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Determinants of Car Users' Switching to Public Transport for the Work Commute

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"All vetenskaps början är förvåningen över att tingen är som de är."

Aristoteles

Licentiate Thesis: Determinants of 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. Since the quality of services is particularly low in medium-sized cities, making the car a much more attractive option, the studies focus on car-use in such cities.

Two 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. 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. Younger participants, when compared to older ones, were, furthermore, positively inclined towards increased frequencies and shorter travel times.

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.

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.

Keywords: Car-use Reduction, Work Commute, Public Transport, Experimental Simulation

The thesis is based on the following two research papers, which will be referred to throughout the text using Roman numerals:

I Eriksson, L., Friman, M., & Gärling, T. (2008). Stated reasons for reducing work-commute by car Transportation Research F, 11, 427-433.

II Eriksson, L., Friman, M., Ettema, D., Gärling, T., & Fujii, S. (Submitted paper). Determinants of car users' switching to public transport.

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Introduction

During recent decades, car traffic has increased considerably. The car enables transportation that brings people positive consequences but also costs for society. Among the positive consequences quoted in connection with motoring, we find individual freedom and independence. The car enables us to conduct diverse activities in different places, e.g. work, purchases of different kinds, and leisure activities. A negative societal effect of car usage is its environmental consequences.

Public transport has a lower societal cost than the car but is less attractive to people. How can it be made more attractive? In the public transport industry, increasing competition has led to increased market-orientation, something which has entailed that customer surveys have become increasingly common, for instance. With the increased competition, there is also an interest in boosting market share. In addition to this, there are also adaptations of service ranges in order to encourage both existing and new travellers to travel more by public transport (Carlsson, 1999; Eriksson, 2006).

There is a desire, both on the part of society and the public transport industry, to change public transport in order to adapt it to those who are frequent car-users today (see final report KOLL framåt 2007). Accordingly, there is a need to investigate how public transport can be made attractive to car-users. In all probability, it will also be necessary to take measures that inhibit motoring.

Different types of factors influence motorists' choice of transport method (Gärling, 2005; Gärling, Eek, et al., 2002). Some are related to the available travel modes range and can be described as instruments of control, chiefly vehicle tolls and bans on car traffic. Others focus on influencing motorists' attitudes towards alternative methods of transport. Factors related to available travel modes and the individual are interconnected, e.g. 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 investigating which public transport solutions motorists perceive to be attractive and are prepared to choose. Armed with such knowledge, it will then be possible to suggest how public transport can adapt its service offering to motorists. In interviews with representatives of some Swedish public transport operators at the beginning of 2006, it was demonstrated that the potential exists for enhancing knowledge of those who are car-users today and do not utilize public transport (Eriksson, 2006). The knowledge gaps that exist regarding motorists are known within the public transport industry and obtaining knowledge is something that the companies require.

In the following section, a review of the determinants of daily travel is presented. This is followed by a section focusing particularly on choosing a means of transport. The sections that follow provide an overview of the implications of car use, including different means of influencing this. 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 society's/the environment's spatial organisation (e.g. proximity to shopping centres and gyms). 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,

transportation method, departure time, and travel route. These travel choices lead to the journey that the individual subsequently makes.

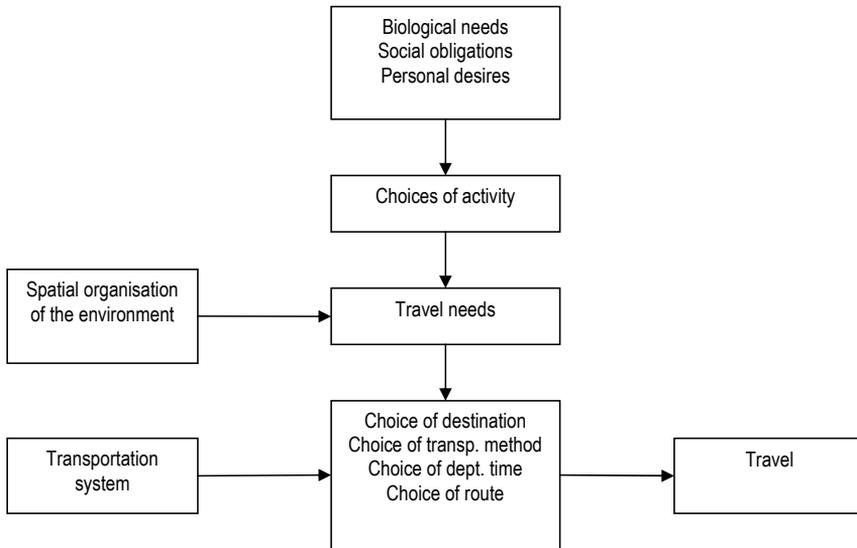


Figure 1. The driving forces of travel. (Based on Gärling, 2005).

