Lars Eriksson

Car Users’ Switching to Public Transport for the Work Commute
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**DISSERTATION**

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Per aspera ad astra

© Lars Eriksson
To Jan, Åke, Ali, and to the memory of Anita and Werner
Doctorial Dissertation: Car Users’ Switching to Public Transport for the Work Commute.

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Abstract

The general aim of the present thesis was to investigate the determinants of car users’ switching to public transport when driving to work.

Four studies were conducted. In the first (Paper I), an Internet survey addressing what people using their cars to commute to work in a medium-size city believe would make them reduce their car-use as well as what improvements to public transport services they believe would make them use those services was conducted. The results showed that, the further to work and/or bus stops - the more the participants desired increased frequencies and shorter travel times, but less often lower fares.

In the second study (Paper II), using a web-based experimental simulation, participants were given the task of planning their travel to and from work, including the performing of additional activities in accordance with predetermined agendas. The main results of this were that shorter travel times and good access to bus stops led to greater bus use while constraints imposed by a busy daily agenda led to greater car-use, in particular if car costs were low.

In the third study (Paper III) a new measure of travel-related subjective well-being (SWB), the 9-item self-report Satisfaction with Travel Scale (STS), was developed. The results showed that STS is reliable and differentiates between changes in travel conditions.

In the fourth study (Paper IV) which attributes other than time and cost contribute to the preference of car over bus in the choice of travel mode was investigated. Using STS, developed in Paper III, the effect of different travel modes on satisfaction with travel was studied. The results showed that ratings
of the attributes fun, lifestyle match, and feeling secure, on which car surpassed bus, accounted for mode differences in satisfaction with travel.

The conclusions of this thesis are that a public transport system must appear attractive, not only to its present users, but also to prospective users who currently use their cars. To appear attractive, it must not be too expensive and must have timetables and routes that allow users to travel in an efficient manner. One measure that can be used to force commuters out of their cars is higher car-use costs; however, car-use costs may need to be substantially higher than the cost of using public transport in order to be effective. As the present research has indicated, the perceived difficulty of using public transport is also an important factor. Raising car-use costs will thus be insufficient unless changes are made to public transport services. A factor complicating this is activity patterns, which are often complex. As has been indicated in the present research, the more complex the activity pattern - the more the car is used as a means of transport. Using STS to measure satisfaction with travel car was generally rated higher than bus. Furthermore ratings of the attributes fun, lifestyle match, and feeling secure, on which car surpassed bus, accounted for mode differences in satisfaction with travel.

**Keywords:** Car-use Reduction, Work Commute, Public Transport, Experimental Simulation, Satisfaction with Travel
The thesis is based on the following four research papers, which will be referred to throughout the text using Roman numerals:

DOI:10.1016/j.trf.2008.04.001

DOI:10.3328/TL.2010.02.03.145-155

DOI:10.1016/j.trf.2010.11.002


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Contributions in the appended papers

Paper I
Main author. Shared writing and data analyses.

Paper II
Main author. Collected data. Shared planning, writing and data analyses.

Paper III
Co-author. Collected data. Shared planning, writing and data analyses.

Paper IV
Main author. Collected data. Shared planning, writing and data analyses.
Acknowledgements

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Contents

Introduction .................................................................................................................................................. 1
Determinants of Daily Travel .................................................................................................................... 2
Travel Needs ............................................................................................................................................. 2
Choosing the Car ...................................................................................................................................... 4
The Problems Caused by Car Use ........................................................................................................... 5
Measures of Influencing Car Use ............................................................................................................. 6
Prohibition ................................................................................................................................................ 8
Road Pricing .......................................................................................................................................... 8
Individualized Marketing ......................................................................................................................... 9
Improvements to Public Transport Services .......................................................................................... 10
Satisfaction with Travel .......................................................................................................................... 12
Summary and Conclusions ...................................................................................................................... 13
Summary of Empirical Studies ................................................................................................................ 14
Study I ...................................................................................................................................................... 15
Study II .................................................................................................................................................... 15
Study III .................................................................................................................................................. 16
Study IV ................................................................................................................................................... 17
Discussion .............................................................................................................................................. 18
Conclusions .......................................................................................................................................... 23
References ............................................................................................................................................ 24

PAPER I
PAPER II
PAPER III
PAPER IV

VIII
Introduction

Car traffic has increased considerably during recent decades. The car enables transportation that brings people positive consequences but also costs for society. Individual freedom and independence are among the positive consequences noted in connection with car use. Thus, the versatile car enables people to conduct diverse activities in different places, for instance, work, purchases of different kinds, and leisure activities. At the same time the negative environmental effects of car use is becoming recognized.

Public transport has a lower societal cost than the car. Although most people use public transport for some trips they make, it is generally perceived to be less attractive and is less chosen. How can it be made more attractive? In the public transport industry, increasing competition has led to an increased marketing orientation, something which for instance has lead to that customer surveys have become common. With the increased competition, there is also an interest in boosting market shares. In addition to this, there are adaptations of services in order to encourage both existing and new travellers to travel more by public transport (Carlsson, 1999; Eriksson, 2006).

