extent and the measures will therefore not have such a great effect on this group.

Life quality values also affect the individual’s choice of travel mode (Garvill et al 1994). Garvill et al found that people who prioritise individual life quality factors such as success, enjoyment, and change also prioritised individual consequences in the form of cost, travelling time, flexibility, and convenience in their choice of travel mode.

Security factors
Security is important for choice of travel mode. Women prioritise security on public transport more than men (Warsén, 1997). Women feel insecure on public transport to a greater degree than men. Almost a third of public transport passengers in Gothenburg say that they are afraid of being threatened or attacked on their journey and many simply avoid travelling (Wassénius, 1997). Rowdiness and disorderly behaviour on late night buses can be perceived as so worrying that a traveller will choose another travel mode. If part of a journey is perceived as unsafe, this can be decisive for the travel mode one chooses. If a traveller does not feel safe at the bus stop, perhaps he or she will choose to cycle or walk. If travellers do not feel safe on the way from home to the stop, they may prefer to travel by car (Andersson, 2001). A Norwegian study (Norheim and Strangeby 1993) indicates that there is a willingness to pay for guard patrols on underground stations. The behaviour of other passengers affects comfort. This became more important the more one travelled by bus or when the person in question was a woman.

In a field study of commuters in Stockholm, it was found that insecurity when travelling on the underground comes both from being afraid of other passengers and from worrying that the train will break down or be stopped in a tunnel (Algers, Olsson &
Travellers over the age of 60 feel more insecure than younger people and people with lower levels of education seem to be more afraid than people with higher education. Getting to and from stations and bus stops is in general perceived as more insecure than the journey itself. Studies from Germany especially show unanimous findings with regard to the feeling of security (Flade 1999b, Hunecke & Preißner 2001, Meyer 1999).

There appears to be a difference in the perception of security depending on how often one travels by public transport. People who travel more seldom feel more insecure. The Traffic and Public Transport Authority in Gothenburg has made calculations of the consequences of people feeling insecure in the public transport system. About 4% of people between the ages of 18 and 74 living in Gothenburg refuse, due to the feeling of insecure, to travel by public transport once a week or more. This is equivalent to 6.5 million crowns in lost revenue a week (Wassenius, 1997).

In summary, it can be said that women feel more insecure walking to and from different travel modes than on the journey itself. Security is an important aspect for travellers that must be considered when planning and designing public transport services. It is mainly people who travel seldom or not at all by public transport who feel more insecure than regular passengers. To attract more people to use public transport, it is important to consider the security aspect. Information about delays, punctuality, frequency of service, speed and value for money, however, were valued higher than security (Wassenius, 1997).

The gender factor
Flade (1999b) has found that women’s mobility is less car-oriented than men’s. In cases where women have access to a car, they often use it for transporting other people. According to Krantz (1999), the difference between women and men depends on how work at home is divided among the household. Women still take greater responsibility for children and the home. Driving to the shops, and driving and fetching the children constitute a large portion of women’s total mobility (Meyer 1999).

Several studies show that women and men make different travel mode choices and have different travelling patterns (Carlsson-Kanyama and Lindén 1999, Hjorthol 1999). Men travel longer distances regardless of the weekday (Carlsson-Kanyama et al, 1999). Another difference is that men spend their leisure time outside the home more often than women (Carlsson-Kanyama et al, 1999). The survey shows that women visit museums and go to exhibitions and concerts more, activities that take place more seldom than men’s sports activities. Studies show that if a woman and a man have the same income, the man is first to buy and own a car to a greater extent than the woman (Jansson and Cardebring 1986).

Hjorthol (1999) showed that about 25% of men in the Oslo region receive some form of allowance for a car, or a company car. For women the figure is 5%. Men use the car more than women do and use the transport system more during rush-hour than women. 60% of all public transport journeys are made by women. Women are less mobile in so far as they do not move so far from home, and their journeys often start and end at the same point, and are often related to the home or family members (Hjorthol 1994). Men tend more to value and choose travel modes that are individual, e.g. car, bicycle or motorcycle (Thelander 1997).
One explanation for the difference between women’s and men’s choice of travel mode (Carlsson-Kanyama et al, 1999) is that women’s workplaces are traditionally located closer to home than men’s. A man will often have his workplace in production of some kind, while a woman’s (Krantz and Wilhemsson, 1996) will tend to be in the public sector. Carlsson-Kanyama et al, (1999) maintains that men’s working places are located on the outskirts of towns and cities where public transport is insufficiently developed and that it is more convenient for women to travel by municipal transport than for men because of the locations of their workplaces. At the same time, other studies show that public transport is not adapted to women’s travel patterns of doing errands on the way and working irregular hours, e.g. in the nursing sector (Friberg 1998).

More women than men say that they have a positive attitude to public transport (Warsén 1997, SLTF 2001). Other differences are that women more often value personal security and environmental aspects.

5.4.4 Journey-specific factors

The probability of taking the car for chained trips increases with the household’s income (Hensher and Reyes 2000). If the family has small children, public transport is used less and the car is used more. It is very common today, for example, to use the car to take the children to the day care centre or school on the way to work.

5.4.5 Policy factors

A contributory cause of people travelling to work by car is that the employer provides a free parking space at the workplace. One American study looks at a number of parking and parking charge policies to see how they affect travel by public transport. When the cost of parking was 20-30% higher than the fare on public transport, motorists chose to leave the car at home and travel by public transport. Changing parking charges give the best single effect, but by far the best is a combination of parking charges and better public transport services. The report concludes with the suggestion that the view of parking policies be changed, and that they should instead be seen as part of the region’s transport policy and not just an isolated programme to address congestion problems (TCRP 1998).

Other studies of economic policy factors, however, have found the effect to be that motorists choose other routes or other times of the day for their journey instead of changing to a different mode of travel (Jakobsson 2001).

5.4.6 Quality factors

Some examples of common quality factors are delays, a poor level of comfort (often referred to as quality defects), security, and reliability. The importance of quality factors in the individual’s choice of travel mode is expected to increase in the future due to changes in social norms and income (Goodwin et al 1991). Quality factors include the perception of how well the vehicle has been cleaned (Loncar-Lucassi 1998). Quality factors can also refer to perceived shortcomings in the transport system.
5.5 PARTICULAR FACTORS INFLUENCING THE CHOICE TO CYCLE

Health aspects are something that both cyclists and non-cyclists say is an important motive for cycling. The distance to work, time saved, and the reliability of the journey are also important factors (Forward 1998, Nilsson 1998). Other factors affecting the choice to cycle to work are the ability to take a shower and the standard of the parking facilities (Goldsmith 1992).

Many motives are given for not cycling; these include road safety, have no bicycle, too far, get sweaty, bad weather, luggage to carry, errands to do on the way, cycle thefts, and low status. Other factors that impact cycling negatively are pressure of time, stress, aggressive driving, fear, shopping on the way, mileage allowance, and access to a car (Davies et al 1997).

In the study by Davies et al (1997) individuals were asked to answer why they had chosen the bicycle for their journey. The main reasons they gave were that the bicycle is the fastest travel mode and that they are not dependent on public transport. For journeys in the central parts of town especially, the speed aspect is a decisive reason. In addition to speed and not being dependent on public transport, other motives in support of cycling are health aspects and fewer parking problems (Beck and Immers 1994).
6 MEASURES INFLUENCING CHOICE OF TRAVEL MODE

6.1 INTRODUCTION

Among the abundance of factors that influence people’s choice of travel mode there are both physical and behavioural measures. Examples of physical measures are measures to increase passengers’ comfort. Examples of behavioural measures include campaigns.

This chapter describes physical and behavioural measures.

6.2 MEASURES TO REDUCE CAR USE

Example of measures that can be taken to influence car drivers to travel less by car are information/education, economic incentives or sanctions, influencing social norms, making car journeys less attractive, reducing the need to travel by changing the locations of homes, workplaces, shops, and leisure centres, or by making alternative means of travel more attractive. The different measures have varying effectiveness, costs, time horizons and political feasibility (CAPTURE 1999).

Another way is to introduce car pools. According to a Norwegian study (Berge 1998) a typical member of a car collective in Norway is a man over the age of 30, with or without children, with a high level of education, and an average income. On average a member travels less than the average Norwegian with access to a car.

6.3 POLICY MEASURES

Many infrequent travellers by public transport enjoy free parking at work but have to pay at home, which means that they feel forced to take the car to work. A fringe benefit tax on free parking might reduce travelling by car in favour of public transport.

In an EU study (WALCYNG 1998) it was found that people who always drive and never cycle to work showed the greatest resistance to choose the bicycle. The parking charge would need to be 30 SEK a day for these people to be persuaded to leave their cars at home. Studies have shown that parking charges (restrictions) are a cost-effective measure (CAPTURE 1999).

However, policy measures in the form of higher costs for cars, can lead to protests against the measure (Jacobsson 2001). Road pricing, according to Jacobsson (2001), is
not an acceptable measure since it is regarded as discriminatory and an infringement of people’s personal freedom.

For policy measures to have the desired effect it is important that there is a high level of acceptance for the measures one is introducing (Steg et al 2000). The public and researchers do not share the same view when it comes to accepting different measures. Measures that are effective in an economic perspective are often not feasible from a social and political point of view, because the distribution of cost and benefit is not balanced between the actors. No single parking strategy is both effective and politically acceptable (TCRP 1998). In the academic world, road pricing is regarded as the optimum solution to transport problems. For society in general, road pricing seems to be a good solution but to the individual it is not and it is the individual who is important to the politicians (Rienstra 1999).

6.4 INDIVIDUAL-SPECIFIC MEASURES

Measures have different effects on different people. A number of researchers have made lifestyle analyses (Berge 1997) by dividing individuals into different groups according to their lifestyle. Others have based their categorisation on the type of road user (Jensen 1997). The results have given us knowledge of what specific measures are suitable for different groups of individuals. A measure must be effective on a personal level to have an effect on the choice of travel mode (Lindén 1994).

Another aspect that must be considered is the fact that individuals have different experiences of travel modes. This means that it is easier to get a person who already cycles to cycle more than to try to influence a person who always chooses the car and seldom or never cycles.

6.4.1 Security measures

In a field study conducted among travellers in Stockholm it was found that all travellers wanted more security on public transport during the evening and at night (Widell, 2001). Measures suggested by the respondents included better lighting, more guard patrols and surveillance cameras. They believed that this would reduce vandalism. 87% were positive to surveillance cameras and 70% felt that the graffiti on the seats added to the feeling of insecurity. More guard patrols on trains, trams and buses was the most popular measure among both regular and occasional travellers.

6.4.2 Influencing attitudes

People’s behaviour is influenced by experiences and habits (Forward 1998b). Routine decisions are, however, difficult to influence with information, which may explain the resistance to change that is often observed (Goodwin 1998).

Influencing attitudes can be used to influence people to change their mode of travel. However, this requires more than simply providing a positive image of the mode in question. An individual who already has a positive attitude to a particular travel mode
may in any case not choose that particular mode (Loncar-Lucassi 1998). There may not always be a definite linkage between attitude and behaviour; there may be other factors that weigh heavier, e.g. social norm or perceived control.

Berge (1997) shows that different lifestyle groups have different attitudes to the environment and car driving. The different groups require different approaches to change their transport behaviour to a more environment-friendly transport alternative. The easiest group to influence generally proves to already be using public transport. And the measures do not have such a great effect (Berge 1996). For the older individual-oriented group, using the car has become a habit, and they do not see the car as an environmental problem. Environmental arguments therefore have little effect; a better approach is to focus on their health. Carlsson-Kanyama and Lindén (1999) maintain that it may be worth investing resources to influence the middle-aged high-income group, since these people have the least tenable travel pattern with regard to energy consumption.

An EU project, INPHORMM (1998), studied ways of using information, publicity and marketing (referred to as communication) to influence people to use their cars less. Within the framework of the INPHORMM project, attempts have been made to encourage the use of environment-friendly modes of travel. A model has been developed in the project with the aim of creating understanding of how communication can be used to change attitudes and behaviour. The results from the project show that by using communication, the general public’s awareness has been raised and attitudes influenced so that travel has changed.

Communication is most effective when implemented by stages (INPHORMM 1998). In the strategy developed (Eriksson and Lindvall 1998), the campaign is run in several different phases. In the first phase, attention must be drawn to a particular mode, e.g. cycling. The next phase involves getting people to become involved. It is in this phase that it is important to approach the different groups in different ways. In the third phase, when people have begun to cycle, contact on a more personal level is needed. And the new cyclists may need to exchange experiences with each other. The final phase is an evaluation of behaviour.

### 6.4.3 Incentives

Both positive and negative incentives can be important complements to a campaign. The idea is to promise people some sort of reward at the beginning for changing their behaviour. When the individual has tried the new behaviour, the hope is that he or she will continue without being rewarded. Depending on where one is in the marketing hierarchy¹ (awareness, acceptance, change of attitude, action and building loyalty) different incentives are needed. A necessary condition for continuing with a new behaviour is that the individual’s experience is positive.

¹ According to the marketing hierarchy developed by Tobbe Eriksson (1998) the first step is to create awareness of and interest in different modes of travel. The next step is to create acceptance and a change of attitude by getting people to realise that they are part of the problem – but also its solution. Everyone can contribute to the solution. A change of attitude is the next step, where arguments are based on emotions instead of on facts. The final step is to put the new mode of travel into the hands of the people who are to use it, i.e. provide the information they need in the form of timetables or suitable cycling routes.
Traffic researchers in Germany (Bamberg, Niestroy & Weber 2000) have estimated different types of information packages (e.g. individualised marketing and mobility counselling/transport service counselling when moving house) to be the most important transport policy measures to increase the use of public transport. It is especially important that the information reaches people when circumstances beyond their control force them to review their choice of travel mode (e.g. when they move house or move to a new job etc).

6.5 TRANSPORT-RELATED MEASURES

6.5.1 Measures for the infrequent traveller

Infrequent travellers use public transport when they have drunk alcohol or when they have parking problems. To make these travellers more satisfied, shorter travelling times, more frequent services, more information about other SL alternatives, and a more flexible fare system are needed. Infrequent travellers feel it is expensive to pay cash.

6.5.2 Measures for the habitual traveller

In order to keep habitual travellers and increase their satisfaction, public transport must be more reliable, information about disruptions must be improved, and busses and trains must be less crowded. Information about disruptions is valued very highly by travellers and lack of adequate information about service disruptions is perceived as just as irritating as the disruption in itself.

6.5.3 Examples of railway initiatives

In Sweden, two railway initiatives have proved that mode-specific measures can be very important for increasing travel by public transport. On the Kustpilen train in Blekinge, travel has increased many times over with its modern trains with a high level of comfort, frequent services and low fares (Lindh and Widlert 1989). The investment in the Svealand line has generated seven times more passengers when travelling times were shortened, very frequent services and greater comfort were introduced (Fröidh 2003).

6.5.4 Examples of combined trips

A study conducted in the USA looked at the effects of the choice between Park & Ride or Bike & Ride and the car for the whole journey. One aim of the study was to identify significant effects on a number of factors that influence cyclists’ choice of travel mode for journeys to work. A cyclist here is defined as a person who cycles at least once a month. The findings indicate that the provision of cycle locks in the cycle park is the most cost-effective of all the measures studied. Another conclusion is that
cycleways are a much better incentive for inexperienced cyclists than wide curb lanes (Taylor and Mahmassani 1996).

6.5.5 Standard-raising measures

A high standard of travel is the single most important factor for increasing market share. The standard of travel consists of a number of measures in the areas of accessibility, timetable, comfort and service.

Service measures

Service measures can be expensive if they require personnel. It is therefore not as obvious that a high level of service is profitable in a strict willingness to pay perspective. However examples of profitable measures, in trains, are special playrooms for children and individual headphone sockets beside passengers’ seats (Kottenhoff 1999).

Toilets are one of the service functions asked for most often. Passengers also want to be able to buy small things they might need, be able to get some form of refreshments and have access to a telephone. Turning stations into restaurant and shopping complexes, on the other hand, is not judged to be a way of increasing travel by public transport (CAPTURE 1999).

Comfort measures

Comfort measures often increase travellers’ willingness to pay by more than what they cost. Examples from a study by Kottenhoff (1999) are that travellers’ willingness to pay is greater than the cost for air conditioning and/or individually adjustable ventilation.

6.5.6 Measures in the infrastructure

CAPTURE (1999) is an EU project that among other things studied physical measures to increase the proportion of public transport travel. City buses, for example, should be able to drive at an average speed of 20 kph: if this is not possible, the problem should be solved by making it easier to get on and off, and giving buses priority even if this means a deterioration in accessibility for car drivers. Single physical measures unfortunately tend to be expensive in relation to the effect they have on the choice of travel mode.

6.5.7 Measures at stations and stops

Several EU projects in 1999 (MIMIC, GUIDE and PIRATE) found that the accessibility of public transport and the standard of the interchanges are important factors if we want to make public transport more attractive. Badly implemented measures can both be ineffective and create opposition to public transport measures.

In a study of track-bound and bus traffic in Stockholm (Algers et al 2001) it was found that the standard of underground stations and bus stops was valued very highly. This also means that travel will increase if the standard can be raised and then maintained. For example, rain shelters with lighting, seats, and information in real time were valued
highly. The EU’s GUIDE project (1999) also showed that cleanness and good lighting at stops and interchanges are valued highly by passengers. Many transport models see an interchange as a barrier within public transport; this may have something to do with the often low standard at the interchanges. Seemingly small problems such as inadequate information, inconsistent signs, shortcomings in security, inconvenient pedestrian routes, and inadequate parking facilities at the stations become barriers for passengers wanting to travel by public transport.

It is not just the information that should be concentrated upon, the possibility to increase ease of orientation or clarity should also be considered. This can be achieved by using a simple network with few and straight lines, a clear infrastructure, short distances in interchange terminals, fast intracity bus routes etc. Track-bound traffic is often easier to remember than bus traffic, because it is not so easy to change. Track-bound traffic therefore contributes to better orientation.

6.6 SPECIAL WALKING/CYCLING MEASURES TO ATTRACT MOTORISTS

In an attitude study in England (Davies et al 1997) the respondents gave examples of measures that should be implemented to increase cycling: speed limits for motor vehicles, traffic regulation, secure bicycle parks, more information about suitable cycling routes, various kinds of encouragement from work.

It is not a complete surprise that car use increases if the mileage allowance is raised. At the same time, there is an increase in cycling if parking facilities for cars are restricted and people use their cars less, especially over distances less than about 5 km. If the distance is more than about 5 km, travel by public transport increases instead. An interesting aspect is that possession of a public transport pass is a more important factor for not cycling than having access to a car. It may be so that once one has bought a pass, one really intends to use it, but if one has access to a car it does not go without saying that one will take the car; it may be there for other members of the household to use (Beck et al 1994).

Forward (1998b) gives some examples of how people can be motivated to choose to walk or cycle instead of using their car for short journeys. In this respect, measures that increase road safety and accessibility for cyclists are important, together with reducing accessibility for cars. Forward also gives some examples of policy measures:

- introduce a system for lending bicycles
- offer ‘company bicycles’
- improve protection against bicycle theft
- expand and improve home deliveries
- improve car rental services
- Give environment-friendly means of transport higher priority and cars lower
- Increase the number of parking spaces for bicycles and reduce the number of spaces for cars
- raise the status of environment-friendly alternatives
- restrict space for car advertising
Another way of encouraging the use of bicycles is to do what a company in London has done: give employees who use their bicycles in the course of their work the same mileage allowance as those who use their cars (Vägverket, Swedish National Road Administration 1998).

6.7 COMBINATIONS OF MEASURES

Getting private car drivers to transfer to other modes of travel requires several kinds of measures (TCRP 1998). Measures that Jensen (1997) and Hass-Klau (KFB Kommuniké 3/99) suggest are to expand the public transport network and at the same time restrict accessibility for motorists and raise the price of petrol, and improve the general conditions for cyclists. Studies show that merely improving public transport will not make motorists choose public transport. Berge’s (1996) conclusion shared by Hass-Klau and Jensen among others; is that getting motorists to transfer requires a combination of restrictions for the car, better prerequisites for pedestrians, cyclists and public transport, communication in the form of campaigns, and information and incentives.
7 CONCLUSIONS AND FURTHER RESEARCH

7.1 SUMMARY AND CONCLUSIONS

A general problem in transferring travellers from car to other modes of travel is that the car is perceived as simple and cheap. Many societies have been built around the car, which has made choosing other travel modes difficult. One of the contributory causes is the force behind the motorised society and economic growth. Another may be the fact that there is no strong lobbying in support of pedestrians and cyclists. Cycling also has an image problem due to the high accident risk in traffic. Another reason is that the car is often a fringe benefit. Approximately 25% of men in the Oslo region receive some form of allowance for a car or a company car. For women the figure is 5%.

