Motivational and Volitional Control of Private Automobile Use

The effectiveness of transport policies

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Av

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Avhandling för avläggande av Filosofie Doktorsexamen i psykologi, som med vederbörligt tillstånd av samhällsvetenskapliga fakulteten vid Göteborgs universitet kommer att offentligt försvaras fredagen den 2 april 2004, kl. 13.00, sal F1, Psykologiska institutionen, Haraldsgatan 1, Göteborg.

Fakultetsopponent: Dr. Linda Steg, Department of Psychology, University of Groningen, Groningen.

Department of Psychology,

Göteborg University, Sweden 2004

DOCTORAL DISSERTATION AT GÖTEBORG UNIVERSITY, GÖTEBORG, SWEDEN, 2004

Abstract

Jakobsson, Cecilia (2004). *Motivational and Volitional Control of Private Automobile Use: The effectiveness of transport policies.* Department of Psychology, Göteborg University, Sweden.

This thesis focuses on car use reduction measures, such as, road pricing, which employ economic disincentives. A number of issues related to the motivational and behavioural effects of economic disincentives were investigated in four empirical studies. Public acceptance of transport policies is commonly proposed as a key factor for any successful implementation. The primary focus of Study I, surveying 524 car owners in Göteborg, was to investigate a proposed model of the determinants of acceptance of economic disincentives with perception of fairness, personal freedom, income, expectations about others' car use and intentions of own car use as predictors. The results supported the model, particularly emphasizing the importance of perceived unfairness for not accepting economic disincentives. The general conclusion of Study II, which was a field experiment employing 80 households in Göteborg, was that economic disincentives alone would not encourage car users to reduce their car use. Instead, the results indicated that conscious planning of household travel was essential. Forty households, which had planned their car use reduction in Study II, were further investigated in Study III. The discrepancies between the number of planned trips and the actual number of trips were interpreted as indicating low motivational and volitional control and were found to be largest for shopping trips, chauffeuring trips and leisure trips. Larger discrepancies were also observed for households having more than one car, children or higher incomes. Study IV examined the adaptations made in response to policies controlling private car use. In a focus group study and an internet-based questionnaire study, it was found that economic disincentives differ from non-coercive individualised marketing in that car users state that they would reduce car use more were economic disincentives implemented in Göteborg, while the corresponding difference with coercive prohibition of car use in the city centre was negligible. In addition, insights obtained from the focus groups indicate that both prohibition of car use in the city centre and individualised marketing may receive more public support than an economic disincentive such as road pricing. Furthermore, if an economic disincentive or another coercive car-use reduction measure is implemented, in the focus group study a preference for a combination with voluntary change measures was expressed.

Key words: Motivational and volitional control, private car use, car-use reduction, economic disincentives, acceptance, effectiveness.

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ISSN 1101-718X ISRN GU/PSYK/AVH/--129—SE

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Göteborg University, Sweden 2004

Printed in Sweden
Kompendiet
Göteborg 2004
ISSN 1101-718X

ISRN GU/PSYK/AVH/--129—SE

To Ludvig

"It is not the strongest of the species that survive, not the most intelligent, but the one most responsive to change."

Charles Darwin

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ACKNOWLEDGEMENTS

I wish to express my deepest gratitude to …

Professor Tommy Gärling, my supervisor, for his excellent guidance during these years.

Dr. Satoshi Fujii for being co-author and his unbelievable skills with statistical analysis.

Peter Loukopoulos for being co-author, our daily talks and for sharing his expertise in the English language.

Claudia Schneider for being co-author and doing a lot of the ground work for Study IV.

Professor Jörgen Garvill for his thorough review of the thesis.

Docent Anita Gärling, Björn Berle and Anders Johansson for my time at Chalmers and their help in obtaining data for Study I.

Docent Anders Biel for reviewing and commenting on a previous version of this research.

Amelie Gamble for her professional help and for being a great friend.

Professor John Thøgersen for his comments on the embryo of this thesis.

Karl Gillholm for invaluable help with Study IV.

Fredrik Good for his helpful assistance with the focus group data.

Dr. Lars Gunnar Krantz and Dr. Anders Larsson for their expertise and help with the national car use data in Study I.