Both society and the public transport industry want to change public transport in order to adapt it to those who are frequent car users today. Accordingly, there is a need for knowledge of how public transport can be made attractive to car users. In all probability, it will also be necessary to take measures that inhibit car use. In Sweden the Swedish public transport Doubling Project is implementing an ambitious strategy aiming at doubling the market share of public transport (SKL, 2010). On a regional level in the Göteborg area the K2020 project has a similair aim with the target year 2025 (K2020, 2009). The Swedish projects are in line with developments in the International Association of Public Transport (UITP). In order to double public transport UITP published a new strategy in June 2009. The aim is to double the volume of public transport travel by the year 2025 (UITP, 2010).
Different types of factors influence car users’ choice of travel mode (Gärling, 2005; Gärling, Eek, et al., 2002). Some are related to the supply of available travel modes resulting from the implementation of transport policies, chiefly vehicle tolls and prohibition of car traffic. Others focus on influencing car users’ attitudes towards alternative travel modes. Factors related to available travel modes and the individual are interconnected, for instance a change in the travel modes can affect the individual’s perceptions. Costs associated with different means of transport are also of significance, as is perceived time pressure.

The main aim of this thesis is to investigate which public transport solutions may decrease car use by making them more attractive for different types of trips. Armed with such knowledge, it will then be possible to suggest how public transport can adapt its service offering to car users. In interviews with representatives of some Swedish public transport operators at the beginning of 2006, it was found that there is a need to enhancing knowledge about those who are car users today and do not utilize public transport (Eriksson, 2006). The knowledge gaps that exist regarding car users are known within the public transport industry and obtaining knowledge is something that the companies demand. It should be pointed out that car use is targeted, not the car users. The travel needs must be catered for by alternative travel modes such as public transport or slow modes.

In the following section, a review of the determinants of daily travel is presented. This is followed by a section focusing on choices of travel mode. The sections that follow provide an overview of the implications of car use, including different means of influence. Finally, the empirical studies are summarized and discussed.
Determinants of Daily Travel

Travel Needs

People conduct activities in different places due to biological needs, social obligations, and personal desires (Vilhelmson, 2007). Not all activities can take place simultaneously, leading to choices of activity which, for some activities, entail that one or more trips will have to be made. Some activities are repeated over time, leading to travel patterns becoming established.

Figure 1 illustrates the fact that the individual’s travel needs are influenced by choices of activity (e.g. where and when purchases are made or exercise is done) and the environment’s spatial organisation (e.g. proximity to shopping centres). The individual’s travel needs together with the surrounding environment and the design of the transportation system give rise to various options which exist for travellers and which encompass the choice of destination, travel mode, departure time, and route. These travel choices lead to the journey that the individual subsequently makes.
The objective of the present research is to investigate influences on choice of travel mode, specifically switching from car to public transport. Thus, the focus in what follows is on choice of travel mode. According to the model in Figure 1, this choice is affected by the other choices, but these are not discussed in detail.

**Choosing the Car**

There are two main types of reasons for choosing the car as one’s mode of transportation over public transport and other alternatives: instrumental and symbolic and affective. Instrumental reasons for using the car include factors such as speed, time, cost, flexibility, safety, and comfort (Jakobsson, 2004). Complicated travel patterns consisting of several errands to be run during the

Figure 1. The driving forces of travel. (Based on Gärling, 2005).
same journey (or an interconnected sequence of journeys) often make the car, due to its versatility, the most attractive travel mode. Such instrumental reasons tend to dominate in multiperson households with children (Jakobsson Bergstad et al., 2011b).

Symbolic and affective reasons are also important. For many, the car is a status symbol which is also perceived as adventurous and pleasurable. For instance, Steg (2005) found that commuting to work by car was primarily due to symbolic and affective reasons. Furthermore, it was also shown that those frequently choosing the car have a more positive attitude towards the car and that men and younger people valued the symbolic and affective reasons for using the car more highly than did others. It is also significant which type of car is used and how it is driven. People communicated their status by means of the car (Gatersleben, 2007).

Car use, with all its advantages, leads to many car users developing, in the long-term, the habit of choosing the car as their mode of transport. A number of repeated occasions of choosing the car leads to habitual behaviour in which the car is chosen without other possible options being considered (Fujii & Gärling, 2005). This is referred to as “script-based” choice (Verplanken, 1997) and results in further increases in the frequency of car use. Since “scripts” are automatically retrieved from memory, the need for cognitive resources to process information about other alternatives is minimized. This allows cognitive resources to be freed up for other uses. However, people become less receptive to influence it their car use results from “script-based” choice.