People’s view of and also their dependence on the car differ from individual to individual. Men value and choose modes of transport that are individual, for example cars, bicycles and motorcycles, to a greater extent. The car is implemented at an early stage in children’s lives and they learn that the car is a status symbol. The car has, though, lost some of its symbolic value and young people of today are distancing themselves from habitual car driving and their parents’ use of their cars.

According to one study, 20% of car journeys are unavoidable; 60% can be influenced (but are dependent on the standard of public transport, working hours and the location of services); and 20% could be replaced by some other mode. Journeys to and from work are considered easiest to transfer from the car while journeys to leave and fetch children are hardest.

Women’s mobility is less car-oriented than men’s. Women still take greater responsibility for children and the home. If the family has small children, public transport is used less and the car is used more. It is very common today, for example, to use the car to take the children to the day care centre or school on the way to work. One of the reasons why children are being driven to school more and more is that parents are free to choose a school for their children and many parents today are driving their children to schools far away from where they live.

There are several theories about how people choose their mode of travel. In psychology qualitative methods are usually used, while in economics it is normal to use quantitative methods. In an attitude-based model the attitude must be measured against actual behaviour. The logit model is the most common economic method of describing how individuals choose between different alternatives. The model shows how strongly different factors influence the choice of travel mode and what linkages exist between the factors.
In normal transport-economic models it is assumed that people are rational and choose the mode of travel that gives them the most benefit. Several researchers, however, maintain that people largely choose a mode of travel according to feeling and habit. This is expressed by our not changing our behaviour just because conditions change (Goodwin 1998, Ben-Akiva et al 1999).

There are many factors that determine the choice of travel mode. Several of them are strongly correlated. In some models a certain factor may explain the choice of travel mode while in another the same variable does not have the same meaning, but is hidden by other explanatory variables (Magelund 1997). Since attitudes variables are related to car use, car use may be better explained by taking the attitude variables into account in the standard mode choice models (Magelund 1997; Steg et al 2000).

Some factors can be influenced by the individual while others are harder to influence. Some can only be influenced by central government (e.g. parking restrictions) while others such as weather, topography and gender are as good as impossible to influence. The government can exert influence through different policy measures. The individual also has a choice that is based on experience, habit and attitude towards the mode of travel. The individual is also influenced by other individuals.

Security is an important aspect for travellers that must be considered when planning and designing public transport. Generally speaking, people who seldom or never travel by public transport feel more insecure than habitual travellers. This shows that it is important to consider the security aspect if more people are going to be attracted over to public transport.

Seemingly minor problems such as inadequate information, inconsistent signs, shortcomings in security, inconvenient pedestrian routes, and inadequate parking facilities at the stations become barriers for passengers wanting to travel by public transport.

Different lifestyle groups require different approaches to change their transport behaviour to a more environment-friendly transport alternative. The individuals who are easiest to influence generally prove to already be using public transport and the measures do not have such a great effect on this group. It may instead be more worthwhile to concentrate resources on influencing the middle-aged, high-income group, since these people have the least tenable travel pattern with regard to energy consumption.

Studies have shown that merely improving public transport will not persuade many motorists to choose public transport. Discouraging private car drivers from driving requires a combination of restrictions for the car (e.g. road tolls, car-free zones, parking charges, better prerequisites for pedestrians, cyclists, and public transport, communication in the form of campaigns, and information and incentives).

Interchanges with public transport must be smooth and easy and it must not be too far to walk if motorists are to be persuaded to use Park & Ride. At the same time, the Park & Ride system must not compete for the passengers who make the whole journey by public transport or who cycle to the station. One solution is to improve things for bus passengers and cyclists at the same time as the Park & Ride facility is built.

A high standard of travel is the single most important factor for increasing market share. Single physical measures unfortunately tend to be expensive in relation to the...
effect they have on choice of travel mode. Parking charges and restrictions are the exception, since they are cost-effective. Comfort measures often increase travellers’ willingness to pay by more than what they cost. Accessibility to public transport and the standard at interchanges are important factors for increasing public transport’s attractiveness. Badly implemented measures can both be ineffective and create opposition to public transport measures.

In the academic world, road pricing is regarded as society’s optimum solution to its transport problems, but not to the individual, who is important to the politicians. Parking policies should be regarded as part of a regions’ transport policy and not just as an isolated programme for addressing the congestion problems.

7.2 THE NEED FOR CONTINUED RESEARCH

Research is needed on how the location of homes, business centres and work places affects our choice of travel mode. Here, overall planning is important to achieve a holistic view, for example a study of how modal split in the area is affected when a new business sets up or new homes built should perhaps be a requirement.

When planning an attractive Park & Ride, its effects on public transport passengers and cyclists should also be studied. The Park & Ride system should not compete for the passengers who make the whole journey already by public transport or who cycle to the station, since it is first and foremost the motorists who are to be attracted to use the Park & Ride.

7.2.1 Factors and models that explain the choice of travel mode

Continued research is needed into which factors should be included in different models to best explain individuals’ choice of travel mode and how these factors co-vary. It is difficult if not impossible to include all factors in one model yet research indicates that explanatory factors are still missing. First and foremost, cycle journeys and journeys made on foot need to be better integrated in the models. The possibility to gather the information to include in the model and ways of quantifying the information should also be studied.

Greater attempts are being made to integrate the results of psychological studies into traditional transport models, but more research is still needed. The degree of explanation of travel mode choice will be improved if subjective factors such as attitudes to describe the choice of travel mode are included in the model.

7.2.2 Knowledge of how different individuals are influenced

More research is needed on how different individuals are influenced by communication. Studies have shown that there is a group of individuals who consume especially large amounts of energy resources through travelling extensively by car. Instruments
should be sought to influence this group to travel in a more environment-friendly manner because if successful, the environmental impact would be substantial.

Studies show that the car satisfies needs that public transport does not. Deeper studies are needed of how public transport can satisfy such needs as identity, status and prestige.

More knowledge is needed about why women value public transport more than men do. Earlier studies indicate that women use public transport more and have a more positive attitude to it. Their points of view can teach us what factors and measures influence the choice of travel mode.

Ways of keeping public transport passengers past the age of 25 should be investigated, since many studies show that 25 is the critical age at which many people abandon public transport in favour of the car.

7.2.3 Study of how different factors affect the proportion of cycling

This literature review has taken up a number of measures for increasing the share of cycling but more research is needed into how and to what extent cycling is influenced by weather and distance, the importance of road signs and also clear information about where to cycle.
8 REFERENCES:


Ajzen, I. and Fishbein, M. Belief, Attitude, Intention and Behavior: An introduction to Theory and Research. Addison-Wesley. 1975


Behavior Research Opportunities and Application Challenges, H. Mahmassani (ed) 1999


Berge, G. Livsstil og transportmiddelvalg, TØI rapport 328, Oslo 1996

Berge, G. Livsstil, miljøbevissthet og transportatferd, TØI rapport 366, Oslo 1997


Bergström, A. Cykling vinterid, VTI meddelande 861, Linköping 1999


CAPTURE, Cars to Public Transport in the URban Environment. EU-projekt, Results, Recommendations & Guidelines, Copenhagen 1999


Carlsson-Kanyama, A. Lindén, A-L. & Thelander, Å. Gender Differences in Environmental Impacts from patterns of Transportation – A Case Study from Sweden, Society & Natural Resources 12, 1999


Domencich, T. & McFadden, D. Urban Travel Demand: A behavioural Analysis. Amsterdam, Netherlands 1975

Edström, N. KFB Kommuniké 2/99, Stockholm 1999


Forward, S. *Behavioural factors affecting modal choice,* part of EU-project ADONIS, Linköping 1998a

Forward, S. *Theoretical models of attitudes and the prediction of drivers’ behaviour* Uppsala Universitet. Psykologi. Uppsala psychological reports no 434, Uppsala 1994

Forward, S. *Valet av transportmedel för kortare resor: Göteborgarnas resvanor och attityder,* VTI rapport 437, Linköping 1998b

Friberg, T. *Förflyttningar, en sammanhållande länk i vardagens organisation,* KFB rapport nr 23, Stockholm 1998


Grue, B and Hoelsaeter, A; *Innfartsparkering med bil og sykkel – Faktorer som påvirker togtrafikantenes valg av transportmiddel til stasjonene i Oslo og Akershus,* TOI notat 1159/2000, Oslo 2000


Gärling, T. *Bilbushålls vilja att reducera bilresande för olika syften.* TRUM 1992:2, Umeå universitet, Umeå 1992

43


Hensher, D. & Reyes, A. *Trip Chaining as a Barrier to the Propensity to use public Transport*. ITS- WP-00-12, Sydney 2000


Hjorthol, R. *Kvinners og menns oppfatning av transportmidlenes egenskaper og symbolverdi*, Sociologisk Tidsskrift, Vol. 7 Nummer 2, 1999


Infartsparkering 1996/97, Underlag för Dennisöverenskommelsen, Region- och trafikplanekontoret, RTK, Stockholm 1992


Jakobsson, C. *Motivational and Behavioral Effects of Economic Disincentives on private Car Use*, Department of psychology, Göteborg, 2001


Jensen, M. *Benzin i blodet kvalitativ del*, DMU rapport nr. 191 Köpenhamn 1997


Lesser, P. *Komfort i kollektivtrafik Chalmers tekniska högskola*. Projektarbete M3, Göteborg, 1986


Lindh, C. *Tågresenärens betalningsvilja för förbättringar av punktlighet, restid och turtäthet*, KTH 1992, TRITA-TPL 92-09-82


Lindquist Dillén, J. *Stated preferences, en metod för att skatta värderingar och beteenden*. Transsek. Solna 1995


Lundgren, Lars J.; *Livsstil och miljö – värderingar, val, vanor*, Kristianstad 1999

Lundin, A; *Försöksverksamhet med nya symboler vid utmärkning av infartsparkeringar*, Stockholm, 1998


Matstoms, P. *Modeller och prognoser för regionalt bilinnehav i Sverige*, VTI rapport 476, Linköping 2002
McFadden, D. *Disaggregated Behavioral Travel Demand’s RUM Side A 30 year Retrospective.* 9th IATRB, conference, Australia 2000


MIMIC, Mobility Intermodality and Interchanges, EU-project, www.sypte.co.uk, www.interchange.co.uk, 1999

Montogomery, H. *Attityder, livsstil, trafikbeteende.* Psykologiska institutionen, Stockholms Universitet, Stockholm 1993


Parkhurst, G. Kenny, F. and Goodwin, P. *Quality Attributes of a Journey – Their identification and impact on travellers,* Transport Studies Unit, University of Oxford, UK 1992


Polks, M. *Gendered Mobility,* Göteborgs universitet, Göteborg 1998


RAC; *Car Dependence*, ESRC Transport Studies Unit, University of Oxford, UK 1995


Sjöstrand, H. *Värdering av kvalitet i lokal kollektivtrafik med Stated Preferencemetoden*. Bulletin 175 Traffic planning, Department of Technology and Society, Lund University, Lund 1999


Thelander Å; *What goes around comes around*. Forskningsrapport nr 2, Lund 1997


Usterud Hanssen, J; *Parkering: et virkemiddel i samordnet areal- og transportplanlegging*. Transportøkonomisk institutt. TOI rapport 349, Oslo 1997


WALCYNG EU-project *How to enhance walking and cycling instead of shorter car trips and to make these modes safer*, Bulletin 165, Lund 1998


Wretling, P. *Påverkar väderförhållanden vintertid färdsmedelval vid resor till arbetet eller skolan?* VTI rapport 44, Linköping1996
PART III

Attracting car drivers to Park & Ride – interviews with users and non-users of Park & Ride facilities
Abstract

The increase in car traffic in many major cities has led to problems involving congestion and pollution. One proposed solution to the transportation problems could be to offer car users attractive Park & Ride lots with good connections to public transport. The aim of this study is to find out how to attract more car drivers to Park & Ride facilities and to investigate if there is a potential for increasing the use of Park & Ride. The purpose is also to characterise these two groups and to understand the extent to which some factors influence the choice of using Park & Ride. Telephone interviews targeting users and non-users of Park & Ride lots were carried out. The principal findings from this work are that there is potential for increasing the use of Park & Ride facilities, especially among women and respondents over 30 years. Some 59% of the non-users say they are prepared to use it at least once a week. The results show that individual security and security for cars are very important criteria for determining what makes a Park & Ride lot attractive. In addition to good marketing and publicity, effective road signs guiding to the facilities and clear signs at the lots are highly recommended.
# TABLE OF CONTENTS

1  **INTRODUCTION** ........................................................................................................... 5
   1.1  **BACKGROUND AND EARLIER STUDIES** ......................................................... 5  
   1.2  **OBJECTIVES** ......................................................................................................... 6  
   1.3  **RESEARCH STATEMENTS** .................................................................................... 7  

2  **METHODOLOGICAL APPROACH** ........................................................................... 8
   2.1  **STATISTICAL TESTS** ............................................................................................. 8  
   2.2  **SURVEY METHODOLOGY** ................................................................................... 8  
      2.2.1  **Description of the lots** .................................................................................. 9  
      2.2.2  **Sampling procedure** .................................................................................... 10  
      2.2.3  **Questionnaire content** .................................................................................. 11  

3  **RESULTS** .................................................................................................................... 12
   3.1  **COMPARISON OF USERS AND NON-USERS** .................................................. 12
      3.1.1  **Correlations** .................................................................................................. 13  
      3.1.2  **Grading of characteristics** .......................................................................... 14  
   3.2  **RESULTS OF NON-USER INTERVIEWS** ............................................................ 15
      3.2.1  **Open questions** ............................................................................................ 15  
      3.2.2  **Statistical test** ................................................................................................ 17  
   3.3  **RESULTS OF USER INTERVIEWS** ..................................................................... 19
      3.3.1  **Open questions** ............................................................................................ 19  
      3.3.2  **Statistical test** ................................................................................................ 21  

4  **SUMMARY AND DISCUSSION** .................................................................................. 22
   4.1  **MEASURES FOR INCREASING THE USE OF PARK & RIDE** ............................... 22  
   4.2  **QUALITY ASPECTS** ............................................................................................ 23  
   4.3  **PotENTIAL FOR INCREASING PARK & RIDE** .................................................. 23  
   4.4  **TYPICAL USERS** ................................................................................................ 24  
   4.5  **DIFFERENCES BETWEEN WOMEN AND MEN** ............................................... 24  

5  **FURTHER RESEARCH** ............................................................................................... 25
   5.1  **TRAVELLING WITH CHILDREN EASIER** ......................................................... 25  
   5.2  **THE EFFECTS OF MEASURES ON MODE SPLIT** ............................................ 25  
   5.3  **COMPETITION BETWEEN PARK & RIDE AND PUBLIC TRANSPORT** .......... 25  

6  **REFERENCES** .............................................................................................................. 26
1 INTRODUCTION

1.1 BACKGROUND AND EARLIER STUDIES

Problems associated with traffic, such as traffic congestion and pollution, have arisen in urban areas in particular. The use of cars has increased and it is estimated that by 2010 passenger traffic will increase by 17% (SIKA 2000). In Sweden, a total of 60% of all passenger journeys are made by car (SIKA 2000).

One proposed solution to many of the transportation problems is to offer car users attractive Park & Ride lots with good connections to public transport. Several of the existing Park & Ride lots in the Stockholm area have a low occupancy rate (SL Konsult 1998). The question then arises of how Park & Ride lots can attract car users.

Whether the Park & Ride mode is chosen or not depends on many factors, such as the supply of public transport, the quality of the parking lot and parking conditions both at home and at the destination (Thurnbull 1995). According to a survey in Stockholm (RVU 86/87), 80% of the commuters heading towards the city centre have a parking cost that is zero or below 10 SEK a day and a parking space arranged within three minutes’ walk from their workplace.

Other factors influencing the choice are time and cost savings compared with driving a car for the whole trip. The walking distance from the parking lot to the platform also has an effect on the choice of mode. Attractive lots usually have a distance of 50 m, while those with distances of more than 300 m are not used as frequently (Infartsparkering 1992). In a Norwegian study, the average walking distance from the parking lot to the platform is 133 m (Usterud Hanssen 1997). In Britain, the parking costs in the city are high and it is usually hard to find a parking space. This has led to an increase in the building of Park & Ride facilities that has increased the accessibility to the city and allowed car users to gain time (Picket and Gray 1996 ref in Lind and Schmidt 1998). As a consequence there is an increase in the total number of trips.

Another purpose of the Britain study was to determine what characterises the users and non-users of Park & Ride. Women and the lower income groups use these lots more frequently.

In the USA, Park & Ride is regarded as a part of public transport. In a report (NCHRP 1995) it is suggested that the use of Park & Ride will be of more importance than it is today as an effective measure against congestion and pollution. Also mentioned are intelligent technology systems (ITS) in the form of information for travellers in their homes and real-time information on buses.

In Stuttgart, Germany, a dynamic information system has been tested in order to increase the use of Park & Ride. The information for travellers comprised available parking places, travel time, next departure time and information about traffic congestion.
At first, the use of the facilities steadily increased, but, after a parking fee was introduced, it slowed down. Some 60% say that the lack of available parking spaces at the destination is the main reason for using the lot. One interesting result from this study is that it is car drivers that start to use Park & Ride instead of driving all the way. Some 80% of the people in the study who use the lot say that they drove all the way before. The study also shows that the inconvenience of finding a parking place in the city centre is worse than the saving in time one can probably make. Dynamic information also increases the use of Park & Ride by 10-20%.

In a study conducted in Gothenburg (GLAB 1997 ref in Lind and Schmidt 1998), car drivers were asked which alternatives they would choose if they received a message about congestion: 11% said that they would park the car and take the train, 14% said they would stay in the car but investigate whether there was a suitable train and over half (56%) said they would ignore the information.

In a Stockholm study (SL Konsult 1998), users were interviewed about their reason for using Park & Ride. Some 30% said that public transport to the Park & Ride lot did not suit them, 18% said that they were short of time and 12% said that it was too far to use a bike or walk. Half the interviewed users said that they had no parking facility at work or that it was too expensive (SL Konsult 1998).

Another study conducted in Stockholm (Lundin, 1998) resulted in a list of characteristics of an attractive Park & Ride lot. They included a secure parking lot for both people and cars, a high frequency of public transport departures, always being sure of getting a parking space and close to services such as shops but also day-care centres. The location of the parking lot is also important in order to attract car users. Some of the advantages that were mentioned were the time saving associated with congestion and not having to spend time on finding a parking space. The conclusions are that environmental reasons were not important; people are instead egoistic or rational when using Park & Ride. The interviewees regard Park & Ride as a convenient solution to some of the problems causing congestion. However, the location has a decisive effect on the attractiveness and using Park & Ride should contribute to making travelling easier.

In seeking to promote Park & Ride, it is desirable to understand the reasons for using or not using Park & Ride lots. Therefore the question arises of how to attract car users to Park & Ride lots.

1.2 OBJECTIVES

The aim of this study is to find out how to attract more car drivers to Park & Ride facilities and establish the potential for increasing their use. One of the aims of this research is to determine how personal factors and other background factors influence the choice of mode. This paper describes both users of these facilities and frequent car drivers’ reasons for using or not using Park & Ride lots. The purpose is also to characterise these two groups. To determine the factors that influence travellers’ decisions to use or not to use Park & Ride and to study possible ways of attracting car drivers to Park & Ride, two surveys were conducted.
1.3 RESEARCH STATEMENTS

The main question to be answered is how car users are to be attracted to Park & Ride. In order to answer this question, users and non-users of Park & Ride have been asked this question. In addition, personal and other background questions were asked. By examining the choice of mode of either Park & Ride or the car for the whole trip and the background factors, it might be possible to understand how the choice of mode is influenced by these factors.

The following research statements or questions are of interest to explore:

❖ There is a relationship between choice of mode and background factors.

❖ What measures would attract car drivers to Park & Ride?

❖ There is a relationship between whether or not a person is willing to use Park & Ride and background factors.

❖ There is a relationship between with what frequency a person is willing to use Park & Ride and background factors.
2 METHODOLOGICAL APPROACH

The following principal methodology was used to explore the research statements above.