Karl Ask, Dr. Ole Boe, Dr. Chris von Borgstede, Ulf Dahlstrand, Dr. Daniel Eek, Fil lic. Kerstin Watson Falkman, Dr. Niklas Fransson, the late Fil lic. Robert Gillholm, Fil lic. Anneli Goulding, Dr. Gunne Grankvist, Dr. Mathias Gustafsson, Docent Pär Anders Granhag, Fil lic. Maria Hartwig, Dr. Linda Hassing, Dr. Lisbeth Hedelin, Ted Hedeström, Dr. E. Ásgeir Juliusson, Fil lic. Lars-Olof Johansson, Dr. Niklas Karlsson, Fil lic., Anneli Larsson, Maria Larsson, Andreas Nilsson, Lars Olsson, Docent Marcus Selart, Rez Shirazi,

Dr. Leif Strömwall, Fil lic. Ingela Thylefors, Dr. Gunilla Torell and Dr. Daniel Västfjäll for your valuable support and helpful discussions.

The administrative and technical staff for assistance with practical matters.

Stein, my partner in life for his love and invaluable support.

Ludvig, my son for being a source of happiness.

The rest of *my family, my parents* and *my sisters* for caring for me.

All the participants in the studies for their efforts (especially those of you who kept a car log for three weeks).

The research has been financially supported by grant #98-0148 from the Swedish Transport and Communications Research Board (now Vinnova), grant #2002-00434 from the Swedish Agency for Innovation Systems, grant #25.9/2001-1763 from the Swedish Research Council for Environment, Agricultural Sciences, and Spatial Planning to Tommy Gärling, and by scholarships to me from the Adlerbert Grant Foundation and the Swedish National Road Authority, the Jubilee Foundation.

Cecilia Jakobsson
Göteborg, 2004

PREFACE

The thesis consists of this summary and the following four papers referred to by their Roman numerals:

I. Jakobsson, C., Fujii, S., & Gärling, T. (2000). Determinants of private car users' acceptance of road pricing. *Transport Policy, 7,* 153-158.

II. Jakobsson, C., Fujii, S., & Gärling, T. (2002). Effects of economic disincentives on private car use. *Transportation, 29,* 349-370.

III. Jakobsson, C. (2004). Accuracy of household planning of car use: Comparing prospective to actual car logs. *Transportation Research Part F, 7,* 31-42.

IV. Loukopoulos, P., Jakobsson, C., Gärling, T., Schneider, C., & Fujii, S. *Car-user responses to travel demand management measures: Goal intentions and choice of adaptation alternatives.* Manuscript submitted for publication.

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Introduction

Due to accelerating global environmental problems, such as global warming, recent years have seen an increased focus on environmental issues. A serious problem in many urban areas is the increasing number of cars causing congestion and pollution (Goodwin, 1996; Greene & Wegner, 1997; Sperling, 1995). Economic incentives and disincentives have been proposed, and to some extent implemented, with the aim of making people switch from using the car to use alternative modes such as public transport, the bicycle, or even walking (Johansson & Mattsson, 1995). However, it does not seem likely that such measures alone will cause dramatic permanent changes in travel. To achieve such changes, other factors besides economic ones must also be considered.

In order to change travel behaviour, people must change their goals and priorities concerning, for example, their activities (Gärling, Eek et al., 2002). Economic disincentives and regulations may to some extent force people to make such changes or may at least instigate the goal of reducing car use. However, since there are many obstacles to achieving this goal the impact on car use may be minimal. This is in line with findings from extensive research on attitude and behaviour inconsistencies (see Ajzen, 2001; Gärling, Gillholm & Gärling, 1998, for overview).

Research also shows that economic charges for car use are not necessarily accepted by car owners (Emmerink, Nijkamp, & Rietveld, 1995; Jones, 1995, 2003; Schade & Schlag, 2003a, 2003b; Schlag & Teubel, 1997; Thorpe, Hills, & Jaensirisak, 2000). This may depend on a number of reasons, such as resistance to paying for something that previously has been free of charge, evoked feelings of limited freedom of choice, and unfairness.

The general aim of this thesis is to examine to what extent car-owning households are motivated and want to reduce their car use when they face the consequences of transport policies. A number of questions will be addressed in the empirical studies. What are the determinants of a positive vs. negative attitude towards economic disincentives? Will economic disincentives make households reduce car use? Finally, are there any differences in acceptance and effectiveness between economic disincentives and other more or less coercive transport policies?