The Problems Caused by Car Use

Use of the car as a mode of transportation has increased considerably during recent decades (OECD, 2001). Between 1960 and 2005, the number of cars in the US increased from 62 million to 137 million, while the number of kilome-
tres travelled increased from 944 billion to 2,719 billion (U.S. Department of Transportation, 2007). In Sweden, where the present research is being conducted, the number of registered cars has increased from 1.2 million in 1960 to 4.2 million in 2005. The number of kilometres driven by cars increased from 56.57 billion in 1999 to 61.82 billion in 2005 (Statistics Sweden, 2006; SIKA, 2006a, 2006b). There are no signs that this increase will come to an end.

On the global level, car traffic is a major energy user and contributes to global warming (U.S. Department of Energy, 2002). The transport sector consumed 28% of the total energy in 2005, resulting in major emissions of greenhouse gases such as CO₂, methane, and NOx (EIA, 2006). The growth of car use reduces the quality of life in urban areas due to noise, traffic accident risks, and inefficient land use (Greene & Wegener, 1997; Gärling & Steg, 2007). In addition, accessibility to various facilities is impaired due to congestion and limited parking spaces.

Because of the accelerating adverse effects on human environments and public health, the reduction of car use is on the political agenda in many countries. Innovations in car technology are not likely to provide, in the short-term, any technical solutions to the problems as long as both the number of cars and car use are on the increase. The current assessment, therefore, is that policy measures must be implemented which reduce car use (e.g. Hensher, 1998; OECD, 1997).

**Measures of Influencing Car Use**

An influence on car use can be exerted in a number of ways, referred to as Travel Demand Management (TDM) measures (Kitamura et al., 1997). Two broad categories exist, one being push measures (e.g. the prohibition of car use and road pricing) and the other being pull measures (e.g. individualized marketing
or improvements of alternative travel modes such as public transport services). This distinction between push and pull measures partly coincides with another distinction between measures influencing supply (road pricing, prohibition of car use, and improved public transport services) and measures directed at influencing car users’ attitudes (individualized marketing) (Richter, Friman, & Gärling, 2009a, 2009b; Thøgersen, 2007).

In an attempt to assess the validity and complementarity of TDM measures, Loukopoulos (2007) proposed another classification based on the following six attributes: The targeting of latent (vs manifest) demand, (the restriction of) time scale, (the restriction of) spatial scale, coerciveness, bottom-up (vs. top-down) processes, and market-based (vs. regulatory) mechanisms. Definitions and three examples of TDM measures, classified according to the described system, are shown in Table 1. There are a number of different TDM measures and it may thus be desirable to have a means of classifying them. The purpose of a classification is to facilitate the evaluation of various measures such as these. By learning from such evaluations of the strengths and weaknesses of the different measures, it may be possible to use different measures which complement each other, for instance a mix of prohibition and individualized-marketing measures.

In what follows, prohibition, road pricing, and individualized marketing will be described in more detail.
Table 1. Proposed System of Classifying Travel Demand Management (TDM) Measures (adapted after Loukopoulus, 2007).

<table>
<thead>
<tr>
<th>Attributes and definitions</th>
<th>Three examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Attribute:</strong> Targeting latent (vs. manifest) demand</td>
<td></td>
</tr>
<tr>
<td><strong>Definition:</strong> Changing unobserved (vs. observed) car use</td>
<td>Prohibition</td>
</tr>
<tr>
<td></td>
<td>No Partly  Yes</td>
</tr>
<tr>
<td><strong>Attribute:</strong> (Restriction of) Time scale</td>
<td></td>
</tr>
<tr>
<td><strong>Definition:</strong> Hours of operation</td>
<td>Yes Yes No</td>
</tr>
<tr>
<td><strong>Attribute:</strong> (Restriction of) Spatial scale</td>
<td></td>
</tr>
<tr>
<td><strong>Definition:</strong> Area of operation</td>
<td>Yes Yes No</td>
</tr>
<tr>
<td><strong>Attribute:</strong> Coerciveness</td>
<td></td>
</tr>
<tr>
<td><strong>Definition:</strong> Declining car users voluntary control</td>
<td>Yes Partly No</td>
</tr>
<tr>
<td><strong>Attribute:</strong> Bottom-up (vs. top-down) processes</td>
<td></td>
</tr>
<tr>
<td><strong>Definition:</strong> Empowering car users to increase voluntary control</td>
<td>No Partly Yes</td>
</tr>
<tr>
<td><strong>Attribute:</strong> Market-based (vs. regulatory) mechanisms</td>
<td></td>
</tr>
<tr>
<td><strong>Definition:</strong> Increasing voluntary control at a cost</td>
<td>No Yes No</td>
</tr>
</tbody>
</table>

**Prohibition**

An example of prohibition is Cambridge in the UK, where a number of measures have been introduced in order to reduce car traffic in the city centre. Parking is always prohibited in certain zones and car traffic is prohibited between 10.00 and 16.00 on weekdays. Additionally, there are traffic barriers which are active at certain times. This has been combined with an upgraded public transport system and park-and-ride facilities (Loukopoulos et al., 2004). Another example is Seoul where, according to Lee et al. (2006), a motorway has been
demolished to prevent car traffic. This led to more car users having to share the remaining road network and to average speed in central Seoul falling by 13%. The results thus indicate that some journeys are not being made any longer or that public transport is being used.