The objective of the present research is to investigate influences on choice of transportation mode, specifically switching from car to public transport. Thus, the focus in what follows is on choice of transportation mode. According to the model in Figure 1, the choice of transportation mode is affected by the other choices, but these are not discussed in detail. In fact, the main focus in what follows is on choosing the car.

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 psychological. Instrumental reasons for using the car as a mode of transportation include factors such as speed, time, cost, flexibility, safety, and comfort (Jakobsson, 2004). Complicated travel patterns, i.e. having to carry out a number of errands

during the same journey (or an interconnected sequence of journeys) often make the car, due to its flexibility, the transportation method of choice. Such instrumental reasons are the most frequent (Jakobsson Bergstad et al., 2009).

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 (2004) found that commuting to work by car was dependent on symbolic and affective reasons and not primarily on instrumental ones. Furthermore, that investigation also showed that those frequently going by car have a more positive attitude towards the car and that men and younger people valued the psychological reasons for using the car more highly than did others. It is also significant which type of car is involved and how it is driven. By taking the car, you can communicate your status.

Car use, with all its advantages, leads to many motorists 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 turn into 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 increasing 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 use elsewhere. However, people who frequently use their cars as an educated “script-based” choice, become less receptive to influence.

The Problems Caused by Car Use

During recent decades, use of the car as a means of transportation has increased considerably (OECD, 2001). Between 1960 and 2005, the number of cars in the US increased from 62 million to 137 million, while the number of kilometres 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; SIKÅ, 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 NO_x (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).

Means of Influencing Car Use

An influence on car use can be exerted in a number of ways, often 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 transport 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) has suggested 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 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, e.g. 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).

Attributes and definitions	Three examples		
	Prohibition	Road Pricing	Individ. Marketing
Attribute: Targeting latent (vs manifest) demand Definition: Changing unobserved (vs observed) car use	No	Partly	Yes
Attribute: (Restriction of) Time scale Definition: Hours of operation	Yes	Yes	No
Attribute: (Restriction of) Spatial scale Definition: Area of operation	Yes	Yes	No
Attribute: Coerciveness Definition: Declining car users voluntary control	Yes	Partly	No
Attribute: Bottom-up (vs. top-down) processes Definition: Empowering car users to increase voluntary control	No	Partly	Yes
Attribute: Market-based (vs. regulatory) mechanisms Definition: Increasing voluntary control at a cost	No	Yes	No

Prohibition

One 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 motorists having to share the remaining road network and to the average speed in central Seoul falling by 13 %, which was less than esti-

mated, however. The results thus indicate that some journeys are not being made anymore 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 too low a price for each movement.

In the Stockholm congestion charging trial, improved public transport was available for 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 & 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, but 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. In simple terms, this works in such a way that a number of households' travel habits and needs are investigated. The results are analysed and individualised plans of action are drawn up for each household's travel needs. 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 modes of transportation entailing 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 2001; see review by Richter et al., 2009a, 2009b). Haglund (1999) discusses experiences from four Swedish cities where individualised marketing, in accordance with Brög's model, has been used and is judged to have given rise to increased travel by public transport. One weakness in this summary, however, is that no figures are specified for the increase. Haglund and Carlsson (1999) point out the danger of unilaterally using just one specific method of marketing.

Improvements to Public Transport Services

As a supplement to the above-listed instruments of control, improvement of the alternatives is required. How will improvements to public transport affect motorists so that their public transport journeys increase? Below, there is a brief overview of previous research. This, however, has not focused on motorists particularly.

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. (2001) found four factors identified as constituting perceived service quality in public transport services. The first factor

was how travellers were treated by staff, i.e. 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 (Felleson & 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 demotivate people from using buses. By means of factor analysis, seven factors were found. Factor 1 was interpreted as inconvenience of route, scheduling, and other service provision; Factor 2 as unwanted arousal from the journey experience; 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 of 8-20%. Effects on other modes of transport are not specified, however.

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% according to Transek (2004). Regional trains, which many counties have invested in, are also said to have been a success but there is a lack of data confirming this. 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 pub-

lic transport; however, it is difficult to measure the effect of such measures on travel.

Summary and Conclusions

There are problems (e.g. environmental) associated with car use. Consequently, measures are required which are aimed at reducing this. A number of measures can and have been taken which affect the range of services, including the prohibition of car use and road pricing, and which influence the attitudes of drivers (individualized marketing). Improving alternative modes of transportation, e.g. public transport services, remains an important complement as long as it is impossible to reduce the number of journeys. Exactly which methods of influence that either separately or in combination provide results has not been fully clarified. A number of factors affect which method(s) of influence are effective in a specific case. Henceforth, the focus will be on what can be done to improve public transport journeys for motorists.

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 in order to reduce car journeys 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.