- The Chi-square (χ²) method is used to compare the two groups of users and non-users.
- Pearson correlation is used to test the statements of relationship between the choice of mode and background characteristics.
- Open questions are categorised and analysed in a qualitative and subjective way. A few open questions have been coded and tested statistically using Pearson correlation.

2.1 STATISTICAL TESTS

Cross-tabulations were used to compare the characteristics of the two groups of users and non-users of Park & Ride. The aim of cross-tabulation analyses is to determine whether there is any relationship between the tested variables. In this study, the chi-square test function (χ²) was used as the answers are stated on a nominal scale. The value for χ² is calculated by taking the squared differences between the observed frequencies and expected frequencies divided by the expected value. This is done for all categories for the factor, which are then summarized, see equation below. The χ² value is compared with a critical χ² value taken from the χ² distribution for different significant levels. Usually the significance is tested at 5% level.

\[ \chi^2 = \sum \frac{(O-E)^2}{E} \]

where

- O = the observed frequency
- E = the expected frequency

2.2 SURVEY METHODOLOGY

The surveys were conducted in a suburban area of Stockholm at three Park & Ride lots targeting people living near one of the Park & Ride lots (non-users) or parking there (users). The data was collected through telephone interviews in October 1999.
The users were asked to participate in a study about Park & Ride facilities when parking at one of the Park & Ride lots. If they agreed, an interviewer called at their home addresses.

After the users’ home addresses were collected, the boundaries of the influence area were set to coincide with the area in which the users lived. Non-users were then called from a telephone register and asked whether they were willing to participate in a study about Park & Ride facilities. Those that agreed to participate were questioned directly on the line.

The chosen area included the Park & Ride lots: Vällingby, Åkeshov and Råcksta which are all situated along the same underground railway line (Green line). These lots were chosen because they are situated along a main road that suffers from congestion. However, the number of occupied spaces is quite low at these lots. At Råcksta, 23% of the spaces are occupied, while the figure at Vällingby (Bräckegatan) and Åkeshov is 42% (SL Konsult 1998b).

In an earlier study (Lindström Olsson 1999), some 25 Park & Ride lots were graded according to the following criteria:

- Security of the lot, for both person and vehicle (high rates if guards, lights or if possible to see through when passing by)
- Ease of parking at the lot (low rate if there are no signs showing the way to the lot)
- Location relative to public transport terminal (high rates if the lot is an interchange)
- Distance between parking lot and platform
- Level of additional service: for example, shops and service for the car
- Type of public transport and frequency

The criteria were graded on a scale of 1 to 5, where 1 is the least important and 5 the most important. For a more complete definition of these criteria see Lindström Olsson (1999).

The average score for each lot helped to determine which of the lots were of interest to study further. One reason for choosing the Vällingby lot was that it obtained the highest average score according to the criteria. Åkeshov received the lowest score and Råcksta has a very low number of occupied spaces in an area where the opposite would be expected (according to the scores). Another aim of choosing these lots was to understand why these lots are not frequently used.

### 2.2.1 Description of the lots

**Vällingby**

Vällingby is fairly difficult to find and is therefore quite easy to drive past. Many turns are needed in order to park. There are 45 spaces and 42% of them are occupied. It costs 10 SEK to park here. The security at the lot appears to be satisfactory since it is possible for passers-by to see the parked cars. In addition to the underground railway, several buses serve the lot.
At Åkeshov, it also costs 10 SEK to park. As there are no road signs from the main road, it is also difficult to find the lot, especially for newcomers to the area. Åkeshov has 166 spaces and 42% are occupied. The lot is in a deserted location, which makes it insecure for both people and vehicles. There are no services around the lot. There is a street nearby where parking is free.

Råcksta
Råcksta is also hard to find. There are two road signs, but the distance between them is long, making it difficult to find the lot. The facility has two floors and the top floor has no roof, which makes it easy for people passing by to see through. Otherwise, it appears to be well lighted. There are approximately 280 spaces. There are no buses that serve Råcksta, only the underground railway. However, there is a fast-food restaurant.

2.2.2 Sampling procedure

Respondents were recruited by an interviewer firm at three Park & Ride lots and from a telephone register comprising non-users living in the influence area of the lots.

A screening question was asked first to obtain the right target groups. The respondents had to use their car as their usual mode for trips, regardless of the purpose. The screening question was put to the people who parked at one of the selected Park & Ride lots and to those who lived in the influence areas of the lots. The survey was designed to take no more than 15 minutes.

The group of users has been defined as the persons that were found parking at a lot on the day of the interview. Users and non-users were asked the same background questions, but different questions were asked about Park & Ride.

Sampling strategy for users
In order to find the users, an interview team was sent out to talk to people when they were parking at one of the lots described earlier. The users were asked to participate in a study about Park & Ride facilities. If they agreed, an interviewer called at their home addresses the same day or the following day. The questions are described later in this paper.

Recruiting users was quite easy at Råcksta but more difficult at the other two lots. At Åkeshov, 44% of the users said that they used the lot for other purposes such as shopping or swimming at the nearby swimming pool. Ten per cent refused to participate. In the street next to Åkeshov, parking was free, making it harder to recruit. At Vallingby, it was even harder to recruit than at Åkeshov, as 79% of the interviewed persons had another reason for parking than to Park & Ride. In this case, 7% refused to participate.

Sampling strategy for non-users
After the users’ home addresses were collected, the boundaries of the influence area were set to correspond to the area in which the users lived. Non-users were then called and asked whether they were willing to participate in a study about Park & Ride facilities. Those that agreed to participate were questioned directly on the line.
Response rate
A total of 158 interviews were completed. Of the completed questionnaires, 71 were users and 87 were non-users. 22 refused to participate and 143 did not belong to the right target groups.

2.2.3 Questionnaire content

The survey was designed to find reasons for using or not using Park & Ride lots and to characterise the two target groups in order to understand certain factors influencing the choice of mode. Information was collected from both users of these chosen Park & Ride sites and frequent car drivers living in the surrounding area.

Questions to both target groups
Both user and non-user surveys collected general background information about household size, age, gender, children’s ages, home and destination addresses, together with the age at which the respondents obtained their driving licence and when they started to use a car more frequently. The background questions were the same for the two groups. Questions about exercise frequency and type of exercise were also asked. They were also asked a question about how far they were willing to walk from a parking place to the platform. One question asked them what they thought would make more people use Park & Ride.

The respondents were asked questions about the road signs at the lot. The respondents were also asked to grade hypothetical negative aspects of a lot and to grade what characterises an attractive Park & Ride lot.

Questions to users
In addition to the background questions and the questions mentioned above, the users were asked about their reasons for starting to use Park & Ride. They were asked to describe their usual trip from home to the final destination and whether any errands were done on the way. The respondents were also asked to say how they would have travelled if the Park & Ride lot had not existed.

Questions to non-users
The non-users were asked questions about their knowledge of the studied Park & Ride lots and whether or not they would use them and if so with what frequency.
3 RESULTS

This section compares and describes the two groups of users and non-users. The results of cross-tabulations are then commented on. Finally, the results of grading the hypothetical negative aspects of a lot and grading the characteristics of an attractive Park & Ride lot are presented. The grading is compared for users and non-users. There is also a comparison between how men and women grade the negative aspects.

3.1 COMPARISON OF USERS AND NON-USERS

Table 3.1 Characteristics of users and non-users

<table>
<thead>
<tr>
<th>Background factors</th>
<th>Users</th>
<th>Non-users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of respondents</td>
<td>72</td>
<td>88</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>39%</td>
<td>51%</td>
</tr>
<tr>
<td>Women</td>
<td>61%</td>
<td>49%</td>
</tr>
<tr>
<td>Average age</td>
<td>45 years</td>
<td>47 years</td>
</tr>
<tr>
<td>Average age when obtaining driving licence</td>
<td>21 years</td>
<td>21 years</td>
</tr>
<tr>
<td>Average age when starting to use car more frequently</td>
<td>26 years</td>
<td>23 years</td>
</tr>
<tr>
<td>Average household size</td>
<td>3 persons</td>
<td>3 persons</td>
</tr>
<tr>
<td>With children between 0 and 6</td>
<td>35%</td>
<td>21%</td>
</tr>
<tr>
<td>With children between 7 and 17</td>
<td>38%</td>
<td>36%</td>
</tr>
<tr>
<td>No exercise</td>
<td>30%</td>
<td>23%</td>
</tr>
<tr>
<td>Exercise 1-2 times a week</td>
<td>35%</td>
<td>46%</td>
</tr>
<tr>
<td>Exercise 3 or more times a week</td>
<td>35%</td>
<td>31%</td>
</tr>
<tr>
<td>Average distance prepared to walk from p-place to platform</td>
<td>521 m</td>
<td>319 m</td>
</tr>
<tr>
<td>Median distance prepared to walk from p-place to platform</td>
<td>325 m</td>
<td>300 m</td>
</tr>
</tbody>
</table>

Chi-square was used to test whether there was a statistical difference between users and non-users. Comparisons of the two groups reveal that the background factors are much the same and they were therefore not found to be significant at the 5% level. In spite of this, some of the results are commented on below. As is shown in Table 3.1, the user group comprises more families with young children, 35% compared with 21% of non-users. Both groups have a similar percentage of older children.

To the question about the type of workout the respondents make the most common answers are, traditional gym exercise together with walking. Some 30% of users do not exercise at all compared with 23% of non-users. However, these results are not statistically significant at the 5% level.
Between users and non-users, there was a significant difference when it came to the age at which the respondent started to use a car more frequently ($\chi^2 = 8.589$, df=3, p=0.035). Non-users started to drive frequently at a younger age than users, which can be seen in Table 3.1. In figure 3.1 one can see that within the non-users group those of 18 to 20 years are in a majority. As has been found in other studies, once a person has bought and started to use a car, it is more likely that the car will be used as the main mode. These results are supported by Matstoms (2002). If a person starts to drive more frequently at a young age, it appears to be more difficult to change to other travel modes.

![Figure 3.1 Ages at which the respondent started to use a car more frequently](image)

Since some users have answered that they are prepared to walk rather long distances between parking place and platform, the median is also shown, see table 3.1. As can be seen in the table both groups are prepared to walk no more than about 300 m. These findings are supported by other studies (Infartsparkering 1992).

### 3.1.1 Correlations

Some interesting significant correlations were found between the following factors:

- Gender and age when obtaining a driving licence
- Gender and age when starting to use a car more frequently

The results of cross-tabulations between gender and age when obtaining a driving licence were found to be statistically significant (p=0.002). Men are more likely to obtain their licence at a younger age (18-20) than women. However, the majority of both men and women obtained their licence at between 18 and 20 years.

Cross-tabulations between gender and the age at which a person starts to drive a car more frequently reveal a statistically significant correlation (p=0.000). Among men, the majority
(68%) start to drive a car more frequently at an earlier age than women (34%). Women are also more evenly distributed between the age groups.

### 3.1.2 Grading of characteristics

Both users and non-users were asked to grade some characteristics of an attractive Park & Ride lot on a scale of 1 to 5. The main results are presented below although they have not been tested statistically.

As can be seen in table 3.2, the most important factor is security for both people and vehicle. Service at the lot is rated as the least important factor. One explanation for this could be that it first has to be safe to park and there has to be good public transport from the Park & Ride lot. After these conditions are fulfilled, there might be a demand for different kinds of service close to the lot.

<table>
<thead>
<tr>
<th>Attractiveness factors</th>
<th>Users of all Park &amp; Ride lots</th>
<th>Non-users of all Park &amp; Ride lots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Security for the car</td>
<td>4.7</td>
<td>4.8</td>
</tr>
<tr>
<td>Security for people</td>
<td>4.7</td>
<td>4.7</td>
</tr>
<tr>
<td>High frequency of buses and trains</td>
<td>4.6</td>
<td>4.6</td>
</tr>
<tr>
<td>Parking at the lot is free</td>
<td>4.6</td>
<td>4.5</td>
</tr>
<tr>
<td>Underground railway, buses and trains all leave from the lot</td>
<td>3.6</td>
<td>3.2</td>
</tr>
<tr>
<td>There are services such as shops at the lot</td>
<td>2.0</td>
<td>2.2</td>
</tr>
</tbody>
</table>

As shown in table 3.2 the ranking is the same for both groups and the scores are also similar for the groups. However, it is interesting to note that there is a difference in scores for the supply of buses and trains from the Park & Ride lot. Users find this factor more important than non-users. One explanation could be that users have more knowledge of the conditions prevailing at the lot.

<table>
<thead>
<tr>
<th>Negative factors</th>
<th>Users of all Park &amp; Ride lots</th>
<th>Non-users of all Park &amp; Ride lots</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is a long way between p-place &amp; platform</td>
<td>4.4</td>
<td>4.1</td>
</tr>
<tr>
<td>It is hard to find the P &amp; R lot</td>
<td>3.5</td>
<td>3.4</td>
</tr>
<tr>
<td>It is hard to park</td>
<td>3.4</td>
<td>3.2</td>
</tr>
<tr>
<td>The use of P &amp; R results in five extra minutes of travelling time</td>
<td>3.2</td>
<td>2.8</td>
</tr>
<tr>
<td>It is not possible to see the bus or train from the parking place</td>
<td>2.3</td>
<td>2.7</td>
</tr>
</tbody>
</table>
As can be seen from the ranking list in Table 3.3, the walking distances between the parking place and platform is given the highest score among the negative factors. Table 3.3 also shows that users give higher scores than non-users to all the negative factors except the last one (it is not possible to see the bus or train from the parking place).

One interesting question is whether the grading differs between genders. The results show that women assign greater importance to the positive factors, apart from high frequency, which men rate more highly. Women also grade the negative factors more highly than men, apart from the walking distance between the parking place and the platform.

In spite of the different scores, the ranking of the factors is similar for gender. However, with respect to ranking security, women have higher scores than men and men in turn have higher scores for a high frequency of public transport.

### 3.2 RESULTS OF NON-USER INTERVIEWS

#### 3.2.1 Open questions

The results from the open questions are discussed below. The open questions have been categorised and analysed in a subjective and qualitative way. Open question number 2 has also been coded into three categories in order to see how the answers depend on the background factors. The answers are coded as: no, yes or yes if some conditions are fulfilled.

1. **Did you know that there was a Park & Ride lot in your neighbourhood?**  
   Nearly 98% said that they knew about the Park & Ride lot.

2. **Would you consider using Park & Ride?**  
   As shown in figure 3.2 some 23% of the non-users said they would consider using it and 49% said no to using it. Nearly 28% said that they would use it if some conditions were fulfilled. Examples here could be if they had a job with a better location, or if they did not have to use their car at work, or if they could save time and money by switching from car to Park & Ride.
3. How often would you use Park & Ride?
Almost 30% said they would be prepared to use Park & Ride once a week, while 29% were prepared to use it several times a week, see figure 3.3. These figures indicate that there is potential for using Park & Ride among non-users.

4. What do you think should be done to get more car users to use Park & Ride?
If it were easier to use and if one could rely on public transport to be on time, more people would use it. The lot should be safe for both people and vehicles. The ticket for
public transport could be combined with the parking ticket. There should be first- and second-class trains. More comfortable trains and free parking are also mentioned.

Many non-users say they would consider using Park & Ride if it were faster and cheaper than taking the car. It should not take longer with Park & Ride than with a car or cost more than the cost of fuel for the same distance. Non-users repeatedly said that, if it were cheaper and if they could save time, they would use it.

Measures such as TV marketing or direct marketing about the supply in the form of maps to people living in the area relatively close to a Park & Ride lot are suggested. Some suggest a lottery on the parking ticket or a bonus system at the beginning to attract attention.

Many of the interviewees stressed the importance of not being sure of getting a parking space. Non-users of Park & Ride finally mention some more extraordinary measures such as congestion charges, banning cars in the city centre and raising the parking fees in the city.

5. Why do you think there are so few users of Park & Ride?
Non-users believe that people are lazy and that it is more convenient to drive all the way to the destination. People have a limited knowledge of and information about the public transport system and Park & Ride. Some people need a car at work or have a free parking space at work.

6. What do you think about the road signs to the Park & Ride lot? Do you think that there could be a problem finding the way if you are new to the neighbourhood?
Some of the non-users said that they had seen the signs and thought they were attractive and easy to find.

3.2.2 Statistical test

Significant correlations were found between the following factors:

- Gender and whether or not non-users are prepared to use Park & Ride.
- Gender and the frequency with which the non-user is prepared to Park & Ride.
- Age when starting to use a car more frequently and whether or not non-users are prepared to use Park & Ride.
- Age when starting to use a car more frequently and the frequency with which the non-user is prepared to Park & Ride.

There is a significant correlation at the 5% level between gender and whether or not non-users are prepared to use Park & Ride (p=0.02). Table 3.4 below shows a cross-tabulation between gender and whether or not non-users are prepared to use Park & Ride. As can be seen in the table, the relative distribution of answers within the group of women is similar. Men answer “No” more frequently to using Park & Ride (64%), while 14% stipulate no conditions. Some 35% of the women say no and 33% make no conditions for Park & Ride.
Table 3.4  *Cross-tabulation between gender and whether or not non-users are prepared to use Park & Ride*

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th>Yes</th>
<th>If some conditions are fulfilled</th>
<th>Total</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>% among men</td>
<td>63.6%</td>
<td>13.6%</td>
<td>22.7%</td>
<td>100.0%</td>
<td>44</td>
</tr>
<tr>
<td>% among women</td>
<td>34.9%</td>
<td>32.6%</td>
<td>32.6%</td>
<td>100.0%</td>
<td>43</td>
</tr>
</tbody>
</table>

Cross-tabulation between gender and the frequency with which a non-user is prepared to Park & Ride is shown in table 3.5. (p=0.012). More men than women (57% and 26% respectively) say that they would never Park & Ride as can be seen in table 3.5. Women appear to be more in favour of Park & Ride than men.

Table 3.5  *A cross-tabulation between gender and the frequency with which a non-user is prepared to Park & Ride.*

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Once a Several times a week</th>
<th>Total</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>% among men</td>
<td>56.8%</td>
<td>22.7%</td>
<td>20.5%</td>
<td>100.0%</td>
</tr>
<tr>
<td>% among women</td>
<td>25.6%</td>
<td>37.2%</td>
<td>37.2%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Table 3.6 shows the cross-tabulations between age when starting to use a car more frequently and whether or not non-users are prepared to use Park & Ride. There is a significant correlation at the 5% level (p=0.032). Of those starting to use a car more frequently at an early age (18-20 years), 61% say no to Park & Ride. However, if non-users started to use a car more frequently at the age of between 26 and 30, they are most likely to consider using Park & Ride.

Table 3.6  *A cross-tabulation between age when starting to use a car more frequently and whether or not non-users are prepared to use Park & Ride.*

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th>Yes</th>
<th>If some conditions are fulfilled</th>
<th>Total</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>% between 18-20 years</td>
<td>60.8%</td>
<td>23.5%</td>
<td>15.7%</td>
<td>100.0%</td>
<td>51</td>
</tr>
<tr>
<td>% between 21-25 years</td>
<td>38.9%</td>
<td>11.1%</td>
<td>50.0%</td>
<td>100.0%</td>
<td>18</td>
</tr>
<tr>
<td>% between 26-30 years</td>
<td>25.0%</td>
<td>50.0%</td>
<td>25.0%</td>
<td>100.0%</td>
<td>8</td>
</tr>
<tr>
<td>% 31 and older</td>
<td>33.3%</td>
<td>22.2%</td>
<td>44.4%</td>
<td>100.0%</td>
<td>9</td>
</tr>
</tbody>
</table>

Table 3.7 shows the cross-tabulations between age when starting to use a car more frequently and the frequency with which the non-user is prepared to Park & Ride (p=0.021). As can be seen, almost 60% of those people who started to use a car more frequently within the youngest age group say that they would never Park & Ride, while,
of those that started at the age of between 26 and 30, 62% say that they would Park & Ride several times a week. In other words, 88% of the non-users that belong to this age group are prepared to use Park & Ride at least once a week.

Table 3.7  A cross-tabulation between the age when starting to use a car more frequently and the frequency with which the non-user is prepared to Park & Ride.

<table>
<thead>
<tr>
<th>% between 1-8 years</th>
<th>% between 19-20 years</th>
<th>% between 21-25 years</th>
<th>% between 26-30 years</th>
<th>% 31 and older</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>56.9%</td>
<td>22.2%</td>
<td>12.5%</td>
<td>22.2%</td>
</tr>
<tr>
<td>Once a week</td>
<td>25.5%</td>
<td>33.3%</td>
<td>25.0%</td>
<td>44.4%</td>
</tr>
<tr>
<td>Several times a week</td>
<td>17.6%</td>
<td>44.4%</td>
<td>62.5%</td>
<td>33.3%</td>
</tr>
<tr>
<td>Total</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td>N</td>
<td>51</td>
<td>18</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

3.3 RESULTS OF USER INTERVIEWS

3.3.1 Open questions

The open questions have been subjectively categorised into groups of similar answers. These groups of answers are presented below. Open questions numbers 1, 3 and 8 have also been coded in order to analyse relationships with personal and background factors. Cross-tabulation has been used for this purpose.