An important point of departure is the activity-based approach to explaining household travel (Axhausen & Gärling 1992; Ettema & Timmermans, 1997; Gärling, Laitila, & Westin, 1998; Kitamura, 1988). This approach assumes that the main purpose of travel is to engage in activities which will fulfil needs such as work, shopping and recreation (Gärling & Garvill, 1993; Vilhelmson, 1999). The location of the home, workplace and nearest shops, as well as the accessibility and quality of transport alternatives is assumed to determine the frequency and length of car trips. The decision making

surrounding such trips ranges from being at a high level of awareness and deliberation when a trip with low frequency (e.g., a weekend vacation trip) is planned, to being at a low level of awareness, automatic and habitual for high frequency trips (e.g., daily work trips) (Verplanken, Aarts, & Van Knippenberg, 1997; Verplanken, Aarts, Van Knippenberg, & Van Knippenberg, 1994)

In this thesis summary, I will first present the theoretical framework. In the following sections an overview of measures aiming to reduce car use by using economic or non-economic disincentives or incentives is presented and findings related to the measures' effects are analysed. Finally, the empirical studies are summarised and discussed.

Theoretical Framework

The theoretical framework developed for this thesis is illustrated in Figure 1. In this framework, an individual's way to attain car-use reduction is assumed to go through a number of phases. In line with theories of the implementation of intentions (Gollwitzer, 1996; Gärling, Gillholm et al., 1998; Heckhausen & Gollwitzer, 1987), these consist of (1) a motivation phase where motivation evokes a goal to reduce car use, (2) a planning phase, where a plan of how the goal can be achieved is created, (3) an implementation phase, where the plan is carried out, and finally (4) an evaluation phase, where the outcome is compared to the goal. In the following subsections, each hypothesized phase of the car-use reduction process is described and discussed separately.

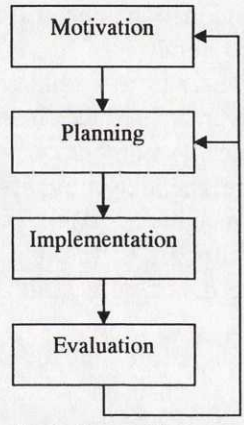

Figure 1. Hypothesized phases of the car-use reduction process.

Motivation

The study of motivation as a determinant of behaviour has a long history in psychology although focus has shifted over the years between so-called "hot"

perspectives, represented by constructs such as emotion, desire, drive, and goal-orientation, and "cold" cognitive perspectives, entailing constructs like information processing, attention, memory, and feedback (Eagly & Chaiken, 1993). Motivational concepts were, for example, central to the behaviourist tradition, which claimed that human behaviour was shaped by reinforcement and the desire to obtain rewards. Cognitive perspectives, on the other hand, have mainly emphasized how people's thoughts and information processing affect feelings and behaviours (Eagly & Chaiken, 1993).

The motivation to reduce car use is, according to the theoretical framework proposed by Gärling, Eek et al. (2002), both induced by external changes such as higher costs (economic disincentives), legislation and social norms, and changes in internal factors, such as attitudes, values and personal norms (Guagnano, Stern, & Dietz, 1995). External changes may help to motivate car users to set car-use reduction goals, at least if these changes are forced. Alternatively, they may produce changes in attitudes. Economic means of control may be forceful if they are difficult to evade. Legislation can be one way to achieve this. If the costs are experienced to be too high, then this may also have the effect of forcing change, but at the same time there may be counterproductive effects on internal factors leading to less motivation or negative influences on goal-setting. Baron and Jurney (1993) have shown that norms such as fairness and infringement on personal freedom prevent people from voting for a coerced reform, despite being in favour of the long-term consequences. This may explain how a generally negative attitude towards different measures designed to reduce car use (Emmerink et al., 1995) can coexist with a high awareness of environmental problems due to car use and an understanding of the need to deal with these problems. In a similar vein, it has been shown how economic incentives may lead to "crowding out" or reduction of pre-existing intrinsic motivation to act socially responsibly (Deci, Koestner, & Ryan, 1999; Frey, 1993; Frey & Jegen, 2001). The individual feels bribed when the control shifts from inside to the outside of the individual, and the reaction to this is rejection rather than acceptance of a suggested measure.

Whether or not there are altruistic motives involved when people decide not to drive is, however, uncertain. Rather, it is well established that car use is related to selfish affective (feelings of freedom, independence, power, status, or privacy) and instrumental motives (travel costs, time, and safety) (Steg, Vlek, & Slotegraaf, 2001). Therefore, a more plausible explanation may be that the economic disincentives cause unwanted reactions in terms of negative attitudes towards the behaviour they are meant to encourage (in this case the reduction of car use), and this may stem from a feeling of being deprived of personal freedom of choice or feelings of unfairness (Thøgersen, 1994).