Study I

The aim of Study I was to investigate what people using their cars to commute to work in a medium-size city believe would make them reduce their car use and what improvements to public transport services they believe 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) stating reasons, the two most frequently given were improved public transport and working from home on some days. Shorter travel times, increased service frequencies, and lower fares were the most frequently given 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 I, a survey was conducted using 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 the higher cost of car use increased, while the perceived difficulty of using public transport decreased, their choices to use buses to commute. 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, using a web-based experimental simulation, another 75 students were recruited who commuted by car to the university. The participants were given the task of planning their travel to and from work, including the performing of additional activities according to predetermined agendas. Four agendas varying in their number of additional activities were compared. The participants were randomly assigned to four groups of approximately the same size (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 greater bus use while constraints imposed by a busy daily agenda led to greater car use, particularly if car costs were low.

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

Discussion

The results of Study I indicate that, in order to reduce car use, commuters traveling 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. Furthermore, 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 put forward by car users as reasons for increasing their use of public transport. Similar results have been shown in other studies (see, for instance, 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, e.g. 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 were on offer 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 changing an acquired car-use habit (Fujii & Gärling, 2005). Furthermore, it is unlikely that a public transport service would fully cater for 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, e.g. the prohibition of car traffic in various zones, parking restrictions, and general measures such as increasing the cost of owning and driving a car.

In Study I, it is also noteworthy that 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 that they are being forced, to switch to public transport. It will then be essen-

tial 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 the 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 also 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 busier agenda that included shopping as well as the daily routine of getting to work and leaving and fetching children at the daycare centre. No principal 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 the perceived difficulty of public transport use, daily activity constraints, and car-use attitude 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 mode of travel 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, e.g. 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.

Forcing people to use their cars for daily travel develops and maintains a positive car attitude (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 remain unchanged. Still, new concepts in public transport services are conceivable (i.e. the call-a-bus service).

Caveats

Some caveats should also be pointed out in the present studies. 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 when it comes to forecasting their own future experiences (e.g. Trope & Liberman, 2003; Wilson & Gilbert, 2003) and that they frequently fail to follow through on 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 tra-

vel times), they may still not do this because, in reality, the change might have less impact than they had anticipated.

A limitation of Study II is that the participants were students, and thus differ in some respects from the general population. Another limitation is that few factors were varied during the experimental simulation. Several other factors potentially affecting the attractiveness of public transport use include bus fares, travel times by bus, seating, and the interiors of vehicles. Using the experimental simulation developed enables additional experiments illuminating the role of these factors to be conducted.

Future Research

Even though the participants felt, when answering a questionnaire or planning their travel in an experimental simulation, that they would reduce their car use if a certain feature of public transport was improved (e.g. shorter distances to bus stops), they may still not do this in real life because the change might have less impact than they had anticipated. Cross-validating the results, by means of interventions involving actual changes to public transport, is thus desirable.

Different methods of eliciting reasons may provide different results. Steg et al. (2001) found that an indirect method revealed different reasons, e.g. an affective attachment to the car, than did direct methods, which tended to reveal instrumental reasons. The present research focused on instrumental reasons for car-use, but psychological reasons may also be important as regards influencing car users not to use their cars (Stradling). Thus, future research should focus on investigating psychological reasons.

Finally, it may be noted that the present studies have focused on the extent to which car users can be made to use public transport. Another issue concerns how they would experience using public transport. Currently, research is being carried out (Ettema et al., 2009) to develop theory and measurement methods to establish the impact on subjective well-being of using public transport (Diener & Seligman, 2004, Eid & Larsen, 2008). It is argued that the direct experience of travel, as well as the extent to which it facilitates involvement in activities, invokes affective and

cognitive responses which add to subjective well-being. Further research is needed in order to find out the extent to which the factors investigated in the present studies also impact on car users' subjective well-being.

Conclusions

The task of making car users give up commuting by car and switch to public transport is not an easy one. The present research sheds some light on this matter. A public transport system must be available 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 used as a means of transport.

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Determinants of 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. Since the quality of services is particularly low in medium-sized cities, the studies focus on car-use in such cities.

Two studies were conducted. In the first (Paper I), an Internet survey addressing what would make car commuters reduce their car-use as well as what improvements to public transport services would make them use those services was carried out. The results showed that, the further to work and/or bus stops - the more increased frequencies and shorter travel times were desired. 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 predetermined. Results showed that shorter travel times and good access to bus stops led to greater bus use while a busy daily agenda led to greater car-use.

The conclusions of this thesis are that a public transport system must appear attractive, not only to its present users, but also to those who currently use their cars. To appear attractive, it must not be too expensive and must allow efficient travel. One measure that can reduce car-use is higher car-use costs. The perceived difficulty of using public transport is also important. Raising car-use costs will be insufficient unless changes are made to public transport. A complicating factor is complex activity patterns. As indicated in the present research, the more complex the activity pattern - the more the car is used.