Road Pricing

Another means of reducing car use is the implementation of road pricing schemes such as those in Trondheim and Stockholm. After the implementation of road pricing in Trondheim in 1992, a survey revealed that most car users had stated that they had not changed their travel behaviour (Loukopoulos et al., 2007). This may have been caused by a too low charge level.

In the Stockholm congestion charging trial, improved public transport was available four months before, during and five months after the actual trial period lasted. Before the trial, public opinion polls were conducted showing 30% support for congestion charging; this support had grown to just over 50% by the end of the trial. Traffic flows decreased by around 22% during the trial (Eliasson, 2008).

In two studies involving car commuters, Steg and Schuitema (2007) found that most people did not intend to change their car use if a pricing policy was implemented. However, it was found that pricing policies were relatively more effective when prices increased significantly, even though commutes were hardly affected.

Goodwin et al. (2004) report that park-and-ride schemes, parking at an out-of-town facility and then using public transport to travel to the city centre, did not always work as intended. The overall amount of travel can even increase as some people who did not previously use public transport use their cars and park at the facility. However, Goodwin et al. also point out that park-and-ride is
often combined with improved public transport, making car travel less attractive. This shows the importance of combining different measures in order for the overall effect to be the desired one.

**Individualized Marketing**

One reason for choosing the car over other alternatives is that information about the alternatives is either missing or incomplete. This was observed by Brög (2002) and, with the aim of counteracting the lack of information, several projects have been conducted using individualized marketing. It works in such a way that a number of households' travel habits and needs are surveyed. The results are then analysed and individualised plans of action made for each household's travel. In this way, the households obtain knowledge of alternative modes of transportation. Some time afterwards, the effect is measured. The purpose is to bring about a mix of travel modes resulting in that the car is used less. The results of projects like this (in Australia and Europe, for instance) show that car use is reduced by 12-14 % (Brög, 2002; Rose & Ampt 2003; see review by Richter et al., 2009a, 2009b). Haglund (1999) discusses experiences from four Swedish cities where individualised marketing has been implemented and is judged to have increased travel by public transport. One weakness in this summary, however, is that no exact figures are specified for the increase.

**Improvements to Public Transport Services**

As a supplement to the above-listed measures, improvement of the alternatives is required. How will improvements to public transport affect car users so that
their public transport journeys increase? Below follows a brief overview of previous research.

In a study of public transport services, Hensher et al. (2003) found that travel times and fares have the greatest impact on negative satisfaction, whereas frequency of service and seat availability constituted the largest sources of positive satisfaction. In another study, Friman et al. (2001a, 2001b) found four factors identified as constituting perceived service quality in public transport services. The first factor was how travellers were treated by staff, that is their willingness to serve, their knowledge, and their competence. The second factor was service reliability. The third factor was simplicity of information (e.g. the availability of departure and destination information). The design of vehicles and space (relating to comfort, safety, and cleanliness) constituted a fourth factor. A transnational study of public transport in nine European cities (Fellesson & Friman, 2008) confirmed these results by highlighting the impact of safety, security, frequency, service reliability, comfort, and the quality of staff behaviour on the level of satisfaction with public transport.

Stradling et al. (2009) examined 68 items which de-motivate people from using buses. Eight factors were revealed by factor analysis, Factor 1 was interpreted as inconvenience of route, scheduling, and other service provision; Factor 2 as unwanted arousal from the journey experience (e.g. crowded bus); Factor 3 as feelings of being unsafe; Factor 4 as the need for autonomy and control; Factor 5 as costs; Factor 6 as self-image; Factor 7 as the preference for independence; and Factor 8 as disability and discomfort.

A summary by Transek (2004) of improvements to public transport shows that bus travel can be increased by introducing trunk route buses. This means prioritising routes with high levels of traffic and supplementing them with feeder routes. The aim is to have high speeds and service frequencies on the trunk route buses. Measures of this type have led to increased journeys by 8-20%. However, effects on other travel modes are not specified.
Another type of public transport is on-demand transportation, often using smaller vehicles, minibuses, or taxis. On-demand transportation can replace routes with low passenger numbers and, by means of services being provided when the need exists, services can be increased by 44-300% (Transek, 2004). Regional trains, which many counties in Sweden have invested in, are also claimed to have been a success but data confirming this is lacking. Moreover, the Stockholm Cross Route has been built and in the autumn of 2001 this was providing 24,000 journeys a day. Other measures such as comfort and safety can also improve public transport; however, it is difficult to measure the effect of such measures on travel.