To successfully compete with such motives, awareness of the central role car use plays for environmental problems and a sense of responsibility must probably be created. Individual benefits such as comfort and speed should be

downplayed and collective losses, such as congestion and pollution, highlighted. To create altruistic reasoning by supporting intrinsic motivation is referred to as "crowding in" effects (Frey & Jegen, 2001).

Over time, economic means of control and legislation may affect social norms, which may in turn impact motivation. A social norm implies a certain amount of compulsion that may make it perceived as less coercive than a measure that is not underpinned by a social norm. This makes a measure supported by a social norm more efficient (Guagnano et al., 1995). Yet, it has been claimed that there is lack of empirical support for the relation between social norms and environmentally friendly behaviour, such as purchasing environmentally friendly products and recycling (Thøgersen & Ölander, 1995). Social norms supporting car-use reduction are probably rare even though there is some empirical evidence for the influence of others or a social pressure for using the car (Gärling & Sandberg, 1997; Kitamura, Nakayama, & Yamamoto, 1999). This can be contrasted to smoking where society has succeeded in inducing a social norm prohibiting smoking in public spaces. Social norms become internalized through learning and may develop into personal norms if they are integrated with individuals' values (Schwartz, 1977). Sanctions and incentives directed towards a personal norm affect the self image. The consequences of breaking a personal norm include negative feelings like guilt and impaired confidence. The consequences of following it may be positive feelings like pride and confidence.

Attitudes towards or evaluations of, for example, transport alternatives are, according to the theoretical framework, the main component of internal motivation. There are several definitions of the concept attitude. The theoretical framework is based on the definition proposed by Eagly and Chaiken (1993). It is used because it is broad and therefore applicable to attitudes to environment and car use. Thus, attitude is defined as a psychological inner state which is expressed by evaluating (overtly or covertly, affectively or cognitively, behaviourally or not) a phenomenon, a behaviour, or an object. The evaluation can be placed on a continuum from extremely negative to extremely positive. An attitude towards car use consists of several components: a cognitive component, which reflects knowledge of and reasoning about, for example, the negative effects caused by car use; an emotional component, where positive and negative feelings towards car use and the environment are involved; and a behavioural component reflecting whether or not the person has an intention to act in line with his or her feelings and knowledge.

Several theories have been suggested to account for an integration of motivational components. In the Theory of Planned Behaviour or TPB (Ajzen, 1985, 1991), motivation to perform a behaviour is assumed to be related to an attitude (positive or negative) towards the behaviour, a subjective norm, which is a judgement of significant others' (family and friends) opinion regarding the behaviour, and the individual's desire to comply or defy the norm. TPB differs

from its predecessor, the Theory of Reasoned Action (Fishbein & Ajzen, 1975), by including perceived behavioural control as a determinant of intention. If individuals lack control over barriers in the environment, it will affect the relationship between attitude and behaviour negatively. A low degree of control may be strengthened if the individual plans how to carry out the behaviour. The attitude towards the behaviour is dependent on the individual's perceptions and salient beliefs about the consequences of the behaviour as well as the evaluation of these consequences. This implies that two people who believe that car use contributes to pollution and should be reduced may have different attitudes towards reduced car use depending on how they evaluate the consequences of a reduction. For example, a person who is less car-dependent may have a positive attitude compared to someone who is more dependent on the car.

Another view is expressed in a game-theoretical approach to decision making. Households are faced with choices reflecting a conflict between the individual's interest and the collective's or society's interest (Dawes, 1980; Messick & Brewer, 1983; Ostrom, 1998). A reduction of car use involves individual sacrifices in order to achieve a collective benefit (reduced air pollution). In such a social dilemma, it is always beneficial for the individual to make the selfish choice. Yet, if a majority choose to act in this way, the outcome is worse for everyone than if the majority choose to act in the collective interest. In other words, it is necessary to make choices that are regarded as sacrifices (for example to reduce car use) in order to achieve an improved outcome for everyone. This insight is probably not always present. When considering behaviours such as car use, the negative consequences for the environment will occur in the future or may be seen as caused by somebody else. Positive consequences, on the other hand, for example, fast transportation, are more easily associated with car use (Everett & Watson, 1987). There are of course negative consequences of car use which affect the individual directly. Most of these exist in urban areas consisting mainly of lack of parking spaces and congestion leading to prolonged travel times. An additional direct individual cost in the form of economic disincentives may outweigh the benefits of car use and make alternatives more attractive.