The results for the questions are commented on below.

1. What made you start using Park & Ride?
Many users mentioned the fact that they started to park at the lot by chance, such as someone telling them or seeing it when passing by (39%). Others said that they were dissatisfied about going by car and with the traffic congestion and were looking for a more convenient solution (25%), while 15% said that the lot was close to their day-care centre for children.

2. Describe your most common trip from door to door and whether you do any errands on the way.
About 20% run errands, leaving children at the day-care centre, on their way to the Park & Ride lot. All the users have answered that they walk at the final destination.

3. If Park & Ride had not existed, how would you have travelled?
To the question about choosing another mode of transport if their Park & Ride lot did not exist, 9% said that they would take the car all the way, while 42% would choose another Park & Ride lot or park on a street nearby and 49% would choose public transport for the whole trip.

4. As you see it, what makes a good Park & Ride lot?
Free parking is mentioned by most of the users. The users would also like to have more spaces at the lot. The place should be secure and not far away from the platform.
5. Which problems do you find when it comes to using the Park & Ride lot?
In overall terms, the users found no problems in parking at the lot, apart from the security for vehicles and people. One major problem that many users mention is not being able to rely on the train to be on time or even worse that the train does not arrive. Some mentioned the insecurity of not knowing whether they were going to get a parking space or not. Another problem that was mentioned was the parking ticket machine, which did not always work and was regarded as tricky.

Users say missing signs or signs that are not visible are a major problem. Many of the interviewed users had seen the lot more by coincidence or heard about it through friends.

6. What do you think should be done in order to get more car users to use Park & Ride? Why do you think so few people use Park & Ride?
Here are some examples of measures mentioned by the users:

- more express trains from the Park & Ride lot to the city centre
- free parking at the lot
- better information and signs
- the Park & Ride lot should be safe and have lights

Marketing should be done, for example in Metro, the free newspaper on the underground railway and buses. This marketing could include, a comparison of travelling costs between taking the car all the way and using public transport. Several respondents mention free or subsidised parking places at work as an obstacle to using Park & Ride.

An easier payment system would be desirable at the Park & Ride lots would be even better. It would also be desirable to have signs with the next departure time of buses or trains. Other suggestions were better lighting and security for both cars and people, together with a guarantee of getting a parking space at the lot.

Short distances between the parking place and platform are suggested, together with attractive surroundings. There should be second and first class facilities on the underground. More comfortable trains are also mentioned.

Another suggestion is better accessibility to the lots to avoid unnecessary loss of time. First the lot should not be hard to find and secondly there should be good access roads. It should also be easy to walk from and to find the way between parking place and platform. Some respondents would like a footbridge or a more direct connection from the lot to the platform.

7. Are you or have you ever been worried about not getting a space at the lot?
The majority of the users said that they were never afraid of not getting a parking space. This answer indicates that there are no such problems at the studied lots. However, it could be a problem at other lots, which are full (SL Konsult 1998b).

8. What do you do if you do not get a parking space?
Several respondents said that they would park either on the street immediately outside or choose another Park & Ride lot. A few chose to drive home to take the underground railway all the way to their destination. This question has also been coded into
car all the way, another Park & Ride lot or parking on a street close by and finally driving home and going by public transport instead. About 15% chose to drive to the city and park there, 78% tried to find another parking place either on a street nearby or at another Park & Ride lot, 6% chose to drive back home and go by public transport from home. The results clearly show that users are determined to use Park & Ride when they arrive at a full lot.

10. What do you think about the road signs to the Park & Ride lot? Do you think that there could be a problem finding the way if you are new to the neighbourhood?
In overall terms, the users said that they missed signs. They thought the signs should be bigger and easier to find. A lot of the users had not seen any signs at all, while others said that they did not know if there were any.

3.3.2 Statistical test

No significant correlations were found between the studied factors.
4 SUMMARY AND DISCUSSION

Finally, is Park & Ride a good measure when it comes to reducing car traffic and easing congestion? This study has described reasons for using or not using Park & Ride and measures that could attract car drivers to Park & Ride. A purpose was also to see if there was any potential for increasing the use of Park & Ride. The purpose of this study has also been to characterise the two groups of users and non-users and to understand the extent to which certain factors influence the choice of using Park & Ride.

The results of this work provide an insight into the potential for increasing Park & Ride. Most likely to consider using Park & Ride are those that started to use the car more frequently at the ages of 26 to 30. Some 59% of the non-users say they are prepared to use it at least once a week.

Some reasons mentioned for using Park & Ride are dissatisfaction about going by car and that the lot was close to their day care. Non-users mentioned that the car is comfortable and convenient as the main reason for driving all the way. Other reasons are that they need the car at work or have free parking at work.

There is a relationship between mode choice and age when starting to use the car more frequently. If a person starts at an early age it seems to be a habit that becomes deeply rooted and therefore is harder to change. There are no significant correlations between the other tested relationships.

4.1 MEASURES FOR INCREASING THE USE OF PARK & RIDE

One of the most important measures that was proposed is more knowledge about Park & Ride. People have a limited awareness of and information about the public transport system and Park & Ride. Some of the ideas that were mentioned by the interviewed people are good marketing, publicity and better road signs. Other important measures were security for both vehicles and individuals, followed by a high frequency of buses and trains. Many users mention not being able to rely on the train to be on time or even worse the train not arriving. Other people say it should be free to park.

In order to get more car drivers to use Park & Ride, it is essential to present figures relating to the time and cost savings when using public transport. In general, both non-users and users mention the importance of saving time and money. This therefore appears to be an important aspect getting more non-users to use Park & Ride.

Furthermore, many of the interviewees pointed to the uncertainty of getting a parking space. More parking spaces at the lots might solve this problem. Some respondents would even like larger spaces for cars. This could be a reaction to the more common use of large cars such as vans and jeeps.
Short distances between the parking place and platform are suggested. The distance received the highest score among the negative factors at the Park & Ride lot. On average both users and non-users are prepared to walk no more than 300 m.

Another suggestion is better accessibility to the lots. It should be easy to walk from and to find the way between parking place and platform. It is also desirable to have signs with the next departure time of buses and trains.

The suggestions from the two target groups differ slightly from each other. The users’ ideas for increasing the use of Park & Ride are more associated with improving their own parking lot. The non-users suggest more general, wide-ranging solutions such as tolls, banning cars in the city centre and raising the parking fees in the city.

4.2 QUALITY ASPECTS

The most highly valued quality aspect on the lot is security for both individuals and vehicles. The problem of security is mentioned several times throughout the questionnaires, which clearly indicates the effect of the factor on making Park & Ride attractive. In spite of the different scores of the quality factors, the ranking of the factors is similar for gender. However, security is valued more highly by women than men, while men give higher scores to high frequency of buses and trains.

Different kinds of service such as fuel and food had the lowest priority. One explanation could be that it first has to be safe to park and there has to be good public transport from the Park & Ride lot. Once these conditions are fulfilled, there might be a demand for different kinds of service. However, there might already be a slight demand for day-care centres close to the lots; see discussion below.

4.3 POTENTIAL FOR INCREASING PARK & RIDE

This study shows that there is probably a potential for changing modes. Some 20% of the users use Park & Ride after leaving their children at day care and 15% say that the lot is close to their day-care centre. These respondents might prefer public transport but probably feel it is difficult to travel with young children. There could be potential for using Park & Ride if parents who are non-users had more opportunity to park after leaving their children at day-care centres.

Nine per cent say that they would take the car all the way if the lot had not existed. However, almost half the users would choose public transport for the whole trip. This means that care must be taken when introducing Park & Ride in order not to compete with the local bus service to the station or those that use bike to the station.

If users find the lot to be full, about 15% choose to drive to the city and park there, 78% try to find another parking place either on a street nearby or at another Park & Ride lot, while 6% choose to drive back home and travel by public transport from home. These answers indicate that there is a potential for increasing Park & Ride.
Some 23% of non-users say they would consider using Park & Ride and nearly 28% say that they would use it if some conditions were fulfilled. Almost 30% are prepared to use Park & Ride once a week, while 29% are prepared to use it several times a week.

As can be seen from the figures above, the percentages of yes and no are not exactly the same (23% considering using it and 30% prepared to use it once a week). This depends very much on the way the questions were asked. The first question is an open question that has then been coded. The “yes”, “no” and “if some conditions are fulfilled” are not always easy to code in the right category since the answer is qualitative. The respondents might have no clear yes or no answers, but, when they answer the next question, which required a box to be marked with a cross, they have to give an exact answer. These answers indicate that there is probably a potential for using Park & Ride among non-users. However, studies have shown that what people say is not the same as what they do. Therefore the potential is probably lower than what the percentages show (59% of non-users of Park & Ride say that they are willing to use it once a week).

4.4 TYPICAL USERS

Typical users can be described as follows:

- They have younger children in the household than non-users
- Are older than non-users when they start to drive a car more frequently
- Assign a higher value than non-users to the fact that both buses and trains leave the lot
- Are women with an average age of 45 years

4.5 DIFFERENCES BETWEEN WOMEN AND MEN

More men than women (64% and 35% respectively) say that they would never Park & Ride. 14% of the men say yes to Park & Ride, while the corresponding figure for women is 33%. Women appear to be more in favour of Park & Ride than men.

Men start driving more frequently at an earlier age than women. If a non-user has started to use a car more frequently at the age between 26 and 30 years and is a woman, she is most likely to consider using Park & Ride at least once a week.
5 FURTHER RESEARCH

The author would like to point to three main research areas:

- How to make travelling by public transport or Park & Ride easier with children?
- The effects of measures on mode split
- Competition between Park & Ride and public transport

5.1 TRAVELLING WITH CHILDREN EASIER

The location of the Park & Ride lot appears to be important. Some 20% of the users use Park & Ride after leaving their children at day care. There may be potential for using Park & Ride if parents have more opportunity to park after leaving their children at day-care centres or, even better, if it were easier to travel with children on public transport. This could be a topic for further research, addressing the question of how to make travelling by public transport or Park & Ride easier with children.

5.2 THE EFFECTS OF MEASURES ON MODE SPLIT

As the study clearly indicates that better and more signs are important, it would be interesting to determine the effect of better signs on the mode split. The effect of marketing on the mode split would also be interesting to study in more detail. Information about the cost of travelling by car and Park & Ride should then be presented to car users.

More research is needed about how much users and non-users are willing to pay for different quality aspects at the lot. Valuation of quality factors such as security and walking distance between parking place and platform will be examined in a forthcoming study.

5.3 COMPETITION BETWEEN PARK & RIDE AND PUBLIC TRANSPORT

This study has shown that the majority of the users of Park & Ride would travel by public transport if the Park & Ride lot did not exist. This shows how important it is not to let Park & Ride compete with the local bus or bicycle. There has to be more research on where the lots should actually be located and what could be done to make the feeder bus attractive enough to retain the people who are already using the bus.
6 REFERENCES

Engström et al. Infartsparkeringar - Knutpunkter i trafiksystemet: Reserapport. Transportforskningsberedningen. TFB meddelande 163; Stockholm

GLAB, Göteborgs lokaltrafik AB, marknadsundersökning 1997 ref i Lind and Schmidt 1998

Infartsparkering 1996/97, Underlag för Dennisöverenskommelsen, Region- och trafikplanekontoret, RTK, Stockholm 1992

Lundin, A; Försöksverksamhet med nya symboler vid utmärkning av infartsparkeringar, Stockholm, 1998

Matstoms, P. Modeller och prognoser för regionalt bilinnehav I Sverige, VTI rapport 476, 2002


Park & Ride för Göteborg – Förstudie; Göteborgs Gatukontor Trafikutredning, Göteborg 1991


RVU 86/87, Resvanor, tidsanvändning och besöksmönster, RTK, Stockholm, 1992

SIKA, Uppföljning av de transportpolitiska målen maj 2000, Sika rapport nr 5, Stockholm, 2000

SL Konsult, Marknadsunderökningar, Stockholm, 1998a


Usterud Hanssen, J; Parkering: et virkemiddel i samordnet areal- og transportplanlegging Transportøkonomisk institutt. TOI rapport 349, Oslo 1997
PART IV

Commuters’ monetary valuation of Park & Ride attributes
Abstract

Problems associated with traffic, such as traffic congestion and pollution, have occurred in major urban areas in particular due to the increased use of cars. One possible way to reduce the use of cars is to replace commuter trips by car with other modes of transport, such as a combination of the car and public transport called Park & Ride. The use of Park & Ride depends on many factors. One important factor is the quality of the Park & Ride lot when it comes to security and availability of space. In this study, a stated preference survey was conducted in order to quantify some standard factors. The factors used in this stated choice experiment were: security at the lot, availability of spaces at the parking lot, costs at the parking lot and walking distances between the parking space and platform. These factors were systematically varied in the scenarios in order to estimate people’s willingness to pay. The results indicate that security at the Park & Ride facility is important. The results also reveal that parking facilities, such as free parking at work, influence people’s choice of mode. Both sexes assign a high value to secure parking, but women are more willing to pay for lights at an unguarded parking lot.
TABLE OF CONTENTS

1  INTRODUCTION ........................................................................................................ 5
   1.1  BACKGROUND ..................................................................................................... 5
   1.2  OBJECTIVES ...................................................................................................... 7

2  METHOD ................................................................................................................... 8
   2.1  INTRODUCTION ................................................................................................ 8
       2.1.1  Data collection method ........................................................................... 8
       2.1.2  Stated-choice experiments ...................................................................... 9
       2.1.3  Quality tests of the experimental design ................................................. 9
   2.2  STATISTICAL ANALYSIS ................................................................................. 10
       2.2.1  Discrete-choice models ......................................................................... 10
       2.2.2  Willingness to pay ................................................................................. 11
       2.2.3  Segmentation .......................................................................................... 12
       2.2.4  Cross tabulation ...................................................................................... 12

3  SURVEY .................................................................................................................. 13
   3.1  SAMPLING STRATEGY ...................................................................................... 13
   3.2  QUESTIONNAIRE CONTENT ............................................................................ 14
       3.2.1  SP choice of mode .................................................................................. 14
       3.2.2  Focus group interviews .......................................................................... 16
       3.2.3  Response rate .......................................................................................... 16
       3.2.4  Useful answers ........................................................................................ 17

4  CHARACTERISTICS OF THE ENTIRE SAMPLE ................................................. 19
   4.1  PERSONAL CHARACTERISTICS ....................................................................... 19
   4.2  COMMUTER CHARACTERISTICS ..................................................................... 21
       4.2.1  Distance between station & work and distance between home & station .... 21
       4.2.2  Chosen time for parking ......................................................................... 21
   4.3  ACTUAL TRAVELLING TIMES AND ESTIMATED TRAVELLING TIMES .......... 22
   4.4  FREQUENCY OF PARK & RIDE ....................................................................... 22
   4.5  RANKING OF MEASURES TO PROMOTE OTHER MODES THAN CAR .......... 23

5  COMPARISON OF USERS AND NON- USERS ....................................................... 25
   5.1  PERSONAL CHARACTERISTICS ....................................................................... 25
   5.2  COMMUTER CHARACTERISTICS ..................................................................... 25

6  COMPARISON OF THE AREAS ............................................................................... 27
   6.1  PERSONAL CHARACTERISTICS ....................................................................... 27
   6.2  COMMUTER CHARACTERISTICS ..................................................................... 27

7  FACTORS THAT INFLUENCE CHOICE OF MODE ................................................. 29
   7.1  PERSONAL CHARACTERISTICS ....................................................................... 29
       7.1.1  Age ........................................................................................................... 29
       7.1.2  Gender ..................................................................................................... 29
       7.1.3  Income .................................................................................................... 30
       7.1.4  Household size ........................................................................................ 30
7.1.5 Children under seven years of age ......................................................... 30
7.1.6 Errands .................................................................................................. 30
7.2 Commuter characteristics ........................................................................ 31
  7.2.1 Distance between home & station and station & work ......................... 31
  7.2.2 Parking costs at work ........................................................................... 31
  7.2.3 Chosen time for parking ...................................................................... 31
  7.2.4 Distance between parking place at work and work ............................. 32
  7.2.5 Parking at home .................................................................................. 33
8 Estimations of SP parameters ...................................................................... 34
  8.1 Base model for the whole sample .......................................................... 34
     8.1.1 Willingness to pay for the factors ..................................................... 35
     8.1.2 Utilities for Park & Ride lots .............................................................. 36
     8.1.3 Willingness to pay for the parking lots ............................................. 37
  8.2 Willingness to pay for segments .............................................................. 38
     8.2.1 Factor: distance from parking space to platform .............................. 39
     8.2.2 Factor: guarded lot with lights and roof .......................................... 42
     8.2.3 Factor: unguarded lot with lights .................................................... 43
     8.2.4 Factor: guaranteed a parking space ................................................ 43
     8.2.5 Willingness to pay for availability of space ...................................... 43
     8.2.6 Segments of gender ......................................................................... 44
9 Summary and discussion ............................................................................. 45
  9.1 Factors influencing choice of mode ......................................................... 45
     9.1.1 Distances to station .......................................................................... 45
     9.1.2 Parking conditions at work ............................................................... 46
     9.1.3 Parking conditions at home ............................................................... 46
     9.1.4 Availability of space ........................................................................ 46
  9.2 Suggested measures .................................................................................. 46
  9.3 Measures at Råcksta and Horthus ............................................................ 47
  9.4 Willingness to pay ................................................................................... 47
     9.4.1 Willingness to pay for the factors ..................................................... 47
     9.4.2 Willingness to pay for the factors per segment ................................. 47
     9.4.3 Different results with different methods .......................................... 47
10 Further research .......................................................................................... 49
11 References .................................................................................................. 50
12 Appendix ..................................................................................................... 53
1 INTRODUCTION

1.1 BACKGROUND

The growth in car traffic is increasing the environmental impacts such as noise and emissions. Physical intrusion, barrier effects and congestion are other examples of the effects of this development (Goodwin 1996). These problems have led to growing interest from politicians, planners and the general public to find acceptable methods to control individual car traffic in central urban areas in larger cities. One way of handling some of the negative effects of car traffic is to transfer car trips to other modes of transport. According to a study in United Kingdom (RAC 1995), the majority (80%) of all car trips can either be transferred to other modes or not made at all.

Most journeys take place by car. Some 50% of all journeys are made by car in the County of Stockholm. However, the County of Stockholm has a well-developed public transport system resulting in the 18% public transport share compared with 7% for the whole country (refers to journey segments) (SIKA 2000). There has been a tendency towards longer travelled distances and, at the present time, we travel an average of 46 km per person and day (SIKA 2000). At the beginning of the 20th century, the average travel distance was half a km a day. However, travelling times have been more constant over the years. The average travelling time a day for all the inhabitants in the Stockholm area is 64 minutes.

As mentioned before, the increased use of cars creates problems, such as traffic congestion, barrier effects, pollution and health problems. A major environmental impact is caused by emissions from road traffic, which contribute about 78% of all carbonate that comes from the transport sector (SIKA 2000). Congestion during peak hours is mostly caused by commuters, and has a negative effect on commercial transport by reducing accessibility, which results in financial losses (Tegnér and Nilsson 2000). About 27% of all the trips in the city and on the main roads leading to the city of Stockholm are deliveries (Bång 1989). Congestion also affects public transport, making it slower (SIKA 2000), especially if the same road space is used.

Other effects that might not be so obvious at first are those that affect children in different ways. Children’s independent mobility has been dramatically reduced due to the space the traffic system consumes in terms of both parking lots and roads. Children’s independent mobility is important for their mental and physical development. The increased traffic has made parents afraid of letting their children use the transportation system on their own. This fear has led to parents driving their children to school and to activities causing even more traffic, especially outside schools and activity centres. In a study conducted in Stockholm, almost 70% of both younger and older children in residential areas comprising detached and semi detached houses say that they are transported by car to their school activities (Heurlin-Norinder 1999). Other studies
support these findings (Hillman 1993, Davis & Jones 1996 ref in Heurlin-Norinder 1999).