In a narrative review of international research on how to attract car users to use public transport, Redman et al. (2011) concluded that it is essential to break car-use habits, for instance by providing free PT tickets for a limited time to enable car users to test PT. To bolster attractiveness of PT, it may be necessary to go beyond core service attributes such as travel time, accessibility and reliability by improving affective qualities. In order to keep (former) car users in PT it is essential that they perceive the service as attractive, not only initially but over time. If this can be accomplished successfully car users may become satisfied PT users (Pedersen et al., in press).

What then constitutes satisfaction with travel? The following section gives an overview of travel-related satisfaction as a context-specific form of subjective well-being. Also the development of a scale to measure travel-related satisfaction is described.

**Satisfaction with Travel**

Subjective well-being (SWB) has been proposed as a measure of people’s satisfaction with outcomes of choices (Kahneman, 1999). At an individual level, both the affective and cognitive components of SWB are partly explained by
stable, genetically influenced personality traits (Tkash & Lyubomirsky, 2006). It is estimated that about 50% of the variance in SWB is accounted for in this way. Research has also demonstrated that SWB depends on life circumstances, explaining about 10% of the variance, while the remaining 40% depends on intentional activities (Lyubomirsky et al., 2005).

Since SWB refers to satisfaction with life in general, it is assumed to be relatively stable across time. Yet, there is still an interest in understanding how changes in SWB depend on context-specific factors, including various forms of consumption (Diener & Seligman, 2004; Diener et al., 2008). An important research question raised by Ettema et al. (2010) and Jakobsson Bergstad et al. (2011a) is whether and how changes in travel context (e.g. switching travel mode or improved level-of-service of public transport) will cause changes in SWB. If it is possible to find a relationship with travel context, SWB has the potential of becoming a new powerful tool for policy evaluations (Diener, 2006).

Satisfaction may also be assessed for life domains including work, family, and leisure. Schimmack (2008) reviews research showing that SWB is influenced by such assessments of domain satisfaction. A form of domain-specific SWB is customer satisfaction (Oliver, 2010), usually defined as the extent to which goods or services fulfil customers’ specific needs. Customer satisfaction with transport services may accordingly be defined as the extent to which the services fulfil travel needs. Customer satisfaction is less general than many other life domains and only applies to those using the service. Similar to SWB, customer satisfaction include both a cognitive and an affective component.

Previous research thus suggests that daily travel is likely to affect individuals’ mood and lead to a cumulative satisfaction. As a consequence, changes in public transport services, either at a functional or affective level, may influence SWB in the domain of travel, that is the affective appreciation as well as cognitive evaluation of travel. Hence, measuring travel-specific SWB may yield an
indication of the effect of travel on people's SWB which is useful information when evaluating different transport policies.

Measurement of SWB in the context of travel has so far been limited to the study by Jakobsson Bergstad et al. (2011a) proposing a 5-item scale (the Satisfaction with Travel Scale or STS). Steg (2005) and Jakobsson Bergstad et al. (2011b) have shown that instrumental as well as symbolic and affective motives for car use are important for satisfaction with public transport. The results of Jakobsson Bergstad et al. (2011a) suggested the need of an improved satisfaction with travel measure that extends the existing STS, especially in the affective domain. Specifically, it should combine cognitive judgments of travel satisfaction with measures of the activation and valence dimensions of mood.

Measuring satisfaction with travel using travel context specific SWB appears to be a viable tool for policy evaluations. The use of such a tool can provide added value to policy evaluations leading to PT catering to the needs of car users.

Summary and Conclusions

Several societal problems (e.g., negative effects on human environments) are associated with car use. Consequently, measures are required which are aimed at reducing car use. A number of measures can and have been taken which affect the supply of travel alternatives, including the prohibition of car use and road pricing, or which influence the attitudes of drivers (individualized marketing). Improving alternative modes of transportation, for instance public transport services, remains an important complement as long as it is impossible to reduce the number of journeys. What measures that either separately or in combination are effective has not been fully clarified. A number of factors affect which
measures are effective in a specific case. Henceforth, the focus will be on what can be done to improve public transport journeys for car users.

**Summary of Empirical Studies**

The general aim of the empirical studies was to investigate what level of quality in public transport services will be required to reduce car travel to work. Since the quality of service is particularly low in medium-sized cities, thus making the car a much more attractive option, the studies focus on car use in cities of this size.

In order to investigate how people actually make travel choices, it is not sufficient to use surveys alone, as was the case in Study I and in Part 1 of Study II. Ideally, field experiments would also be needed. The difficulties and costs associated with this made it prohibitive, however, so a more tractable alternative solution was sought. Such a solution is using experimental simulations, as in Part 2 of Study II, which permits the simulation of otherwise costly alterations to transport infrastructure.