Table 1. Positive, negative, direct and delayed consequences of private car and public transport.

		Direct	Delayed
Private car	+	Fast Comfortable Prestigious Private Flexible Free choice of route Possible to carry cargo etc. Predictable Payment later Pleasure of driving	
	-	Congestion Difficult to park	Environmental deterioration Fuel cost Maintenance cost
Public transport	+	Time to read Possibility to rest/sleep No worries about parking	Reduce environmental deterioration
	-	Pay a fare Uncomfortable Crowded Not private Exposed to weather conditions Limited possibility to carry cargo Inflexible Low prestige Long travel time Low possibility to choose route	

Everett and Watson (1987) and Garvill (1999) posit two reasons as to why car use fails to be reduced despite the majority of the negative environmental effects. One reason is that the positive effects favour the individual, while the negative effects accrue mainly to society. A second reason is that the positive effects materialize closer in time than the costs. In Table 1 some possible positive and negative consequences of car use are summarized and compared to benefits and costs of public transport. The table probably includes the most important barriers to motivate car-use reduction. A majority of car users will be stuck in this phase, unwilling to set a car-use reduction goal and move into the phase of planning.

Planning

The psychology of planning was initiated by Miller, Galanter, and Pribram's (1960) book *Plans and the Structure of Behavior,* which was influenced by computer simulations of human problem solving processes (see Newell, Shaw & Simon, 1958). Miller et al. (1960) viewed planning as the missing link between knowledge and action. According to Das, Parrilla, and Kar (1996), planning is a broad concept which, in addition to what an individual knows, involves allocation of attentional resources and regulation of cognitive processes.

Planning has been viewed from a number of perspectives resulting in different research traditions. There are, for example, the neuro-psychological, the cognitive, and the developmental perspectives as well as perspectives adding the social context to planning (Friedman & Scholnick, 1997). Every research tradition implies different definitions of planning corresponding to their perspective. One frequently used general definition of planning is given by Hayes-Roth and Hayes-Roth (1979) as "the predetermination of a course of action aimed at achieving some goal" (pp. 275-276)

After having set a car-use reduction goal, households form plans and implementation intentions. Implementation intentions entail commitments to the plan for how to attain the goal (Gärling & Fujii, 2002). Such a plan, in turn, consists of sets of predetermined choices contingent on specified conditions. In the planning phase different means of car-use reduction are considered. A range of such adaptation alternatives has been suggested (Gärling, Gärling, & Johansson, 2000; Gärling, Gärling, & Loukopoulos, 2002; Kitamura & Fujii, 1998). They may be classified as (1) changes of travel needs (choose closer destinations, refrain from activities) and (2) changes of travel patterns (switch travel mode, trip chaining, car-pooling).

A household that has set a reduction goal may start by evaluating the different possibilities, considering both attractiveness and costs, and then making choices among the alternatives. The choice process may be repeated each time a trip is made or may be made in advance if the trip is planned or frequently made. Gärling et al. (2000) assumed that the following alternatives were considered: (1) trip suppression, (2) switching mode, (3) substituting destinations, (4) trip chaining, and (5) car pooling. However, the results showed that almost everyone only chose (1).

In a similar conceptualization, it is proposed that over time car-using households compare the current situation to a reference value or goal (Gärling, Eek et al., 2002; Loukopoulos, Gärling, Jakobsson, & Fujii, in press). If they experience a discrepancy, some action is carried out with the aim of minimizing this discrepancy. It is further claimed that in making plans for how to reduce car use, households may, in addition to strategies such as those mentioned above, consider longer-term strategic changes such as moving to another residence,

thus perhaps making possible the sale of the household vehicle, changing work place, or changing work hours (e.g., compressing the work week).

Loukopoulos et al. (in press) suggest that households prefer options that attain their car-use reduction goal at a minimal cost. That people adapt in this way has consistently been demonstrated in research on cost-benefit tradeoffs in decision making (Payne, Bettman, & Johnson, 1993). In line with this, a cost-minimization principle was proposed. It is thus assumed that car users set a goal to reduce car use which has monetary costs, time costs, or inconveniences, and that they prefer to attain this goal at a minimal cost. Since it may not be possible to immediately attain the car-use reduction goal, it is further hypothesised that the adaptation alternatives are chosen consecutively over time. At the top of the hierarchy less costly adaptations are found such as making car use more efficient by better planning and coordination of trips. If further action needs to be taken in order to reach the reduction goal, car users will next try not to make certain trips by suppressing activities. Finally, in order to reach large reductions of car use, switches to alternative modes are contemplated.