One proposed solution to many of the transportation problems is to replace long trips with a combination of the car and public transport, consisting of a short car trip and a longer trip by public transport (hereinafter called Park & Ride). Park & Ride could either be used in less densely populated areas where public transport is not profitable because of the lower demand or be located around the city centre at points where the congestion starts. Parking lots close to a station or terminal could give travellers in less densely populated areas an attractive way of using public transport (Engström et al). In suburban areas, there is usually a feeder bus with a low frequency, which might not be an attractive alternative for many car drivers.

A Park & Ride system with parking lots situated on the main roads leading to the city centre could also be a safety valve that could be used if the roads are congested (Vägverket 2000). From an environmental point of view, it is beneficial to minimise trips by car and maximise the public transport part of the journey. Moreover, Engström et al (1990) argues that the highest socio-economic utility is achieved if the lots are located at public transport terminals in sparsely built-up areas.

Timesaving benefits may be generated by the use of Park & Ride facilities, especially in heavily congested areas. Fuel saving and reductions in other vehicle running costs can also be produced. The switch of modes can reduce air pollution and energy consumption per passenger-kilometre (Turnbull 1995). As Park & Ride combines the advantages of car driving in the less densely populated areas with public transport in the urban areas, introducing Park & Ride facilities could be an attractive alternative. Whether or not the facility is used is heavily dependent on many factors, such as the supply of public transport, the quality of the parking lot and the parking conditions both at home and at the destination (Turnbull 1995).

Public transport has the potential to attract new customers if the switch between car and public transport is made easier (IMPULS 2000). A study conducted in Washington State revealed that the demand for Park & Ride depends on the capacity and the charge at the parking lot (Hendricks and Outwater 1998). In their study, the shift in demand at Park & Ride lots was estimated when increasing capacity and user fees. It was found that the traveller’s choice of mode depends primarily on travelling time and the costs associated with both the drive to the parking lot and the public transport that follows. However, the decision is also affected by the availability of space at the Park & Ride lot. The project revealed that 35% of all respondents said that they were willing to pay USD 2 a day for increased capacity and more security (Hendricks and Outwater 1998).

Other studies have shown that parking supply at the destination has a significant impact on people’s choice to use the car to reach their destination (Usterud Hanssen 1997). A study conducted in Norway revealed that, if employees had free parking at work, only 17% used public transport compared with 48%, if they did not have free parking. Over 40% say that the main reason for using Park & Ride or Bike & Ride is the parking restrictions at their destination (Grue and Hoelsaeter 2000). Another factor that also influences the choice of public transport is the distance between home and station (Tjade 1989 ref in Usterud Hanssen 1997), see Table 1.1. For distances of more than 5 km, the choice of public transport decreases dramatically from 75% to 38%, if
the respondents have to pay for parking at the destination. When parking at the destination is free, the corresponding figures are instead 37% and 18%.

Table 1.1 shows the choice of using public transport for different distances and for the two groups: having to pay or having free parking at work (Tjade 1989 ref in Usterud Hanssen 1997).

<table>
<thead>
<tr>
<th>Distance</th>
<th>Have to pay for parking</th>
<th>Free parking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 km</td>
<td>78%</td>
<td>40%</td>
</tr>
<tr>
<td>1 – 1.9 km</td>
<td>67%</td>
<td>36%</td>
</tr>
<tr>
<td>2 – 4.9 km</td>
<td>75%</td>
<td>37%</td>
</tr>
<tr>
<td>5 – 10 km</td>
<td>38%</td>
<td>18%</td>
</tr>
</tbody>
</table>

Recent research generally focuses on how to make public transport more attractive (Kottenhoff et al 2003, Börjesson & Eriksson 2000) or ways of making the car less attractive through policies and restrictions (Marshall and Bannister 2000, Jakobsson 2001). According to recent research (Vägverket 2000), there is a need for more Park & Ride facilities in the Stockholm area. However, few studies explore the effects parking conditions at stations have on behaviour and choice of mode, or how Park & Ride can reduce congestion and pollution.

1.2 OBJECTIVES

The main purpose of this part of the thesis is to define commuters’ willingness to pay for different factors describing the quality of Park & Ride lots. From Park & Ride Study 1 and the literature review within this thesis, four factors were identified for further study and for use in forecast models. Parking conditions at home and at work were also found to be of interest.

Another aim is to investigate how background factors influence the choice of mode and how parking at the destination and home influence the choice of mode. This paper presents the survey design, general descriptive statistics about the commuters, commuters’ willingness to pay and to some extent the factors that influence the choice of mode.
2 METHOD

2.1 INTRODUCTION

This research uses a model that is able to predict people’s behaviour or explain their behaviour, based on a number of factors that are thought to influence the choice. By tradition, transportation planners use logit models (see description below) to describe people’s choice of modes. There are other choice models, but, as logit models are widely used in transport research, a logit model is used to analyse the data in this study. There are two methods for collecting data for the logit model; Revealed Preferences and Stated Preferences, which are discussed below.

A postal study was conducted using the stated-preference approach and, in addition to hypothetical questions, socio-economic characteristics were collected together with the commuters’ travel information for all their travel opportunities and their commonly mode of transport for work trips.

2.1.1 Data collection method

Stated-preference (SP) is one approach to investigate travellers’ willingness to pay related to travel choices and behaviour in hypothetical transportation environments (Louviere et al., 2000). Another is Revealed Preference (RP), which relates to actual choices and behaviours in real transportation environments.

In this study, the SP method is used to quantify factors that influence people’s choice of mode. The respondents choose between hypothetical scenarios or state their preference by choosing one alternative from a choice set (group of alternatives). SP techniques are selected when it is difficult to collect responses for modes that are not in use and can therefore not be studied in real life or, when secondary factors are difficult to distinguish from the primary ones (Ortúzar and Willumsen, 2001). Primary or hard factors, such as travel costs and travelling time, are often used in transport models. Socio-economic factors and the quality of a mode are examples of secondary or soft factors. SP surveys also require fewer operational resources than RP, as every individual is asked to make more than one choice.

There are advantages to the SP methods, but there are also disadvantages, depending on the design and the way the factors with their corresponding levels are presented in the questionnaire (Louviere et al., 2000). We cannot be sure that people act as they say they will. The design is therefore very important if results that are close to the way people behave are to be obtained. In this survey, a fractional factorial design is used for the choice experiments. A fractional factorial design permits the reduction of scenarios. Only the main effects, which assume that all the factor products are negligible, are studied.
Rating, ranking and stated choice are all different ways of designing SP experiments. In rating, one alternative is considered at a time. All the alternatives are rated on a scale, numerical or verbal. Consistency problems could occur if there are many alternatives. In other words; does the respondent use the same scale for all the alternatives? In ranking, the respondents have to consider all the alternatives at the same time. If cards are used, this is fairly easy to do. One disadvantage of ranking is that the choice situation is not the same as in real life. Ranking also limits the number of alternatives that may be considered due to fatigue. Stated choice is a realistic choice as it reminds us of the number of choices that are made in reality. In this study, stated-choice experiments are used.

2.1.2 Stated-choice experiments

In stated-choice experiment surveys, respondents are asked to choose one alternative from a set of hypothetical alternatives with different characteristics. The alternatives are described using factors such as travelling time, travelling distance and quality of the mode (characteristics).

The factors are given different values, called levels, which are varied experimentally. Normally, the aim is to have an orthogonal design. This means that the factors vary totally independently of each other, in other words they are uncorrelated. However sometimes the dominating questions are rejected resulting in a non-orthogonal design.

2.1.3 Quality tests of the experimental design

How levels of factors are combined into alternative and the way these are combined is called the experimental design.

The answers may result in too many lexicographic answers; i.e. the respondent simplifies the task. If the respondent finds the task too difficult, he/she could try to find ways of making the task easier by sorting the alternatives one factor at a time. For example, the respondent could sort all the alternatives by the cost and then by the distance. Then the data will not show the respondents real preferences.

Lexicographic answers could also be a sign that one factor has been varied too much in the design, making the factor of decisive importance and resulting in a wrong monetary value. The respondents cannot show their real preferences. The data from a pilot study can be checked for lexicographic answers and, if necessary, the design can be changed.

The data might also produce unreasonable answers, which could be detected and removed. The respondent might also be tired if there are a lot of questions. This could be detected in the model used for analysing the data.
2.2 STATISTICAL ANALYSIS

2.2.1 Discrete-choice models

Discrete-choice models have been developed to investigate factors influencing travel behaviour. The common theoretical base is random utility theory (Ortúzar and Willumsen, 2001, Domencich and McFadden 1975). In this theory, it is assumed that individuals always choose the alternative with the highest utility and that there is a random part that cannot be observed by the analyst. The models offer a sophisticated analysis of how various factors influence the choice of mode and the trade-offs people make between these factors. A discrete-choice model predicts a probability made by an individual as a function of any number of factors that describe the alternatives. Discrete-choice models can be based on either observed behaviour (Revealed Preferences data) or on hypothetical choice surveys (Stated Preference data).

The two most popular discrete-choice models are multinomial logit and nested logit models (Ortúzar and Willumsen, 2001). The mixed logit and random effects are also models becoming more and more common. Logit models are mathematical models that are widely used to describe the way individuals choose between different alternatives (Ben-Akiva and Lerman 1985). These statistical mathematical models combine economics with a psychological view of the choice process. Logit models are used also to estimate the effects of different measures. Through the model, it is also possible to understand the individual’s choice based on a number of factors that are thought to influence the choice of behaviour. The discrete-choice data is analysed in this thesis by estimating a logit model, using the Alogit (1995) software computer program. Maximum likelihood is the statistical estimating method used. The method involves finding the parameter values for which the probability is greatest that the estimated model agrees with the observed behaviour in the basic data set.

As the model is based on the fact that all individuals choose the alternative with the highest utility and the utility depends on the characteristics of the alternative and the individual’s measured characteristics, the utility of an alternative $i$ to person $n$ can be written as:

$$U_{in} = V(X_{in}) + \varepsilon_{in}$$

(1)

where $V(X_{in}) = \beta_1 X_{i1} + \beta_2 X_{i2} + \ldots$

and

- $U_i$ total utility for alternative $i$
- $V(X_i)$ observable part described as a linear function of parameters and variables
- $\beta_i$ parameters which characterise choices that are estimated
- $X_{i1}$ characteristics (factors) describing the alternatives and socio-economic variables for the individuals
- $\varepsilon$ unobservable part

The unobservable part is due to:

- Missing factors
• Unobserved differences in the preferences of individuals
• Measurement errors
• Use of proxy variables

The unobservable part is assumed to be stochastic and equally distributed with a standardised variance. Assuming that the unobservable part is independently identically Gumbel distributed the probability of choosing a particular alternative \( i \) (multinomial logit model) is given by the form:

\[
P_i = \frac{\exp(\mu V(X_i))}{\sum_j \exp(\mu V(X_j))}
\]

\( P_i \) = probability of choosing alternative \( i \)
\( V(X_i) \) = observable part of the utility
\( j \) = all the alternatives the individual chooses between
\( \mu \) = scale parameter

The scale parameter cannot be estimated separately. Instead the estimated parameters \( \beta \) are a product of \( \beta \) and \( \mu \).

For a more complete description of the logit model see Ben-Akiva and Lerman, 1985.

2.2.2 Willingness to pay

The estimated vector of parameters \( \beta \)s is then used to find the respondents’ willingness to pay (w.t.p.) for the levels of a factor. The willingness to pay for a level of a factor can be obtained by taking the ratio between parameter \( \beta_k \) for the variable \( k \) and the cost parameter \( \beta_{cost} \).

willingness to pay (w. t. p.) = \( \frac{\beta_k}{\beta_{cost}} \)

**Standard error of w.t.p.**

In addition to the \( \beta \)s, Alogit also estimates standard errors (SE) of the \( \beta \)s, as well as correlations between the \( \beta \) parameters. The SEs and correlations can be used to estimate the SE for the willingness to pay ratio \( \frac{\beta_k}{\beta_{cost}} \). This has been done in a Norwegian study (Kjorstad 1995) and Swedish study (Sjöstrand 2001).

As we have a ratio as the estimation \( \frac{\beta_k}{\beta_{cost}} \), the standard error for the willingness to pay ratio is calculated as follows:

\[
\text{SE of w.t.p.} = \sqrt{ \left( \frac{\beta_k}{\beta_{cost}} \right)^2 \left[ \frac{\text{var}(\beta_{cost})}{(\beta_{cost})^2} + \frac{\text{var}(\beta_k)}{(\beta_k)^2} - 2 \frac{\text{cov}(\beta_{cost}, \beta_k)}{\beta_{cost} \beta_k} \right] }
\]
where the $\beta_k$ is the estimated parameter for any variable and the $\beta_{\text{cost}}$ is the estimated parameter for the cost variable.

Calculations are usually made with a 5\% risk, which means that, in 95\% of cases, the value is within the interval. If there is a 95\% confidence interval, the $t$-value should be greater than $\pm 1.96$.

### 2.2.3 Segmentation

Using the data set in this study, estimations of segments have been made based on personal characteristics, areas and travel characteristics. To test whether there is a significant difference between the willingness to pay for two segment groups (w.t.p. 1 and w.t.p. 2), the following test statistics can be used:

$$T = \frac{\text{w.t.p.}1 - \text{w.t.p.}2}{\sqrt{\text{S.E.}(\text{w.t.p.}1)^2 + \text{S.E.}(\text{w.t.p.}2)^2}}$$

The normal distribution has been used in obtaining the critical values.

### 2.2.4 Cross tabulation

Two-way cross-tabulation analyses have been used in order to determine whether there is a significant difference at the 5\% level between groups of respondents. In this study, the chi-square ($\chi^2$) method is used, as the answers are stated on a nominal scale. This method involves comparing the actual frequencies in the table with the frequencies that are expected. The $\chi^2$ value is obtained by taken the sum over all categories in the table. The $\chi^2$ value is compared with a critical $\chi^2$ value taken from the $\chi^2$ distribution for different significant levels.

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

where

- $O$ = the observed number
- $E$ = the expected number under independency

Cross-tabulations have also been used to relate characteristics and the choice of mode to see whether there are significant correlations at the 5\% level.
3 SURVEY

A user and non-user survey of the Park & Ride mode was conducted in 2002 and evaluated to determine the importance of specific variables, such as security and availability of space at the Park & Ride lot. The survey collected information on the actual travel choices made by the user (revealed preference) and information relating to hypothetical situations (stated preferences). The stated preferences data were evaluated to assess the travellers’ willingness to pay.

Figure 3.1 The studied parking lots.

3.1 SAMPLING STRATEGY

The survey was conducted in two suburban areas of Stockholm, targeting people living near a Park & Ride lot or passing it on their way to work. The two areas were chosen because they have substantial congestion on the main routes leading to the city. Three lots were studied in what is called the western area and, in the northern area, one lot was studied, see Figure 3.1. The western area includes the Park & Ride lots at Brömmaplan, Islandstorget and Råcksta, all of which are situated along the same underground railway line (Green line). Horthus is the Park & Ride lot in the northern area. Horthus serves the underground railway, buses and trains, while the three other serve only the underground railway. Horthus is a lot which has one of the highest damage levels of all the lots in the Stockholm area. In spite of this, there is rarely room at the
lot. Räcksta is a lot that has the opposite problem, a large number of empty spaces. Islandstorget and Bromma plan are two lots that were added to the study when it was found that it was not possible to collect the required number of respondents from Räcksta alone. However, these three lots are regarded as one in the analyses.

By using a screening questionnaire, the right group of respondents was found. Respondents were limited to adults with a driving licence, the opportunity to use a car (not a company car) at least once a week for their trip to work and starting their commuter trip between 6.30 and 9 am. Their destination should be the city centre or they should pass through the city centre on their way to work.

Respondents were collected and classified into two groups, users of Park & Ride and non-users of Park & Ride. Users were defined as the people who use Park & Ride at least once a week for their journey to work. The users were asked to participate in a study about Park & Ride facilities when parking at one of the chosen Park & Ride lots on their way to work. If they agreed, a questionnaire was sent to their home addresses. Non-users were defined as people who drove their car on one of the interview days on one of the main routes leading to the city and passing one of the Park & Ride lots. The interviewer took the car numbers of those cars passing one of the specific points just before the lots. The owner of the car and in most cases also the driver were then called and asked the screening questions and whether they were willing to participate in the study. Both groups received the same questionnaire.

### 3.2 QUESTIONNAIRE CONTENT

The survey was designed to define commuters’ willingness to pay for different aspects of Park & Ride lots and also to collect detailed information about commuter characteristics. Information was collected from both users of these chosen Park & Ride lots and commuters or passing the lots on their way to work.

The general commuter characteristics that were studied were commonly used mode with travelling time and travel cost, walking times, in-vehicle time, frequency of public transport, waiting time at interchanges, travel cost and travelling time with other modes available to them compared with that commonly used mode and, finally, parking conditions at home and at work. The survey also included questions about respondents’ time of arrival at the parking lot and the extent to which they would use Park & Ride if they were guaranteed a parking space at the lot. Questions were also asked about travellers’ frequency of using Park & Ride and the measures or incentives that would make them use Park & Ride more frequently than today. Questions were also asked about distances between stations and work and parking costs at work. The respondents were also asked whether they could estimate their mileage cost to work by car and the distance to work. Socio-economic questions were also included, such as income, age, gender and family size.

#### 3.2.1 SP choice of mode

The survey included two kinds of stated-preference choice set. The first was a pair wise set within the Park & Ride mode, while the other was between modes. In the between modes section, only the Park & Ride mode choice was hypothetical, while the rest of
the choices were the respondents' familiar or available modes. However, this data will be used for further analysis in the PhD project. Only the between modes are analysed in this part.

In this survey, two factors had three levels and the other two had four levels. This leads to a total design with $3^24^2 = 144$ combinations. As only the main effects were of interest, a fractional design was used and the combinations of the factors were reduced to 16. The factors and levels were chosen on the basis of previous research (Lindstrom Olsson 1999) and focus group interviews, see following section 3.2.2. The factors used in this survey were: price of parking, security at the parking lot, availability of spaces at the parking lot and walking distances between parking lot and station. According to the design, these factors are systematically varied in the scenarios. Table 3.1 describes the factors and levels used in the survey.

### Table 3.1 Description of the factors and levels

<table>
<thead>
<tr>
<th>Factors</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parking fee</td>
<td>♦ No cost to park&lt;br&gt;♦ It costs SEK 5&lt;br&gt;♦ It costs SEK 12&lt;br&gt;♦ It costs SEK 25</td>
</tr>
<tr>
<td>Security at the P&amp;R facility</td>
<td>♦ Unguarded, no lights&lt;br&gt;♦ Unguarded, with lights&lt;br&gt;♦ Guarded, has a roof</td>
</tr>
<tr>
<td>Distance from parking space to the platform</td>
<td>♦ It is 25 m to the station form your car&lt;br&gt;♦ It is 100 m to the station from your car&lt;br&gt;♦ It is 300 m to the station from your car</td>
</tr>
<tr>
<td>Availability of spaces at the parking lot</td>
<td>♦ You are sure of getting a parking space at any time&lt;br&gt;♦ You do not get a parking space once a month&lt;br&gt;♦ You do not get a parking space once every other week&lt;br&gt;♦ You do not get a parking space once a week</td>
</tr>
</tbody>
</table>

A block design was used in order to make the questionnaire shorter and less tiring for the respondent. Each respondent was presented with eight pair wise choices. Figure 3.2 gives an example of these questions.
1 You are on your way to work and wish to use the Horthus parking lot next to Danderyd Hospital. Which of these two alternatives do you prefer?

**Alternative 1**
- It costs SEK 5 a day to park
- It is 100 m to the station from your car
- The parking lot:
  - is guarded, has lights
  - has a roof
- You **always get a parking space** for your car.

**Alternative 2**
- It costs SEK 12 a day to park
- It is 25 m to the station from your car
- The parking lot:
  - is unguarded
  - has lights
- You **always get a parking space** for your car.

I prefer: [ ] Alternative 1  [ ] Alternative 2  [ ] Either of them, can’t choose

*Figure 3.2 An example of a stated-choice experiment*

3.2.2 Focus group interviews

A group of colleagues at the department of infrastructure were put together in a group to discuss factors influencing the choice of Park & Ride and reasonable levels of some of these factors. In the focus group there were participants that had never used Park & Ride and others that were quite familiar with the mode. Three of the four factors that were discussed in the group were used in the stated choice experiment. These were price of parking, security at the parking lot and walking distances between parking space and platform. The highest level chosen in the stated choice experiments for the price factor was SEK 30. The price could, according to the focus group, have been higher for a higher quality at the lot. The group suggested service for the car as an example of high quality.