While Studies I and II involved voluntary choice, a forced choice approach in the context of an experimental simulation was used in Study IV to investigate the satisfaction with travel using a new Satisfaction with Travel Scale developed and tested in Study III. In another experimental simulation in Study IV, participants were forced to choose bus or car and indicate how the different travel modes differ.
Study I

The aim of Study I was to investigate what work commuters believed would make them reduce their car use and what improvements to public transport services they believed would make them use those services. An Internet survey addressing these questions was carried out. All the survey participants (n = 1218) were employed by companies located in the centre of a medium-size Swedish city (pop. 82,000).

Among 76% of the car users (n = 602) who stated any reasons, the two most frequent were improved public transport and working from home on some days. Shorter travel times, increased service frequencies, and lower fares were the most frequent reasons for increasing public transport use.

Four logistic regression analyses were performed to determine the influence of background factors on the car users’ stated reasons. The longer the distance to work and/or bus stops, the more the participants desired increased frequencies and shorter travel times, but less frequently lower fares. Younger participants, compared to older ones, were positively inclined, furthermore, towards increased frequencies and shorter travel times.

Study II

In Part 1 of Study II, another survey was conducted, this time of a sample of university students (n=69) in order to determine the role of various factors in preventing car users from switching to public transport for their work commute. All participants commuted to the university by car. The dependent measure was their stated choice of using the bus when the cost of driving to work increased. The results of a regression analysis showed that higher costs of car
use increased and greater perceived difficulty to use public transport decreased intention to use the bus for the commute to the university. Although having non-significant effects in the regression analysis, daily activity constraints and a positive car attitude were negatively correlated with the choices to use the bus.

In Part 2 a web-based experimental simulation was conducted employing another 75 students who commuted by car to the university. The participants were given the task of planning their travel to and from work, including performance of additional activities according to predetermined agendas. Four agendas varying in the number of additional activities were compared. The participants were randomly assigned to four conditions (high vs. low car costs and good vs. bad access to bus stops).

The main results were that shorter travel times and better access to bus stops led to a higher frequency of bus use while constraints imposed by a more busy daily agenda led to a higher frequency of car use, particularly if car costs are low.

All in all, the results indicated that improvements to public transport services (travel time, access to bus stops) increase bus use during work commutes and that these effects increase for higher car-use costs.

**Study III**

The aim of Study III was to investigate the role of subjective well-being in travel satisfaction and mode choice. A new measure of travel-related SWB, a 9-item self-report Satisfaction with Travel Scale (STS), was developed. In a survey of 155 undergraduates, STS, mood ratings, and ratings of SWB were collected for three hypothetical weekdays differing in travel mode, travel time, access to bus stops, and daily activity agenda. The results showed that STS is reliable and differentiates between changes in travel conditions. STS, mood, and to some ex-
tent SWB were shown to be affected by travel mode (bus vs. car), travel time, access to bus stops, and the number of activities in the daily agenda.

**Study IV**

The aim of Study IV was to investigate which attributes other than time and cost contribute to the preference of car over bus in the choice of travel mode. In a survey of 123 undergraduates the effect of different travel modes on satisfaction with travel (measured by the STS developed and tested in Study III), mood and subjective well-being were assessed by presenting scenarios with a forced choice of car or bus for the typical commute to and from work. In general car was rated higher than bus on satisfaction with travel. Ratings of the attributes fun, lifestyle match, and feeling secure, on which car surpassed bus, accounted for these mode differences in satisfaction with travel. Thus it is concluded that not only time and money are important attributes taken into account when the different travel modes (car and bus) are evaluated.

It was also shown that satisfaction with travel partially mediated the effect of travel mode on mood. Yet, satisfaction with the day as a whole was not influenced by travel mode when mood was controlled.
Discussion

The purpose of this thesis is to investigate which public transport solutions may decrease car use by making them attractive to car users. Armed with such knowledge, it will then be possible to suggest how public transport can adapt its service offering to car users.

The results of Study I indicate that, in order to reduce car use, commuters travelling to work by car in a medium-size Swedish city feel that public transport services need to be improved. It may thus be inferred that they do not perceive current public transport services to be attractive. This may also account for many of them stating that, in order to reduce car use, they would consider working more from home. The generality of these results is implied by the fact that they are in line with previous research findings from other countries (Curtis & Headicar, 1997; Kingham et al., 2001; Shannon et al., 2006). Among several background factors characterizing the sample of car users, only the distance to work and/or bus stops seemed to moderate the frequency of the stated reasons. Still, these effects were weak and should be interpreted with caution.

How can public transport be improved and become attractive? In response to this question, the results of Study I showed that increased service frequencies, shorter travel times (including a direct bus service), and lower fares were stated by car users to be reasons for increasing their use of public transport. Similar results have been shown in other studies (see, e.g., Kingham et al., 2001). The moderating effects of age and distance to work and/or bus stops were weak. In medium-size cities, relatively long distances are coupled with a customer base smaller than in larger cities. For this reason, it will be costly to design a public transport system that provides increased service frequencies and shorter travel times. One possibility is considering alternatives to conventional public transport, for instance call-a-bus, car sharing schemes, and personal rapid transit (see, for instance, Victoria Transport Policy Institute, 2007). Future
research should be directed towards investigating the feasibility and attractiveness of such alternatives.