In some previous research, knowledge of planning has been obtained with the use of interactive interviews (Ettema & Timmermans, 1997; Gärling et al., 2000; Jones, Bradley, & Ampt, 1989; Jones, 1979; Lee-Gosselin, 1989, 1990; Turrentine & Kurani, 1998). The interviewees respond to questions about how they would act if they are forced to reduce their car use during a day or sometimes more than a day. The drawback of this method is that it may encourage the participants to plan more than they normally do (Gillholm, Ettema, Selart, & Gärling, 1999), so that its predictive power is limited[1] (Gärling, Gillholm et al., 1998). Furthermore, planning is likely to be interwoven with executing the plan. Recently, Doherty and Miller (2000) developed a computer-based method in which interviewees reported their plans recurrently by logging on to a PC every day. Each time they were to report what they had done since the last time they logged in: changes in their plans, and new plans they may have. A main finding was that the planning horizon is very short.

Households' strategies to reduce car use were studied by Lee-Gosselin (1989). First, the respondents were asked to report their normal car use during one week in a travel diary, and then they were asked how they would adapt their car use if fuel was in short supply. Respondents were also asked questions about the feasibility and acceptance of change. The results showed that a reduction of 10-20% was perceived to be possible. There was a preference for changes that are under the individual's direct control such as walking, biking, suppressing activities, and chaining trips. Car pooling and using public transport were less favoured.

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[1]The primary purpose with these methods has, however, been identification of restrictions, not the study of the planning of trips.

Ettema (1996) used data from interviews to develop a computer simulation of the planning phase. Computer simulation is an example of production system models (Doherty, Axhausen, Gärling, & Miller, 2001; Gärling, Kalén, Romanus, Selart, & Vilhelmsson, 1998; Gärling, Kwan, & Golledge, 1994; see review in Ettema & Timmermans, 1997). In these types of models, decisions are assumed to be made about a range of activities within a certain time span. The decisions concern where and when activities will take place and how the trips between different locations are made.

Previous research has shown that a behaviour which has developed into a habit is less guided by intentions (Bentler & Speckart, 1979; Ouelette & Wood, 1998; Verplanken & Aarts, 1999). This is a possible reason as to why habitual behaviours are difficult to change. In a field study car-use reduction was obtained for one group of households with a strong car habit by increasing awareness through letting the respondents fill out a travel diary (Garvill, Marell, & Nordlund, 2003). The travel diary included questions about contextual factors such as weather and available alternatives to the car. Overall, the study showed that participants did not change their car attitude or car habit and the relation to car use was unaffected. This implies that even though the phase of planning may result in a plan for how to change car use, habits will still be barriers to a changed car-use pattern because they are not consciously controlled. On the other hand, if a change in car use eventually is established and becomes habitual, this resistance will help to preserve the new travel patterns.

Implementation

Even if planning prepares car users for a reduction in car use, there may still be discrepancies between the intentions formed in the planning phase and the implementation of these plans. The reasons behind these discrepancies can be found both within the individual as well as in the environment. In attitude theory the concept perceived behavioural control is used to describe the degree of control a person believes he or she has over events related to the success of performing a behaviour or reaching a goal. These control beliefs include skills, knowledge, needed resources and opportunities. They are assumed to have an indirect influence on behaviour through intentions. An issue is whether perceived control corresponds to actual control (Ajzen, 1991). In particular, the factors related to available opportunities and resources may be misjudged.

In previous research on car-use reduction, the terms error of omission and error of commission have been used when car users fail to implement an intention concerning how much to use the car (Fujii & Gärling 2003; Gärling, Gillholm et al., 1998). The latter, referring to a failure to use the car despite having stated they would, may be due to the fact that people are unrealistic and do not take into account concurrent plans, that they tend to change their minds due to fragile or unstable intentions, or that they forget intentions. Unexpected

events may also occur that prevent people from implementing their intentions. When a household has planned to reduce their car use but the reduction fails, this is an error of omission. The reason for it may be unexpected difficulty in giving up some habitual car trips, or because car trips are added due to lack of control over situational factors, which may in turn lead to unexpected or impulsive behaviour. It has been shown that impulsive behaviour is less influenced by intentions since they are less elaborate or specific (Gollwitzer, 1996). The intentions are also formed close in time to their implementation because they are influenced by situational factors (Gärling, Gillholm et al., 1998).