3.2.3 Response rate

At the end of May and the beginning of June, 925 of 2150 commuters who were called or asked agreed to participate in the survey and had a questionnaire sent to their home addresses. Table 3.2 shows the reasons why some respondents were excluded from the survey and the number that refused. The main reasons for not participating were that the commuters did not belong to the target group (25%), that they did not commute between the target hours or that they did not commute or pass through the requested destination area.
Table 3.2 The reasons why users were excluded from the survey.

<table>
<thead>
<tr>
<th>Users of Park &amp; Ride</th>
<th>Horthus</th>
<th>Brommaplan</th>
<th>Islandstorget</th>
<th>total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>willing to participate</td>
<td>150</td>
<td>160</td>
<td>310</td>
<td>68</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>reason for not participating</th>
<th>Horthus</th>
<th>Brommaplan</th>
<th>Islandstorget</th>
<th>total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>refuses</td>
<td>10</td>
<td>21</td>
<td>31</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>do not commute</td>
<td>4</td>
<td>7</td>
<td>11</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>do not use Park &amp; Ride for work trip</td>
<td>17</td>
<td>38</td>
<td>55</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>do not start to commute between the target hours</td>
<td>4</td>
<td>9</td>
<td>13</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>do not commute to the target destination area</td>
<td>18</td>
<td>16</td>
<td>34</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>total asked</td>
<td>203</td>
<td>251</td>
<td>454</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Some 47% of all the collected car numbers belonged to the right target group and were asked if they were willing to participate. Of the drivers who were called, 10% refused for some reason. As can be seen in Table 3.3, 615 (36%) car drivers agreed to participate in the study. The largest group of n-participating individuals comprises people who use a company car; 27% of the non-users of Park & Ride used company cars. They were excluded from the survey as the results might be affected when the car drivers do not pay all the costs of travelling to work.

Table 3.3 The non-users’ reasons for not participating.

<table>
<thead>
<tr>
<th>Car drivers or non-users</th>
<th>Horthus</th>
<th>Brommaplan</th>
<th>Islandstorget</th>
<th>total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>willing to participate</td>
<td>315</td>
<td>300</td>
<td>615</td>
<td>36</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>reason for not participating</th>
<th>Horthus</th>
<th>Brommaplan</th>
<th>Islandstorget</th>
<th>total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>refuse</td>
<td>81</td>
<td>89</td>
<td>170</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>do not commute</td>
<td>38</td>
<td>47</td>
<td>85</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>language problem</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>~0</td>
<td></td>
</tr>
<tr>
<td>using company car</td>
<td>206</td>
<td>256</td>
<td>462</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>do not start to commute between the target hours</td>
<td>26</td>
<td>28</td>
<td>54</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>do not commute to the target destination area</td>
<td>193</td>
<td>112</td>
<td>305</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>total called</td>
<td>862</td>
<td>834</td>
<td>1696</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

3.2.4 Useful answers

A total of 925 (454+615) individuals agreed to participate in the study and had a questionnaire sent to their homes. 633 questionnaires were sent back after one reminder call and 629 questionnaires were used in the analysis. This represents a response rate of 68%. This is a quite low response rate when considering that the pilot study received a
rate of more than 90%. The pilot study was conducted in April while the main study was conducted in May and June which could explain the low respond rate. Multiple phone calls were done in order to get in contact with the respondents. In addition to the questionnaires excluded from the study, there were individuals who did not answer all questions or misunderstood a question.

Further on in the analysis, Råcksta, Islandstorget and Brommaplan will be treated as one lot called the western area. In Table 3.4, the percentages of users from the four lots are presented. These three lots have more in common than Horthus, when it comes to the modes of transport that serve the lots and they are situated relatively close to each other.

Table 3.4 The percentages for the four lots

<table>
<thead>
<tr>
<th>Users of:</th>
<th>percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horthus</td>
<td>48.6%</td>
</tr>
<tr>
<td>Råcksta</td>
<td>23.0%</td>
</tr>
<tr>
<td>Brommaplan</td>
<td>16.7%</td>
</tr>
<tr>
<td>Islandstorget</td>
<td>11.7%</td>
</tr>
</tbody>
</table>
4 CHARACTERISTICS OF THE ENTIRE SAMPLE

The survey targeted two areas in Stockholm, as described earlier. From the northern area, 311 valid questionnaires were returned and, from the western area, 318 valid questionnaires were returned. In this section, the characteristics for the entire sample are presented, starting with the personal ones. In Appendix 1, all the data is shown.

In chapter 5 there is a comparison between users and non-users of Park & Ride. In the following chapter 6 the two areas are compared. Finally in chapter 7 there is a discussion of the factors that were found in this study influence the mode of choice.

4.1 PERSONAL CHARACTERISTICS

In overall terms, almost 48% of the sample are men and 52% are women. Most of the respondents fall into the age range of 31 to 60 years, see Figure 4.1. There are only 5% of the commuters in the youngest group of 21 to 30 years.

The average age of the entire sample was 46 years and the average household size was 3.2 individuals, with a majority of three to four members in a household. Some 33% of the households were living alone or as a couple and 34% of the households have children under the age of seven.
Figure 4.2 The household income groups (thousand SEK).

About 18% of the respondents have household incomes under SEK 400,000, while nearly a quarter had incomes above SEK 800,000, see Figure 4.2. The average income for an inhabitant in Stockholm County was for the year 2000 SEK 220,000 (SCB 2002). The majority (70%) of the commuters performed errands on their way to or from work.
4.2 COMMUTER CHARACTERISTICS

All the figures relating to the commuter characteristics are shown in Appendix 2.

4.2.1 Distance between station & work and distance between home & station

About 20% of the respondents had distances of less than 50 m between station and work, while about 7% had less than 50 m between home and station. As can be seen in Figure 4.3, the distances between home and station are longer than between station and work. One explanation to this result could be that the respondents within this sample have destinations within the city centre, where the distances to a station are relatively short as the public transport system is well established.

![Distances between home & station and station & work](chart.png)

*Figure 4.3 The distances between home & station and station & work.*

4.2.2 Chosen time for parking

The respondents appeared to prefer to leave the car at the parking lot at times between 7 and 8 am. Some 15% said they would like to park or leaves the car before 7 am, while only 7% said they would like to park after 8.30 am.
4.3 ACTUAL TRAVELLING TIMES AND ESTIMATED TRAVELLING TIMES

Each respondent was asked to estimate his/her travelling time (estimated travelling time) for each mode they had the opportunity to use for their commuter journey and their actual travelling time for the mode they usually use. The actual average travelling times given by the users of that mode and the estimated travelling times by those not using that mode are shown in Figure 4.5. As shown, the average estimated travelling times are overestimated for all the modes. However, the estimated travelling time for Park & Ride is close to the actual travelling times probably much depending on the purpose of this study, interview with Park & Ride users. The travelling times for public transport are overestimated by 31% compared with the actual travelling times. Other studies support that travellers overestimate the travelling times for the mode they are not familiar with.

![Actual travelling times and estimated travelling times](image)

*Figure 4.4* The actual average travelling times (grey staples) given by the users of that mode and the estimated travelling times by those not using that mode.

4.4 FREQUENCY OF PARK & RIDE

If commuters are guaranteed a parking space at a lot, this influences their intention to use Park & Ride. Figure 4.6 shows a comparison between the frequencies with which commuters use or do not use Park & Ride at present and the frequency with which they would use Park & Ride if they were guaranteed a parking space at the lot. As can be seen, those people who say that they never or seldom use Park & Ride are affected. There is evidently potential for encouraging private car drivers to use Park & Ride. It is
interesting to note that 41% say that they never or seldom use Park & Ride, but, after being guaranteed a parking space at the lot, only 26% say never or seldom.

![Diagram showing frequency of Park & Ride and guaranteed parking space]

*Figure 4.5 The frequency of Park & Ride compared with the frequency if guaranteed a parking space.*

### 4.5 RANKING OF MEASURES TO PROMOTE OTHER MODES THAN CAR

In the questionnaire, the commuters were asked to rank three measures from a list of 14 that would make them use Park & Ride more often or start to use Park & Ride. In Figure 4.7 and 4.8, the three measures marked by all individuals have been added together in the horizontal bars. As shown in the figures, free Park & Ride lots are the most frequently marked option among both users and non-users of Park & Ride. Second and third places are occupied by being guaranteed a parking space and easy to find the lot. However, as can be seen in the figures, non-users of Park & Ride have marked double the frequency of buses and trains far more frequently than users. The figures also show that non-users of Park & Ride have a greater preference for a congestion charge of SEK 30 than users, according to the way they have answered.
Figure 4.6 Non-users' first, second and third choices of measures added together for each of the 14 measures.

Figure 4.7 Users' first, second and third choices of measures added together for each of the 14 measures.
5 COMPARISON OF USERS AND NON-USERS

The two defined groups of respondents, users and non-users of Park & Ride, have been compared according to their personal and commuter characteristics. Two-way cross-tabulations were used to contrast the personal characteristics and travel characteristics of the choice of mode in order to see whether there were significant differences at the 5% level. The column percentages in Appendix 3 and 4 show the distributions of cases across personal and traveller characteristics.

5.1 PERSONAL CHARACTERISTICS

No statistically significant differences between users and non-users were found regarding ages, incomes, household size, households with small children or errands.

**Gender**

A statistically significant difference was found between gender and if the respondent is a user or non-user (p=0.003, chi2=8.645, df=1). Women are more frequently users of Park & Ride than men (59.4% and 39.8% respectively), while the opposite situation is found among non-users.

5.2 COMMUTER CHARACTERISTICS

There were significant differences at the 5% level between users and non-users for the factors: parking costs, distance between parking place at work and work, frequency of Park & Ride, frequency when guaranteed a parking space, chosen time for parking and parking at home, see appendix 4 for the figures.

**Parking conditions at work**

The majority of Park & Ride users have to pay to park at work, 61% compared with 39% of private car drivers (p=0.000, chi2=28.19, df=1). These findings are supported by another study (Usterud Hanssen 1997). Non-users of Park & Ride have shorter average distances to walk between their parked car at work and work. A conclusion could be that if a commuter has good parking conditions at work he/she is more likely to use car as the usual mode.
Figure 5.1 A comparison of distances between parking place at work and work for users and non-users

Parking at home
The majority of both groups park outside their homes (83% of users and 74% of non-users). This is not surprising as many of the commuters in this research came from areas with detached/semi-detached houses. Some 11% of non-users park outside on a parking lot, while only 6% of Park & Ride users park outside on a lot (p=0.022, chi2=11.43, df=4). The results from this question should be looked upon with care due to how the question was asked.
6  COMPARISON OF THE AREAS

There were not found any significant differences between the areas when it comes to ages, gender, income, household size, errands, and children under seven years of age, distances between station and work or distances between home and work. Nor were any significant differences found when it came to parking costs at work or distances between parking place at work and work. Appendix 5 and 6 show the figures of the areas. In this section some interesting findings are presented.

6.1 PERSONAL CHARACTERISTICS

As the relative distribution of the respondents across the two areas is similar, no comments on the personal characteristics are needed.

6.2 COMMUTER CHARACTERISTICS

Frequency of Park & Ride and frequency when guaranteed a parking space
There is a significant difference in the frequencies of using Park & Ride between the areas (p=0.006, chi2=14.60, df=4). The intention the respondents have to use Park & Ride more often or start to use it is probably higher in the northern area (p=0.089, chi2=8.077, df=4), due to that in the northern area, there is probably an latent demand for more parking lots, as can be seen at Horthus. The northern area has a change, for the answer “never or less than once a month”, from 45% to 22% compared with 38% to 30% for the western area, see appendix 6.

Parking at home
In the northern area, parking outside the home is more common (83%) than in the western area (72%) while parking on the street is more common in the western area than in the northern area (p=0.000, chi2=62.41, df=4). There might be more detached/semi-detached houses in the northern area, which could help in explaining the differences. However these results should be handled with care for reason explained in the discussion section.

Choice of mode
Commuters in the northern area use private cars significantly more frequently than those living in the western area 48% and 38% respectively (p=0.045, chi2=9.721, df=4). The opposite situation applies to Park & Ride, with 32% in the northern area and 44% in the western area. Public transport is used by about 15% in both areas.
Figure 6.1 The usually used modes for the areas.
7 FACTORS THAT INFLUENCE CHOICE OF MODE

Two-way cross-tabulations were used to contrast the personal characteristics and travel characteristics of the choice of mode in order to see whether there was any relationship between choice of mode and the characteristics. As the samples for bicycles and other modes were quite small (2.0% and 1.9%), they were excluded from further analysis.

7.1 PERSONAL CHARACTERISTICS

Even though almost all the following factors do not have a statistically significant value for chi-square, all the factors are commented on. In Appendix 7, there is a table with all the figures.

7.1.1 Age

Park & Ride is preferred by the ages of 31-40 years, while the public transport mode generally attracts those between 41 and 50 years. One reason why the 31-40 years prefers Park & Ride could be that the people in this age group have young children that need to be taken to day-care centres or school. However, these results are not significant.

7.1.2 Gender

There is a significant difference between women and men with regard to their commuter trip (p=0.012, chi2=12.86, df=4). As might be expected, the car is preferred by 54% of men compared with 46% of women, see appendix 7. As can be seen in Figure 7.1, Park & Ride is chosen by more women than men.
7.1.3 Income

People travelling by public transport are more likely to have lower incomes than those travelling by car or Park & Ride. Some 53% of the people that choose Park & Ride have household incomes of more than SEK 600,000 compared with 45% of car users. However, these findings are not statistically significant.

7.1.4 Household size

This factor does not have a statistically significant value for chi-square. In any case, households of three to four persons are the most common household size for all modes. Among Park & Ride users, there are very few single-person households (8%). Among public transport users, 15% are single households.

7.1.5 Children under seven years of age

Park & Ride appears to attract more families with children less than seven years of age than public transport or cars. Park & Ride has shares of about 22%, while public transport and cars have 14% and 7% respectively.

7.1.6 Errands

Significantly more car and Park & Ride users make errands on their way to and from work (p=0.032, chi2=10.55, df=4). About 71% in both groups run one or more errands, while the corresponding figure for the public transport users is 62%.
7.2 COMMUTER CHARACTERISTICS

7.2.1 Distance between home & station and station & work

There is no significant correlation between these distances and the choice of mode. This is the opposite of what was expected. Other studies have shown that the distance between home and station influences the choice of mode to work (Tjade 1989 ref in Usterud Hanssen 1997). If a commuter has a long distance to a station at home, the probability that he/she will take the car or use Park & Ride instead of using public transport for the whole trip is fairly high. A possible explanation could be the data set used in this research could be too small.

7.2.2 Parking costs at work

In overall terms, the majority of the commuters who use a private car as the usual mode do not have any monthly parking cost (71%), compared with 35% of public transport users (p=0.000, chi2=65.62, df=4). This is in the line with recent work (ref till Trängsel projektet snart klart) and a study done in Norway (Naess and Sandberg 1998). About half the Park & Ride users have parking costs.

![Number of commuters of mode choice and parking costs](image)

*Figure 7.2 The number of commuters for each choice of mode and parking cost.*

7.2.3 Chosen time for parking

The preferred time or used time for parking at a lot influences the choice of mode. Park & Ride users prefer earlier parking times than car and public transport users (p=0.002, chi2=37.2, df=16). One reason could be that a lot becomes full at a certain
time and users of Park & Ride knows this and want to be certain of getting a parking space.

![Number of commuters of mode choice and preferred parking hours](image)

**Figure 7.3 The numbers of commuters by choice of mode and preferred parking hours**

### 7.2.4 Distance between parking place at work and work

A significant correlation was found between distance to work from the parked car and mode choice. Overall car drivers have shorter distances between parking place at work and work ($p=0.045$, chi2=21.35, df=12). A Park & Ride user is more likely to have a distance of more than 100 m than the other two travel modes have. The distance between parking place at work and work that has an influence on mode choice. A long distance between parking place and work promotes public transport.
7.2.5 Parking at home

There is a correlation between how easy or convenient it is to park at home and mode choice (p=0.012, chi2=31.41, df=16). For instance, a commuter can park in a garage in the basement or have the car parked just outside or even inside the house. More Park & Ride users park outside their homes (84.2%) compared with car and public transport users, where the percentages are 74% and 73% respectively. When parking at a lot outside, the car is more frequently chosen (13.2%). However, when parking in a garage for a number of cars, 12.6% choose public transport rather than the car and Park & Ride (6.8% and 6.2% respectively), see appendix 8. For reasons explained later in the discussion these results should be interpreted with care.
8  ESTIMATIONS OF SP PARAMETERS

8.1  BASE MODEL FOR THE WHOLE SAMPLE

From the four factors and as a result of the levels they obtained, seven variables were constructed, as shown in Table 8.1. Alogit (1995) was used to estimate the parameters (betas). The table shows the estimation results for the entire data set of 8*629 (5032) observations. As can be seen the parameters have the right signs as expected and the t-ratios are over 1.96, which means the beta coefficient has a 95% probability of not being zero. The t-ratio for the price parameter is large (37.4), which means that the standard deviation (SE) is small, leading to a stable value for the price parameter.

Table 8.1 The estimated parameters.

<table>
<thead>
<tr>
<th>Modelling variables</th>
<th>Estimate (beta)</th>
<th>t-ratio</th>
<th>Beta divided by beta for the cost parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price/parking fee</td>
<td>-0.1037</td>
<td>37.4</td>
<td>1.0000</td>
</tr>
<tr>
<td>Distance between parking space and platform</td>
<td>-0.0022</td>
<td>6.0</td>
<td>0.0216</td>
</tr>
<tr>
<td>Guarded lot with lights and roof</td>
<td>1.1680</td>
<td>11.6</td>
<td>-11.2633</td>
</tr>
<tr>
<td>Unguarded with lights</td>
<td>0.5785</td>
<td>7.3</td>
<td>-5.5786</td>
</tr>
<tr>
<td>Guaranteed a parking space</td>
<td>0.6925</td>
<td>7.6</td>
<td>-6.6779</td>
</tr>
<tr>
<td>Parking lot is full once a month</td>
<td>0.3013</td>
<td>3.7</td>
<td>-2.9055</td>
</tr>
<tr>
<td>Parking lot is full twice a month</td>
<td>0.2730</td>
<td>3.6</td>
<td>-2.6326</td>
</tr>
<tr>
<td><strong>Summary statistics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.363</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( R^2 ) const</td>
<td>0.362</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>No of observations</strong></td>
<td>4735</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
8.1.1 Willingness to pay for the factors

In this section, the willingness to pay for four of the factors is presented and discussed.

- Distance between parking space and platform
- Guarded lot with lights and roof
- Unguarded with lights
- Guaranteed a parking space

The t-values for the two variables describing the lower quality levels of the factor guaranteed a parking space are quite small (3.7 and 3.6), resulting in uncertainty about the willingness to pay and therefore they have been excluded from further analysis. An explanation to this uncertainty of the estimated parameters could be that the factor was not discussed in the focus group. The chosen levels in the questionnaire are probably difficult to enter into the situation.

The willingness to pay for the factors is calculated as the ratio $\frac{\beta_k}{\beta_{\text{cost}}}$. As shown in Figure 8.1, the willingness to pay for a guarded parking lot with lights and roof is SEK 11.3 +/-1.9. Being guaranteed a space at the lot is valued to SEK 6.7 +/-1.7. This value can be compared with a study conducted in Washington State (Hendricks and Outwater 1998) in which 35% of all the respondents said that they would pay USD 2 (almost SEK 20) a day for increased capacity and security. In this study, 50% of the non-users were willing to pay for increased capacity and security compared with 33% of the users.

As can be seen in Figure 8.1 the willingness to pay for an unguarded lot with lights is half the willingness to pay for a guarded lot. For the distance between the parking space and platform, the respondents value to SEK 2.2 +/-0.7 for every 75 metres they do not need to walk.
Figure 8.1 The willingness to pay for the factors.

8.1.2 Utilities for Park & Ride lots

Calculated utilities using the estimated parameters of an excellent lot and a worst lot, together with the utilities of Råcksta and Horthus, are shown below. The utilities should be regarded as the difference between a basic utility, which is set at zero in the following example (could be any number).