Even if an improved public transport system would be provided in medium-size cities, it would probably still be the case that car users would have to make sacrifices, especially initially because of their known difficulties in changing an acquired car-use habit (Fujii & Gärling, 2005). Furthermore, it is unlikely that a public transport service would fully cater to car users’ needs as regards time and flexibility. In order to increase public transport use, it is thus also essential to make car use less attractive. It is not likely in the near future that conditions governing car use in medium-sized cities will deteriorate due to congestion. Other measures need to be taken to reduce the relative attractiveness of car use, for instance the prohibition of car traffic in various zones, parking restrictions, and general measures such as increasing the cost of owning and driving a car.

It was noteworthy that in Study I many participants did not know what would make them use their cars less frequently when commuting to work or how public transport should be made more attractive. Assuming that these car users are negatively inclined towards using public transport, they may need to be forced, or feel forced, to switch to public transport. It will then be essential that they perceive the service to be attractive after starting to use it (Friman, Edvardsson, & Gärling, 2001; Friman & Gärling, 2001). Fujii, Gärling, and Kitamura (2001) found that habitual car users who were forced to choose public transport during a temporary closure of a motorway changed their negative perceptions of, and attitudes towards, public transport in a positive direction. For this reason, some of them continued to use public transport after their cars had once again become an alternative.

The results of Part 1 of Study II show that increasing the cost of car-use increases the likelihood of participants choosing the bus to commute to work. However, the perceived difficulty in using public transport was shown to have a strong counteracting effect. Additionally, the results suggested that daily activity constraints and a positive car-use attitude may be important impediments to
choosing public transport. In Part 2, having good access to bus stops increased the number of bus trips and decreased the number of car trips. Car use increased with a more busy agenda that included shopping as well as the daily routine of getting to work and leaving and fetching children at the daycare centre. No main effect of car cost was found, but the increase in car-use with busy agendas was strengthened by low car costs. In an experimental simulation, some of the factors identified in the survey in Study I were thus found to affect car use.

It should be noted that perceived difficulty of public transport use, daily activity constraints, and attitudes towards car use are different types of impediments to choice of public transport. Daily activities necessitate trip chaining, but are not necessarily dependent on the perceived difficulty of travelling by public transport. However, daily activities impose restrictions on the choice of travel mode since many activities (e.g. shopping at a department store) are difficult to carry out using public transport. Car users will then be less likely to feel that using public transport is a viable alternative. Sacrifices will have to be made by car users, for instance allocating more travel time (since it takes longer by bus and on foot). Ideally, all the functions needed for daily life should be available close to either the home or the workplace, including supermarkets and daycare facilities.

A positive car-use attitude may be developed and maintained by forcing people to not use their cars for daily travel (Fujii et al., 2001; Fujii & Gärling, 2003b). In this vein, the experimental simulation in Study II suggests that, by improving access to bus stops and shortening travel times, in conjunction with transparent car-use costs, car users can be made to travel by public transport. This would potentially break the car users’ habit and change their attitude towards both car use and public transport.

In general, commutes to and from work are targeted in order to increase the number of trips by public transport. Therefore, a great complexity of daily agendas further increases the challenge of increasing the attractiveness of public transport services. This may not be possible to accomplish if destinations re-
main unchanged. Still, as pointed out above, new concepts in public transport services are also conceivable.

The question then is if people will be satisfied if improved public transport is available. Investigating satisfaction with travel is important, hence a scale measuring satisfaction with travel was needed. The results of Study III demonstrate a relationship between the experienced quality of travel (as measured by STS) and overall well-being (SWB). Yet, the fact that SWB is also influenced by other factors suggests that efforts to increase SWB through improving the quality of travel need to be balanced against efforts in other domains (e.g. improving residential quality or social cohesion). Also, it is suggested that time pressure is a significant factor affecting satisfaction with travel and overall well-being. This factor has been largely overlooked in cost-benefit analyses of policies based on utility maximisation. An implication is that land use and transport policies should not only strive to reduce travel times and relieve congestion, but also focus on options to combine multiple activities in a daily activity pattern (e.g. stores located near work places, public transport nodes or day care centres). There is a great potential of innovation with respect to possibilities of utilizing travel time as well as time spent in stations and at stops. Perhaps going back to the old days when a train stop meant that you could pop out to buy a newspaper albeit in a much more modern form such as providing wireless LAN aboard vehicles to read newspapers, vending machines to buy soda, coffee, sweets etc.