Evaluation

The outcome of the car-use reduction is evaluated in parallel to the implementation. A basic principle is that human behaviour is goal-directed and controlled by negative feedback (Carver & Scheier, 1982, 1998). Negative feedback informs of a discrepancy between the current state and a goal, and if any discrepancy is registered, how much and in which direction behaviour needs to be changed. The effectiveness of negative feedback requires an exact reduction goal. Transparency, immediacy, and high frequency of feedback are assumed to increase its significance and thereby its probability to produce a change. Negative feedback may also provide information about, for instance, the cost and effectiveness of the different measures. It may furthermore vary with respect to its scope. For example, negative feedback may provide information about the individual or environmental costs of private car use. If the chosen measures fail to achieve the reduction goal, one may choose another measure. However, it may also cause a change in the reduction goal or that it is given up. This is assumed to be a more frequent occurrence when the reduction goal is unrealistic or the commitment is low. Car-use reduction exceeding the reduction goal may also occur, particularly if the feedback is vague, infrequent, or delayed. As in the former case when one fails to reduce enough, this may lead to new planning or a change of the reduction goal.

Even if the reduction goal is attained, there may be negative side effects making the change unstable. Sacrifices may for example be experienced more negatively than expected. The reduction goal is also assumed to be subordinate to other important goals like comfort and well-being of the family (Powers, 1973). If the evaluation shows that the reduction goal is in conflict with any of these higher goals, it may be changed or abandoned.

Economic Disincentives

Overview

Economic disincentives are only one class of transport policy measures that may reduce the levels of car-use related congestion, noise, and air pollution in metropolitan areas (Banister, 2000). As this and other proposed measures focus on changing or reducing demand for car use, they are generally referred to as travel demand management (TDM) measures (Kitamura, Fujii, & Pas, 1997; Kitamura et al., 1999; Meyer, 1999). Other terms with similar meanings include transport system management (Pendyala, Kitamura, Chen, & Pas, 1997), mobility management (James, 2002; Rye, 2002), and travel blending (Rose & Ampt, 2001). The last two, perhaps more than the others, have been used when describing urban and social changes by influencing attitudes. Still, these may also be termed TDM measures. Thus, Meyer (1999) defines a TDM measure as "... any action or set of actions aimed at influencing people's travel behaviour in such a way that alternative mobility options are presented and/or congestion is reduced" (p. 576).

The various TDM measures differ in effectiveness, cost, and technical, political and public feasibility. The view that TDM measures vary in coerciveness has also been generally adopted (Steg & Vlek, 1997; Stradling, Meadows, & Beatty, 2000; Vlek & Michon, 1992). Coercive TDM measures are sometimes referred to as push measures and non-coercive TDM measures as pull measures. Vlek and Michon (1992) suggest that the following TDM measures, ordered from more to less coercive, are feasible ways of implementing car-use reduction policies: physical changes such as, for instance, closing out car traffic or providing alternative transportation; law regulation; economic incentives and disincentives; information, education, and prompts; socialisation and social modelling targeted at changing social norms; and institutional and organizational changes such as, for instance, flexible work hours, telecommuting, or "flex places."

Since economic disincentives are the primary focus of the empirical studies in this thesis, the remainder of this section is devoted to a more thorough review of previous research on their acceptance and effectiveness.

A Classification

Fees or charges in connection with car use, frequently referred to as road pricing or road user charging, have three main purposes: (1) Financing maintenance of old and building new infrastructure; (2) reducing air pollution; and (3) reducing congestion in urban areas (Lindberg, 1995). They are either general and affect all car users equally, or differentiated referring to charges for car use in specific areas or at certain times of the day.

The price of gasoline is the most common example of a general charge. It is affected partly by the world market of oil, partly by a range of taxes including carbon dioxide and energy taxes. Car users may compensate for the higher costs by driving less, improving maintenance of the car or by "eco-driving" in order to reduce gasoline use.

Parking fees are another widely used type of charge that can be differentiated both in time and space. These fees, tickets for violation of parking regulations, and the supply of parking spaces are seen as important means of limiting car use in many city centres. However, in Sweden the effect on car-use reduction has been minimal (SOU 1997:35).