The utility is a linear function and is expressed as:

\[ V(X_i) = \beta_1 X_{i1} + \beta_2 X_{i2} + \ldots \]

The utility for an excellent parking lot \((U_e)\) with the estimated parameters in this research could be expressed as follows:

\[ U_e = (-0.1037) \times 0 + (-0.0022) \times 25 + 1.168 + 0.6925 = 1.806 \]

The first zero is because the parking lot is free of charge, 25 m between parking space and platform, the next figure stands for a guarded lot with lights and roof and finally a guaranteed parking space.

If the same calculations are performed for a worst parking lot \((U_w)\), the following result will be:

\[ U_w = (-0.1037) \times 30 + (-0.0022) \times 300 + 0 + 0 = -2.451 \]

A worst parking lot has a fee of SEK 30, is located 300 m from the platform, is un-guarded with no lights and the parking lot is full once a week.
The utility for the Horthus parking lot (U_H) is as follows:

- \[ U_H = (-0.1037) \times 0 + (-0.0022) \times 100 + 0 + 0.2730 = 0.053 \]

In this case, Horthus is defined as a parking lot with no fee, has 100 m to the platform, unguarded and no lights and travellers do not get a parking space twice a month.

Finally the utility for Råcksta parking lot (U_R) is as follows:

- \[ U_R = (-0.1037) \times 0 + (-0.0022) \times 25 + 0 + 0.6925 = 0.6375 \]

Råcksta is defined here as a parking lot with no fee, with 25 m to the platform, unguarded with no lights and travellers are always guaranteed a parking space.

![Utility of some Park & Ride lots](image)

Figure 8.2 The utilities of some Park & Ride lots.

As shown in Figure 8.2, Råcksta has higher utility than Horthus.

### 8.1.3 Willingness to pay for the parking lots

As can be seen in Figure 8.3, commuters value an excellent Park & Ride lot to SEK 17. At a worst parking lot, the user has to be paid to park (SEK 24). The worst Park & Ride lot has a fee of SEK 30, has 300 m to the platform, is unguarded with no lights and the parking lot is full once a week. Zero willingness to pay represents a Park & Ride lot with no parking fee, no distance between parking space and station, parking lot is full once a week and unguarded lot.

As shown in Figure 8.3 Råcksta has a higher willingness to pay than Horthus. This result is in the line with the results from a previous study (Lindström Olsson 1999). In that study Råcksta got higher scores than Horthus. Horthus got lower scores much depending on the security problems at the lot. Even though Horthus has longer dis-
tances to the platform and experiences a large amount of damage, it is already overfull early in the morning. This is much due to the latent demand in the area for more Park & Ride spaces.

Figure 8.3 The willingness to pay for two hypothetical and extreme lots in comparison to Råcksta and Horthus.

8.2 WILLINGNESS TO PAY FOR SEGMENTS

It is interesting to investigate how willingness to pay varies between segments. The results can be used to introduce different measures to different segment groups. The willingness to pay for the following segments have been studied:

- Personal characteristics
- Errands
- Travel characteristics
- Areas

Some groups were found to be of more interest, which are discussed below, one factor at a time.
8.2.1 *Factor:* distance from parking space to platform

For this factor, the willingness to pay for not having to walk 75 m between parking space and platform is estimated. The willingness to pay has a spread of SEK 3, where the lowest is SEK 5 and the highest is SEK 3.5.

**Personal segment**

As can be seen in Figure 8.4, younger travellers value the distance factor more than older commuters. This is significant at 10 % level.

![Diagram](image)

*Figure 8.4 The willingness to pay for different age groups for the distance factor.*

Willingness to pay also increases with income, as shown in Figure 8.5. There is a significant difference between middle- and high- income groups. The higher income group have almost double willingness to pay than the middle income group.
Travel characteristics

Choice of mode
There is a significant difference in willingness to pay between car drivers and public transport users. Car drivers have the highest willingness to pay 3.1 +/-1.1 while public transport users have the lowest, SEK 0.75 +/-1.7, as can be seen in Figure 8.6. There is also a significant difference between car drivers and Park & Ride in willingness to pay (SEK 1.4 +/-1.0). Car drivers have generally larger willingness to pay than other modes (Algers et al 1995).
Figure 8.6 The willingness to pay for the different mode users for the distance factor


Distances between parking space at work and work:
It is interesting to see (Figure 8.7) that the willingness to pay increases by the distance factor apart from the segment group that has distances over 200 m, where it instead decreases. However, the differences are not significant.

Figure 8.7 Willingness to pay for the factor for segments of distance between parking space at work and work.
Parking costs at work
No significant difference was found between those that have or do not have to pay to park at work.

8.2.2 Factor: guarded lot with lights and roof

How the willingness to pay varies between some chosen segments of personal and travel characteristics is described in this section. For the factor with the highest security level, the parking lot has guards, lights and roof. Some segments have a much lower willingness to pay or higher than the average of SEK 11. The spread lies between SEK 9 and 15.

Travel characteristics

As can be seen in Figure 8.8, car drivers have a significantly higher willingness to pay than Park & Ride users (SEK 13 +/-2.9 and SEK 9 +/-2.8 SEK respectively). For public transport the willingness to pay is SEK 12 (+/- 4.5 SEK).

![Willingness to pay for a guarded lot](image)

Figure 8.8 The willingness to pay for the different modes.
8.2.3 Factor: unguarded lot with lights

For the factor unguarded lot with lights, the willingness to pay has a spread of between SEK 3 and 10. Some segment groups of interest are discussed below.

**Personal**

There is a significant difference at 15% level between the genders. Women are willing to pay more than men (SEK 6.7 +/- 2 and SEK 4.5 +/- 2.1 respectively). Studies show that women prioritise security in the transport system more than men (Warsén, 1997). Otherwise men usually have higher willingness to pay than men because of their higher income. Women have about 82% of the income of men on average (SCB 2002).

**Errands**

The commuters with errands have a significant higher willingness to pay than those with no errands (SEK 6.5 +/- 1.8 and SEK 3.5 +/- 2.4). There was no question in the survey of what the errands were. However in another study (Lindström Olsson 1999) the results show that a major part of the errands is leaving or fetching children at day care or school. One possible explanation to the higher valuation could be that when an individual get a child the more concern about security he/she gets.

**Travel characteristics**

Park & Ride users have a lower willingness to pay (SEK 4.5) than the other modes. Those using a bicycle as their main mode have the highest willingness to pay (SEK 10). However, the bike group is very small compared with the other groups and the result could therefore be somewhat misleading.

8.2.4 Factor: guaranteed a parking space

The only segment group that has a significant difference at 10% level for the factor guaranteed a parking space is errands. Those commuters that have errands value a guaranteed parking space more than those with no errands (SEK 4.1 +/- 3.0 and SEK 7.6 +/- 2.0 respectively)

8.2.5 Willingness to pay for availability of space

- Parking lot is full once a month
- Parking lot is full twice a month
Willingness to pay for the above two factors has a wide spread among the segment groups and varies between the segments in an inconsistent manner. The t-value is relatively low. One explanation for this spread could be that it might be harder for the respondents to understand the hypothetical question of availability of space. For this reason, these factors are not analysed. Another reason could be that levels used for this factor was not discussed in the focus group. An explanation could be that commuters with errands feel they are in more need of car for their trip than the others who are more free to choose another mode. A study in Norway showed that it is considered more inconvenient to leave or fetch children than shopping on the way (Grue and Hoelsaeter (2000).

### 8.2.6 Segments of gender

Willingness to pay for the four factors is shown in Figure 8.9, segmented into men and women. This way of presenting the results also makes it easier to see how the willingness to pay varies between the factors within the same segment. As can be seen, women and men have the same willingness to pay for a guarded lot, but women value an unguarded lot with lights more highly than men. A possible explanation of this result could be that women value their individual security more than men. Lights at the lot make women feel safer, while guards make both men and women feel security for their vehicle.

![Figure 8.9 Willingness to pay for the variables and segments by gender.](image-url)
9 SUMMARY AND DISCUSSION

With the increased levels of travelling by car, causing congestion and environmental problem in urban areas, Park & Ride systems might have some potential to ease this congestion. This research has focused on quantifying some quality factors that might have an impact on the use of Park & Ride facilities. The survey explored the impact on willingness to pay for the following factors:

- the parking fee
- the distance from the parking space at the Park & Ride lot to the platform
- availability of spaces at the parking lot
- security at the parking lot

The way in which the parking conditions at home and at work influence the choice of mode has also been investigated, in addition to the influence of personal characteristics.

The results of this work provide an insight into ways of increasing the quality at parking lots near stations to encourage the use of Park & Ride. The principal findings are that commuters value a guarded lot with lights and roof more than being guaranteed a parking space at the lot. Lights at the lot are also highly valued compared with the willingness to pay for the distance between parking space and platform. Other results show that parking facilities at work have a powerful effect on people’s choice of mode. Park & Ride users and public transport users appear to have longer distances between parking place at work and work than car users. The majority of Park & Ride users have to pay for parking at work. The results also indicate that the security at the Park & Ride facility is important. It is somewhat surprising to discover that there is no significant difference between women and men when it comes to a guarded parking lot with lights and roof. However, women value an unguarded parking lot with lights more highly than men.

The model created in this research describes the choice between Park & Ride lots. However, it is more interesting to study the choices between Park & Ride and other modes. The data from this study will be used for further analysis in the PhD project were a mode choice model will be explored.

9.1 FACTORS INFLUENCING CHOICE OF MODE

9.1.1 Distances to station

The data in this research shows that the distance between station and work or between home and station has no significant impact on the choice of mode. However, other studies
have shown that the distances between home and station influence the choice of mode (Usterud Hanssen 1997). If there had been more questionnaires to analyse the results might have been different.

9.1.2 Parking conditions at work

If a commuter has free parking at work, he/she is more likely to choose the car. In overall terms, the majority of the commuters who use a car as their commonly used mode of transport do not have any monthly parking costs (71%), compared with 35% of public transport users. This is in line with a recently conducted study in Stockholm (Bång et al 2003). About half the Park & Ride users have parking costs. Other studies support the finding that this is an important factor when it comes to the choice of mode. On average, non-users have shorter distances to walk between their parked car and work.

9.1.3 Parking conditions at home

A significant correlation was found between parking conditions at home and choice of mode. One conclusion could be that parking in a garage with many other cars often means an inconvenience in collection the car. It is definitely not as convenient as parking close to the house. However the alternative answers of the multiple-choices question, of the parking on the street and parking at the homes, could be misinterpret as the same kind of parking. This makes it hard to draw any reliable conclusions from about how convenient the parking is and the impacts on mode choice.

9.1.4 Availability of space

In overall terms, the data shows that, when commuters are guaranteed a parking space at a lot, they are more willing to use Park & Ride than before. There is probably a potential for encouraging car users to change to Park & Ride. Even those that already use Park & Ride are frequently willing to use it more. For example in the northern area 45% answer that they never or less than once a month would use but after being guaranteed a space, 22% answer that they never or less than once a month would use Park & Ride. The corresponding figures for the western area are 38% and 30%. In the northern area, there is probably a latent demand for more parking lots and spaces, as the pressure is high at Horthus, which is overparked early in the morning.

9.2 SUGGESTED MEASURES

Free Park & Ride lots are the most frequently selected option of measures among both users and non-users. Second and third places are being guaranteed a parking space and easy access to the lot. However, non-users select double the frequency of buses and trains much more frequently than users. Non-users, to a greater extent than users of Park & Ride, propose a congestion charge of SEK 30 as a good way of making car drivers switch to Park & Ride. Could this mean that car drivers have a more positive attitude towards a congestion charge than non-users? From a study conducted in Norway the
result show that as the number of car ownership increases a respondent is less likely to agree to toll-rings (Thorpe 2002).

9.3 MEASURES AT RÅCKSTA AND HORTHUS

If the quality or standard at Råcksta was increased to make it an excellent lot and a fee of SEK 10 was introduced, Råcksta would retain the same occupancy rate as today. However, it would probably be better only to improve the standard at Råcksta in order to raise the occupancy rate. However at Horthus, which is already over parked, it would be better to introduce a fee or organise more parking spaces.

9.4 WILLINGNESS TO PAY

Commuters value an excellent Park & Ride lot to 17 SEK. An excellent parking lot has guards, lights and roof, a short distance between parking space and platform, parking spaces that are always available and it is also free of charge. In the case of a worst parking lot, the user has to be paid to park (SEK 24). Such a lot has a fee of SEK 30, has 300 m to the platform, is unguarded with no lights and the parking lot is full once a week.

9.4.1 Willingness to pay for the factors

The respondents value a guarded lot with lights and roof to SEK 11 for. Being guaranteed a space at the lot is worth almost SEK 7. If an unguarded parking lot has lights, the willingness to pay is nearly SEK 6. One conclusion could be that it is more economical to put lights at the lot, as making it safe with guards is more expensive.

For the distance between the parking space and platform, the respondents are willing to pay SEK 2 for every 75 metres they do not have to walk. In the first place, a guarded lot is preferred, followed by guaranteed parking spaces at the lot.

9.4.2 Willingness to pay for the factors per segment

Women and men have the same willingness to pay for a guarded lot, but women value an unguarded lot with lights more highly than men. One explanation of this result could be that women value individual security more than men. Lights on the lot would make women feel safer, while guards make both men and women feel security for the car. Men might be more concerned about the car than women.

9.4.3 Different results with different methods

The stated preference method revealed that guarded lots with lights and roof have a higher willingness to pay than being guaranteed a parking space. However, these factors did not receive the same ranking when it came to the question of the measures that would
make commuters start to use Park & Ride. In this question, being guaranteed a parking space is given a higher ranking than a guarded lot.

Both methods used in this research reveal that individual security and security for cars is very important criteria when it comes to determining what makes a Park & Ride lot attractive. However, the two methods that have been used produce slightly different results. When using the stated preference method a guarded lot with lights and roof receives a higher value than being guaranteed a parking space, see Table 9.1. When asking about the measures that would make commuters start to use Park & Ride, a guarded lot comes much further down the list of suggested measures. In addition to the measure of making it free to park at the lot, being guaranteed a parking space and easy to find and park at the lot are suggested measures.

A possible explanation of the slightly different results could be that the question was asked in different ways. For example, in Study 2, the respondents were asked to choose three measures from 14 available on a list of measures that would make them use Park & Ride more frequently or start to use it.

<table>
<thead>
<tr>
<th>Method</th>
<th>Stated-preference method used in Study 2</th>
<th>Ranking of 14 measures that would make commuters start to use Park &amp; Ride Method used in Study 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ranking of factors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>No fee at the lot</td>
<td>No fee at the lot</td>
</tr>
<tr>
<td>2</td>
<td>Guarded lot</td>
<td>Guaranteed a parking space</td>
</tr>
<tr>
<td>3</td>
<td>Guaranteed a parking place</td>
<td>Easy to find and park at the lot</td>
</tr>
</tbody>
</table>

Table 9.1 The ranking of factors using two different methods.
10 FURTHER RESEARCH

In this section, some important topics are identified for further research.

*Use the estimated parameters in a model*

It would be interesting to put the estimated parameters in this research in a transport forecast model. This would get the effects of improving the quality of Park & Ride lots on the mode split.

*Location of a Park & Ride lot*

Previous studies have shown that mostly car users switch to Park & Ride while other studies have shown that it is mostly travellers by bicycle and public transport that change modes. It seems to be important to be careful when introducing Park & Ride as an alternative mode to car. There has to be more knowledge about where to locate the lots in order not to move people already using public transport or bicycle users changing modes. There should be more research about what additional measures that are needed to keep the political goal of transferring from car to Park & Ride.

*Parking conditions at home*

The research showed that the majority of users and non-users of Park & Ride park outside their homes. It would be interesting to study the effects parking facilities at home has on the choice of mode.

*Finding other factors that influence the choice of mode*

In this study, only four quality factors have been quantified. There are most probably other quality factors that would also be useful to quantify and put into a forecast model. The quantified factors in this study should also be quantified together with the cost and price factors in order to obtain a more balanced view of people’s willingness to pay for the quality factors.

*Test some of the proposed measures*

It would also be interesting to test some of the proposed measures in reality to see the impacts the measures have on the choice of mode.
11 REFERENCES


Bruzelius, N and Janson, C; *Infartsparkering i Stockholm: Efterfrågeanalys och efterfrågeprognoser*; VBB, Stockholm 1981


Domencich, T. & McFadden, D. *Urban Travel Demand: A behavioural Analysis*. Amsterdam, Netherlands 1975

Engström, M-G; Taflin, L and Wenninger, T; *Infartsparkeringar - Knutpunkter i trafiksystemet: Reserapport*; Transportforskningsberedningen. TFB meddelande 163; Stockholm 1990


Grue, B and Hoelsaeter, A; *Infartsparkering med bil og sykkel – Faktorer som påvirker togtrafikantenes valg av transportmiddelet til stasjonene i Oslo og Akershus*; TOI notat 1159/2000, Oslo 2000

Hendricks, S and Outwater, M; *Demand forecasting model for park-and-ride lots in King County, Washington*; Transportation Research Record 1998 nr 1623, UT-GIVNINSSTAD 1998

Heurlin-Norinder, M; *Närmiljöns funktioner. Exempel på bra och dåliga miljöer för barn*; KFB & VTI forskning/research nr 27:2, Linköping 1999

---

50

Jakobsson, C. Motivational and Behavioral Effects of Economic Disincentives on private Car Use, Department of psychology, Göteborg, 2001


Krantz, L-G; Rörlighetens mångfald och förändring – Befolkningens dagliga resande i Sverige 1978 och 1996; Göteborgs universitet, serie B nr 95, Göteborg, 1999

Lind, G and Schmidt, K; Impuls – förstudie, Erfarenheter av dynamisk trafikinformation vid park & Ride anläggningar, Stockholm 1998


RAC; Car Dependence, ESRC Transport Studies Unit, University of Oxford, UK 1995


SIKA, Uppföljning av de transportpolitiska målen maj 2000, Sika rapport nr 5, Stockholm, 2000


Thorpe, N. Public Acceptance of Road-user Charging – A Case-study of the Toll-rings in Norway. IATSS RESEARCH vol 26, no 1, 2002


51
Usterud Hanssen, J; Parkering: ett virkemiddel i samordnet areal- och transportplanlegging. Transportökonomisk institutt. TÖI rapport 349, Oslo 1997

Vägverket, Korta miljöanpassade resor, en litteraturstudie, rapport nr 342, Solna 1998

12 APPENDIX

Appendix 1 The personal characteristics for the sample.

<table>
<thead>
<tr>
<th>Age</th>
<th>Number of answers = N</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-30</td>
<td>4.8</td>
</tr>
<tr>
<td>31-40</td>
<td>28.9</td>
</tr>
<tr>
<td>41-50</td>
<td>30.0</td>
</tr>
<tr>
<td>51-60</td>
<td>28.1</td>
</tr>
<tr>
<td>60+</td>
<td>8.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>47.6</td>
</tr>
<tr>
<td>Female</td>
<td>52.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Household income SEK k/year</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;200</td>
<td>1.9</td>
</tr>
<tr>
<td>201-400</td>
<td>16.6</td>
</tr>
<tr>
<td>401-600</td>
<td>28.3</td>
</tr>
<tr>
<td>601-800</td>
<td>28.5</td>
</tr>
<tr>
<td>&gt;801</td>
<td>24.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Household size</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 pers</td>
<td>7.7</td>
</tr>
<tr>
<td>2 pers</td>
<td>26.8</td>
</tr>
<tr>
<td>3-4 pers</td>
<td>51.8</td>
</tr>
<tr>
<td>5 or more</td>
<td>13.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Children under 7</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>66.8</td>
</tr>
<tr>
<td>Yes</td>
<td>33.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Errands</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>30.8</td>
</tr>
<tr>
<td>Yes</td>
<td>69.2</td>
</tr>
</tbody>
</table>
Appendix 2  The commuter characteristics for the sample.