The results of Study IV showed as expected that car was rated to be different than bus on several other attributes than travel time and cost, including fun, exercise, flexibility, feeling secure, comfortable, polluting, and lifestyle match. Most of these attributes are affective rather than instrumental, thus supporting the suggestion to cater more for affective motives than presently done (Redman et al., 2011). Instrumental attributes are still core. Enhancing affective attributes (e.g. lifestyle match) must therefore not be made at the expense of not improving instrumental attributes (e.g. accessibility). Furthermore, different
attributes are perhaps important for different segments of the users, instrumental for families with children, affective for other potential users.

The present studies have some limitations. Although filling out a questionnaire which requires reasons to be stated for reducing car-use may provide some clear answers, psychological research has demonstrated that, in general, people are not accurate in forecasting their own future experiences (e.g. Trope & Liberman, 2003; Wilson & Gilbert, 2003; Pedersen et al., in press) and that they frequently fail to implement their intentions (Fujii & Gärling, 2003a). For instance, Stradling, Meadows, and Beatty (2000) found that, of a sizeable minority of car drivers (33%) who would like to reduce their car-use, very few (5%) believed that they would in fact do that. Another observation is that frequent car users tend to have more negative perceptions of public transport than do actual users of public transport (Fujii et al., 2001; Fujii & Gärling, 2003b). Furthermore, when focusing on a particular feature, its importance may be exaggerated at the expense of other features (Schkade & Kahneman, 1998). Thus, even though participants felt, when answering a questionnaire in the present study, that they would reduce their car use if a certain feature of public transport was improved (e.g. shorter travel times), they may still not do this because, in reality, the change might have less impact than they had anticipated.

A limitation of Studies II-IV is that the participants were students, and thus that they differ in some respects from the general population that may affect their travel choices. Another limitation is that few factors were varied in the experimental simulations. Several other factors potentially affecting the attractiveness of public transport use include bus fares, travel times by bus, seating, and the interiors of vehicles. There is a need to develop the experimental simulation such that additional experiments illuminating the role of these factors can be conducted.

A limitation of Studies III and IV is that in these studies the participants were also requested to report feelings. Since they were then asked to imagine how they would feel, the results are susceptible to biases. It is known that
people access different types of knowledge from specific to general when reporting on emotions (Robinson & Clore, 2002). Hence it is possible that the feelings reported in the studies may differ from feelings that would result from similar but real-life experiences. However it has been shown that feelings can be induced in simulations even if an event is not experienced in real life (Westermann et al., 1996). Still, these findings need to be followed up in future research assessing feelings resulting from actual travel should be.

Conclusions

The task of making car users give up commuting by car and switch to public transport is not easy. The present research sheds some light on it. A public transport system must be accessible and must appear attractive, not only to its present users but also to prospective users now travelling by car. To appear attractive, it must not be too expensive and must have timetables and routes that allow users to travel in an efficient manner. One measure that can be used to force commuters out of their cars is to raise the cost of car-use; however, in order to be effective, the cost of car-use may need to be substantially higher than the cost of public transport. As the present research has indicated, the perceived difficulty of using public transport is also an important factor. Thus, raising car-use costs will be insufficient unless changes are also made to public transport services. A factor complicating this is activity patterns, which are often complex. As has been indicated in the present research, the more complex the activity pattern - the more the car is likely to be used for travel.
References


Car Users’ Switching to Public Transport for the Work Commute

The general aim of the present thesis was to investigate the determinants of car users’ switching to public transport when driving to work.

In the first study (Paper I), an Internet survey addressing what commuters believe would make them reduce their car-use as well as what improvements to public transport services would make them use those services was conducted. The results showed that, the further to work and/or bus stops - the more the participants desired increased frequencies and shorter travel times, but less often lower fares. In the second study (Paper II), using a web-based experimental simulation, participants planned their travel to and from work, including the performing of additional activities. The main results were that shorter travel times and good access to bus stops led to greater bus use while constraints imposed by a busy daily agenda led to greater car-use, in particular if car costs were low. In the third study (Paper III) a new measure of travel-related subjective well-being (SWB), the 9-item self-report Satisfaction with Travel Scale (STS), was developed. The results showed that STS is reliable and differentiates between changes in travel conditions. In the fourth study (Paper IV) which attributes other than time and cost contribute to the preference of car over bus in the choice of travel mode was investigated. Using STS, developed in Paper III the effect of different travel modes on satisfaction with travel was studied.

The conclusions of this thesis are that a public transport system must appear attractive, not only to its present users, but also to prospective users who currently use their cars. To appear attractive, it must have timetables, routes, and fares that allow efficient travel. One measure that can be used to force commuters out of their cars is higher car-use costs; however, car-use costs may need to be substantially higher than the cost of using public transport in order to be effective. As indicated, the perceived difficulty of using public transport is also an important factor. A complicating factor is complex activity patterns. Using STS to measure satisfaction with travel car was generally rated higher than bus. Furthermore ratings of the attributes fun, lifestyle match, and feeling secure, on which car surpassed bus, accounted for mode differences in satisfaction with travel.