<table>
<thead>
<tr>
<th>Distance between station and work</th>
<th>N= number of answers</th>
<th>619</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;50 m</td>
<td>20.5</td>
</tr>
<tr>
<td></td>
<td>50-100 m</td>
<td>15.5</td>
</tr>
<tr>
<td></td>
<td>100-200 m</td>
<td>18.9</td>
</tr>
<tr>
<td></td>
<td>200-300 m</td>
<td>17.3</td>
</tr>
<tr>
<td></td>
<td>300-500 m</td>
<td>16.6</td>
</tr>
<tr>
<td></td>
<td>&gt;500 m</td>
<td>11.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Distance between home and station</th>
<th>N= number of answers</th>
<th>605</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;50 m</td>
<td>7.1</td>
</tr>
<tr>
<td></td>
<td>50-100 m</td>
<td>9.6</td>
</tr>
<tr>
<td></td>
<td>100-200 m</td>
<td>18.0</td>
</tr>
<tr>
<td></td>
<td>200-300 m</td>
<td>15.5</td>
</tr>
<tr>
<td></td>
<td>300-500 m</td>
<td>24.6</td>
</tr>
<tr>
<td></td>
<td>&gt;500 m</td>
<td>25.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parking cost at work</th>
<th>N= number of answers</th>
<th>629</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td></td>
<td>52.6</td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td>47.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Distance between p-place and work</th>
<th>N= number of answers</th>
<th>552</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;10 m</td>
<td>24.3</td>
</tr>
<tr>
<td></td>
<td>10-50 m</td>
<td>33.5</td>
</tr>
<tr>
<td></td>
<td>50-100 m</td>
<td>16.5</td>
</tr>
<tr>
<td></td>
<td>&gt;100 m</td>
<td>25.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chosen time for parking</th>
<th>N= number of answers</th>
<th>591</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before 7.00</td>
<td></td>
<td>15.1</td>
</tr>
<tr>
<td>7.00-7.30</td>
<td></td>
<td>28.1</td>
</tr>
<tr>
<td>7.30-8.00</td>
<td></td>
<td>29.6</td>
</tr>
<tr>
<td>8.00-8.30</td>
<td></td>
<td>19.8</td>
</tr>
<tr>
<td>After 8.30</td>
<td></td>
<td>7.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parking at home</th>
<th>N= number of answers</th>
<th>620</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside your home</td>
<td></td>
<td>77.7</td>
</tr>
<tr>
<td>On a parking lot outdoors</td>
<td>9.5</td>
<td></td>
</tr>
<tr>
<td>Parking in a garage for a number of cars</td>
<td>7.9</td>
<td></td>
</tr>
<tr>
<td>Parking on the street</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>1.3</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Distance to work</th>
<th>N= number of answers</th>
<th>606</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10 km</td>
<td></td>
<td>13.4</td>
</tr>
<tr>
<td>10-15 km</td>
<td></td>
<td>23.1</td>
</tr>
<tr>
<td>15-20 km</td>
<td></td>
<td>29.4</td>
</tr>
<tr>
<td>20-25 km</td>
<td></td>
<td>12.4</td>
</tr>
<tr>
<td>&gt;25 km</td>
<td></td>
<td>21.8</td>
</tr>
</tbody>
</table>
Appendix 3  The personal characteristics of users and non-users.

<table>
<thead>
<tr>
<th></th>
<th>Users</th>
<th>Non-users</th>
<th>X²</th>
<th>df</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21-30</td>
<td>4.6</td>
<td>4.9</td>
<td>7.119</td>
<td>4</td>
<td>.130</td>
</tr>
<tr>
<td>31-40</td>
<td>32.5</td>
<td>26.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>41-50</td>
<td>24.1</td>
<td>33.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>51-60</td>
<td>29.5</td>
<td>27.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60+</td>
<td>9.3</td>
<td>7.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>40.1</td>
<td>52.2</td>
<td>8.645</td>
<td>1</td>
<td>.003</td>
</tr>
<tr>
<td>Female</td>
<td>59.9</td>
<td>47.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Household income SEK k/year</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;200</td>
<td>1.8</td>
<td>1.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>201-400</td>
<td>17.6</td>
<td>16.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>401-600</td>
<td>25.7</td>
<td>29.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>601-800</td>
<td>30.2</td>
<td>27.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>801´+</td>
<td>24.8</td>
<td>24.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Household size</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 pers</td>
<td>6.8</td>
<td>8.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 pers</td>
<td>30.8</td>
<td>24.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-4 pers</td>
<td>49.8</td>
<td>53.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 or more</td>
<td>12.7</td>
<td>14.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Children under 7</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>68.0</td>
<td>66.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>32.0</td>
<td>33.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Errands</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>32.9</td>
<td>29.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>67.1</td>
<td>70.4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix 4 The commuter characteristics of users and non-users.

<table>
<thead>
<tr>
<th>Distance between station and work</th>
<th>N</th>
<th>Users 233</th>
<th>Non-users 386</th>
<th>N. S</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50 m</td>
<td>23.6</td>
<td>18.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50-100 m</td>
<td>16.3</td>
<td>15.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100-200 m</td>
<td>17.6</td>
<td>19.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>200-300 m</td>
<td>18.0</td>
<td>16.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>300-500 m</td>
<td>16.3</td>
<td>16.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;500 m</td>
<td>8.2</td>
<td>13.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>281</td>
<td>312</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td>200</td>
<td>200</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Distance between home and station</th>
<th>N</th>
<th></th>
<th></th>
<th>N. S</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50 m</td>
<td>6.7</td>
<td>7.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50-100 m</td>
<td>10.7</td>
<td>8.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100-200 m</td>
<td>17.8</td>
<td>18.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>200-300 m</td>
<td>13.9</td>
<td>16.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>300-500 m</td>
<td>20.5</td>
<td>27.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;500 m</td>
<td>30.4</td>
<td>22.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>594</td>
<td>441</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td>400</td>
<td>300</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Parking cost at work

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th></th>
<th></th>
<th>N. S</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>39.1</td>
<td>60.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; SEK 5 / day or &gt; SEK 50 / month</td>
<td>Yes</td>
<td>60.9</td>
<td>39.1</td>
<td></td>
</tr>
<tr>
<td><strong>Max. SEK/day</strong></td>
<td>300</td>
<td>280</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Max. SEK/month</strong></td>
<td>4800</td>
<td>4000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Distance between p-place and work</th>
<th>N</th>
<th></th>
<th></th>
<th>N. S</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10 m</td>
<td>19.9</td>
<td>26.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-50 m</td>
<td>29.8</td>
<td>35.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50-100 m</td>
<td>15.2</td>
<td>17.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;100 m</td>
<td>35.1</td>
<td>20.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>1102</td>
<td>155</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td>75</td>
<td>35</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Frequency of Park & Ride

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th></th>
<th></th>
<th>N. S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Every day</td>
<td>40.0</td>
<td>8.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-4 days a week</td>
<td>36.6</td>
<td>8.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-2 days a week</td>
<td>14.5</td>
<td>6.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Few times or once a month</td>
<td>6.4</td>
<td>11.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never or less than once a month</td>
<td>2.6</td>
<td>64.9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Frequency when guaranteed a parking space

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th></th>
<th></th>
<th>N. S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Every day</td>
<td>47.5</td>
<td>16.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>Percentage</td>
<td>Error</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------</td>
<td>------------</td>
<td>-------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-4 days a week</td>
<td>37.7</td>
<td>15.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-2 days a week</td>
<td>8.9</td>
<td>12.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Few times or once a month</td>
<td>4.7</td>
<td>15.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never or less than once a month</td>
<td>1.3</td>
<td>41.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chosen time for parking</th>
<th>N</th>
<th>Chi-Square</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before 7 am</td>
<td>225</td>
<td>55.14</td>
<td>4</td>
<td>.000</td>
</tr>
<tr>
<td>7 am-7.30 am</td>
<td>366</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.30 am-8 am</td>
<td>22.7</td>
<td>10.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 am-8.30 am</td>
<td>37.8</td>
<td>22.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After 8.30 am</td>
<td>26.7</td>
<td>31.4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parking at home</th>
<th>N</th>
<th>Chi-Square</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside your home</td>
<td>235</td>
<td>11.43</td>
<td>4</td>
<td>.022</td>
</tr>
<tr>
<td>On a parking lot outdoors</td>
<td>385</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parking in a garage for a number of cars</td>
<td>7.7</td>
<td>8.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parking on the street</td>
<td>2.6</td>
<td>4.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>2.1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX 5  The personal characteristics for the areas.

<table>
<thead>
<tr>
<th></th>
<th>Northern area</th>
<th>Western area</th>
<th>X²</th>
<th>df</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21-30</td>
<td>4.6</td>
<td>5.1</td>
<td></td>
<td></td>
<td>N. S</td>
</tr>
<tr>
<td>31-40</td>
<td>29.6</td>
<td>28.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>41-50</td>
<td>27.0</td>
<td>33.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>51-60</td>
<td>29.6</td>
<td>26.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60+</td>
<td>9.1</td>
<td>7.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>49.4</td>
<td>45.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>50.6</td>
<td>54.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Income SEK k/year</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;200</td>
<td>1.7</td>
<td>2.0</td>
<td></td>
<td></td>
<td>N. S</td>
</tr>
<tr>
<td>201-400</td>
<td>15.2</td>
<td>18.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>401-600</td>
<td>27.7</td>
<td>29.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>601-800</td>
<td>26.3</td>
<td>30.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>801´+</td>
<td>29.1</td>
<td>20.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Household size</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 pers</td>
<td>8.1</td>
<td>7.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 pers</td>
<td>24.0</td>
<td>29.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-4 pers</td>
<td>51.0</td>
<td>52.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 or more</td>
<td>16.9</td>
<td>10.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Children under 7 year</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>64.1</td>
<td>69.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>35.9</td>
<td>30.4</td>
<td></td>
<td></td>
<td>N. S</td>
</tr>
<tr>
<td><strong>Errands</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>30.6</td>
<td>30.9</td>
<td></td>
<td></td>
<td>N. S</td>
</tr>
<tr>
<td>Yes</td>
<td>69.4</td>
<td>69.1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix 6 The commuter characteristics for the areas.

<table>
<thead>
<tr>
<th>Distance between station and work</th>
<th>N</th>
<th>North-</th>
<th>Western</th>
<th>area</th>
<th>area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>304</td>
<td>313</td>
<td>N. S</td>
<td></td>
</tr>
<tr>
<td>&lt;50 m</td>
<td></td>
<td>20.7</td>
<td>20.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50-100 m</td>
<td></td>
<td>15.5</td>
<td>15.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100-200 m</td>
<td></td>
<td>15.8</td>
<td>22.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>200-300 m</td>
<td></td>
<td>19.1</td>
<td>15.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>300-500 m</td>
<td></td>
<td>16.8</td>
<td>16.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;500 m</td>
<td></td>
<td>12.2</td>
<td>10.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance between home and station</td>
<td>N</td>
<td>303</td>
<td>300</td>
<td>N. S</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;50 m</td>
<td></td>
<td>6.6</td>
<td>7.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50-100 m</td>
<td></td>
<td>9.6</td>
<td>9.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100-200 m</td>
<td></td>
<td>17.5</td>
<td>18.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>200-300 m</td>
<td></td>
<td>15.5</td>
<td>15.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>300-500 m</td>
<td></td>
<td>23.4</td>
<td>26.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;500 m</td>
<td></td>
<td>27.4</td>
<td>23.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parking cost at work</td>
<td>N</td>
<td>311</td>
<td>316</td>
<td>N. S</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; SEK 5 / day or &gt;SEK 50 / month</td>
<td>No</td>
<td>51.8</td>
<td>53.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>48.2</td>
<td>46.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. SEK/day</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. SEK/month</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance between p-place and work</td>
<td>N</td>
<td>265</td>
<td>285</td>
<td>N. S</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;10 m</td>
<td></td>
<td>24.9</td>
<td>23.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-50 m</td>
<td></td>
<td>30.2</td>
<td>36.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50-100 m</td>
<td></td>
<td>17.0</td>
<td>16.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;100 m</td>
<td></td>
<td>27.9</td>
<td>23.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mode choice</td>
<td>N</td>
<td>295</td>
<td>301</td>
<td>9.721</td>
<td>.045</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Car</td>
<td></td>
<td>47.5</td>
<td>38.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Park &amp; Ride</td>
<td></td>
<td>32.2</td>
<td>44.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public transport</td>
<td></td>
<td>15.9</td>
<td>14.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bike</td>
<td></td>
<td>2.0</td>
<td>2.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>2.4</td>
<td>1.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency of Park &amp; Ride</td>
<td>N</td>
<td>308</td>
<td>312</td>
<td>14.60</td>
<td>.006</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Every day</td>
<td></td>
<td>14.9</td>
<td>26.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-4 days a week</td>
<td></td>
<td>17.9</td>
<td>19.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-2 days a week</td>
<td></td>
<td>11.7</td>
<td>7.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Few times or once a month</td>
<td></td>
<td>10.7</td>
<td>8.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never or less than once a month</td>
<td></td>
<td>44.8</td>
<td>37.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency when guaranteed a parking space</td>
<td>N</td>
<td>303</td>
<td>309</td>
<td>8.077</td>
<td>.089</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>Study 1</td>
<td>Study 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------</td>
<td>---------</td>
<td>---------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Every day</td>
<td>27.7</td>
<td>28.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-4 days a week</td>
<td>25.4</td>
<td>22.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-2 days a week</td>
<td>12.9</td>
<td>9.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Few times or once a month</td>
<td>12.5</td>
<td>9.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never or less than once a month</td>
<td>21.5</td>
<td>30.1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Chosen time for parking**

<table>
<thead>
<tr>
<th>Time</th>
<th>Study 1</th>
<th>Study 2</th>
<th>Chi-square</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before 7 am</td>
<td>18.4</td>
<td>12.0</td>
<td>9.118</td>
<td>4</td>
<td>.058</td>
</tr>
<tr>
<td>7 am -7.30 am</td>
<td>30.9</td>
<td>25.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.30 am-8 am</td>
<td>26.4</td>
<td>32.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 am -8.30 am</td>
<td>17.7</td>
<td>21.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After 8.30 am</td>
<td>6.6</td>
<td>8.0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Parking at home**

<table>
<thead>
<tr>
<th>Type</th>
<th>Study 1</th>
<th>Study 2</th>
<th>Chi-square</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside your home</td>
<td>83.3</td>
<td>72.0</td>
<td>26.41</td>
<td>4</td>
<td>.000</td>
</tr>
<tr>
<td>On a parking lot outdoors</td>
<td>8.7</td>
<td>10.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parking in a garage for a number of cars</td>
<td>6.8</td>
<td>9.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parking on the street</td>
<td>0</td>
<td>7.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>1.3</td>
<td>1.3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Appendix 7 The personal characteristics and choice of mode

<table>
<thead>
<tr>
<th></th>
<th>Car (42.7)</th>
<th>P &amp; R (38.3)</th>
<th>Public (15.0)</th>
<th>X2</th>
<th>df</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N</strong></td>
<td>253</td>
<td>227</td>
<td>89</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21-30</td>
<td>5.1</td>
<td>4.0</td>
<td>7.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31-40</td>
<td>28.5</td>
<td>32.2</td>
<td>21.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>41-50</td>
<td>28.9</td>
<td>27.3</td>
<td>32.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>51-60</td>
<td>29.6</td>
<td>27.7</td>
<td>27.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60+</td>
<td>7.9</td>
<td>8.8</td>
<td>11.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>254</td>
<td>227</td>
<td>90</td>
<td>12.86</td>
<td>4</td>
<td>.012</td>
</tr>
<tr>
<td>Male</td>
<td>54.3</td>
<td>39.2</td>
<td>52.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>45.7</td>
<td>60.8</td>
<td>47.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Income SEK/year</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>244</td>
<td>214</td>
<td>82</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;200'</td>
<td>1.2</td>
<td>.9</td>
<td>3.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>201'-400</td>
<td>16.4</td>
<td>14.0</td>
<td>22.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>401'-600</td>
<td>30.8</td>
<td>23.9</td>
<td>29.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>601'-800'</td>
<td>25.8</td>
<td>33.6</td>
<td>26.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>801'+</td>
<td>25.8</td>
<td>27.6</td>
<td>18.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Household size</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>253</td>
<td>228</td>
<td>88</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 pers</td>
<td>9.1</td>
<td>5.3</td>
<td>10.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 pers</td>
<td>26.9</td>
<td>27.2</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-4 pers</td>
<td>52.2</td>
<td>53.5</td>
<td>47.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 or more</td>
<td>11.9</td>
<td>14.0</td>
<td>15.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Children under 7</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>230</td>
<td>186</td>
<td>66</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>67.4</td>
<td>63.4</td>
<td>78.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>32.6</td>
<td>36.6</td>
<td>21.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Errands</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>255</td>
<td>228</td>
<td>89</td>
<td>10.55</td>
<td>4</td>
<td>.032</td>
</tr>
<tr>
<td>No</td>
<td>29.0</td>
<td>28.5</td>
<td>38.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>71.0</td>
<td>71.5</td>
<td>61.8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Appendix 8 The cross-tabulation between travel characteristics and choice of mode

<table>
<thead>
<tr>
<th></th>
<th>Car (42.7)</th>
<th>P &amp; R (38.3)</th>
<th>Public (15.0)</th>
<th>X²</th>
<th>df</th>
<th>Sg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance between station and work</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>251</td>
<td>226</td>
<td>90</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;50 m</td>
<td>16.7</td>
<td>23.5</td>
<td>21.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50-100 m</td>
<td>13.2</td>
<td>16.8</td>
<td>16.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100-200 m</td>
<td>20.3</td>
<td>19.0</td>
<td>14.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200-300 m</td>
<td>16.3</td>
<td>15.5</td>
<td>22.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>300-500 m</td>
<td>18.7</td>
<td>16.8</td>
<td>13.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;500 m</td>
<td>14.7</td>
<td>8.4</td>
<td>12.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance between home and station</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>248</td>
<td>218</td>
<td>88</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;50 m</td>
<td>5.2</td>
<td>8.3</td>
<td>9.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50-100 m</td>
<td>9.3</td>
<td>9.6</td>
<td>8.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100-200 m</td>
<td>16.1</td>
<td>18.8</td>
<td>18.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200-300 m</td>
<td>14.9</td>
<td>16.1</td>
<td>14.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>300-500 m</td>
<td>27.8</td>
<td>21.6</td>
<td>25.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;500 m</td>
<td>26.6</td>
<td>25.7</td>
<td>25.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parking costs at work</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>256</td>
<td>229</td>
<td>90</td>
<td>65.62</td>
<td>4</td>
<td>.000</td>
</tr>
<tr>
<td>No</td>
<td>71.1</td>
<td>34.9</td>
<td>51.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; SEK 5 / day or &gt; SEK 50 / month</td>
<td>28.9</td>
<td>65.1</td>
<td>48.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance between p-place and work</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>246</td>
<td>186</td>
<td>71</td>
<td>21.35</td>
<td>12</td>
<td>.045</td>
</tr>
<tr>
<td>&lt;10 m</td>
<td>28.5</td>
<td>19.4</td>
<td>21.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-50 m</td>
<td>35.8</td>
<td>30.1</td>
<td>36.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50-100 m</td>
<td>17.5</td>
<td>17.2</td>
<td>11.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;100 m</td>
<td>18.3</td>
<td>33.3</td>
<td>31.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chosen time for parking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>238</td>
<td>221</td>
<td>82</td>
<td>37.2</td>
<td>16</td>
<td>.002</td>
</tr>
<tr>
<td>Before 7 am</td>
<td>13.0</td>
<td>18.1</td>
<td>9.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 am -7.30 am</td>
<td>24.8</td>
<td>34.8</td>
<td>24.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.30 am-8 am</td>
<td>29.0</td>
<td>27.1</td>
<td>39.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 am-8.30 am</td>
<td>22.7</td>
<td>15.8</td>
<td>24.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After 8.30 am</td>
<td>10.5</td>
<td>4.1</td>
<td>2.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parking at home</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>250</td>
<td>227</td>
<td>89</td>
<td>31.41</td>
<td>16</td>
<td>.012</td>
</tr>
<tr>
<td>Outside your home</td>
<td>74.0</td>
<td>84.2</td>
<td>73.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On a parking lot outside</td>
<td>13.2</td>
<td>6.6</td>
<td>6.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parking inside a garage for a number of cars</td>
<td>6.8</td>
<td>6.2</td>
<td>12.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parking on the street</td>
<td>3.6</td>
<td>2.2</td>
<td>6.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>2.4</td>
<td>.4</td>
<td>1.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance to work</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>249</td>
<td>219</td>
<td>87</td>
<td>33.55</td>
<td>16</td>
<td>.006</td>
</tr>
<tr>
<td>&lt;10 km</td>
<td>14.4</td>
<td>7.7</td>
<td>19.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance Range</td>
<td>Value 1</td>
<td>Value 2</td>
<td>Value 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-15 km</td>
<td>26.9</td>
<td>18.3</td>
<td>23.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-20 km</td>
<td>24.9</td>
<td>38.8</td>
<td>25.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-25 km</td>
<td>13.7</td>
<td>12.3</td>
<td>8.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;25 km</td>
<td>20.1</td>
<td>22.8</td>
<td>24.1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>