Differentiated charges have recently become associated with congestion charging. Congestion charging aims at reducing traffic congestion in central urban areas, particularly during peak travel time on weekdays. The goal is to obtain less queuing, and to make the travel times both shorter and less variable. Congestion charging may also be divided into several subcategories such as toll rings and zone-based charges. In Stockholm a toll ring was planned as part of the "Dennis agreement" which however has not been implemented (Ahlstrand, 1998). The idea was to charge car users when they passed into the toll ring. An alternative scheme was to divide the city centres into zones. Car users are charged when driving in a zone, not only when they pass the toll ring. This is called zone-based charging and the charge may vary between different zones. The payment may be made with a smartcard or by paying for daily, weekly, or monthly passes which are displayed on the windscreen. Various intelligent systems have been discussed which will make it technically feasible to differentiate the charge depending on, for example, time or kilometres spent on the road or within the zone, time of the day and congestion at the time.

Public and Political Acceptance

Public and political acceptance have been proposed as key factors for the successful implementation of road pricing schemes (Schade & Schlag, 2003b; Schlag & Teubel, 1997). The reason is the low acceptance where implementation of road pricing has failed, for example in Stockholm and Hong Kong (Hau, 1990). The difficulty in obtaining political and public acceptance may in fact be a main reason why implemented road pricing schemes are very rare around the world despite the alleged effectiveness in reducing the problems caused by car traffic as well as the potential to raise funds for alternatives to the car through collected revenues. In this thesis acceptance is defined as a positive attitude towards road pricing measures or other TDM measures. Others (e.g. Schade & Schlag, 2003b; Schlag & Teubel, 1997) distinguish between acceptability which is the attitude before implementation of a potential future TDM measure and acceptance which refers to the attitude including the behavioural reactions after the implementation of a measure.

Attitudes toward implementation of a policy measure are related to beliefs of its consequences. These beliefs have two components (Fishbein & Ajzen, 1975): expectations of what consequences the measure will have and how positively or negatively these consequences are evaluated. Expected effectiveness of a policy measure, that is the extent of general car-use reduction followed by positive environmental effects, is one such key factor that may enhance acceptance (Bamberg & Rölle, 2003). However, a low level of acceptance is expected in line with the discussion in the previous section on motivation implying a tendency to act in self-interest and not consider collective future consequences. A low degree of acceptance is also found in most studies (Jones, 1995; Schade & Schlag, 2003a; 2003b; Schlag & Teubel, 1997).

Car users' resistance to paying a fee for road use may also be related to how they perceive the cause of the problem (Jones, 2003); if the negative effects are seen as being caused by others rather than by oneself, this may be considered as extremely unfair. Alleged or actual unfairness due to income and regional differences may also result in a low level of acceptance (Emmerink et al., 1995; Jones, 2003).

Car users will furthermore resist road pricing because they will be paying for something that has always been free of charge (Jones, 1995). Car users will no longer be free to use roads without contributing to cover the environmental costs, and this infringement on freedom may add to resistance. This may either result in the scheme failing to be implemented, or causing problems like "rat running," where car users avoid being charged by driving in unpriced areas and consequently causing problems in these areas (Emmerink et al., 1995; Goh, 2002; Seale, 1993).

Research on norms against voting for coerced reforms shows that people are concerned about fairness and freedom of choice, and therefore opposed to, for example, increased gasoline taxes even though they support the intended purpose (to reduce global warming) (Baron, 1995; Baron & Jurney, 1993).

When designing a system there are several important issues where fairness plays a central role, for example, which area or roads to include in the pricing area, the size of the charge and how to distribute the revenues (Langmyhr, 1997). Personal freedom and privacy are also important concerns to be taken into account when collecting the charge and when monitoring vehicles in order to reveal non-payers.

Effectiveness

A few field experiments have been conducted with the aim of assessing the effectiveness of road pricing schemes. In one such experiment reported in Hug, Mock-Hecker, and Würtenberger (1997), an electronic charging system was used. The charges depended on time and route choice. Driving in rush hours and on roads with the heaviest traffic was charged most. The test area was located in

Stuttgart and included one main road and two parallel roads. There were three toll stations on each road and car users were charged when passing them. About 400 test drivers were selected. Interviews were made and responses to questionnaires collected before, during, and after the trial period. Participants were also asked to keep a travel diary. The charge for driving during rush hours was varied over the different periods. A "park and ride" service was available for those who preferred to park the car and use the subway service running every third or fourth minute. The general results showed that the test drivers preferred earlier or later departures (avoiding the expensive rush hour) and changes of route (choosing a cheaper road) to alternative travel modes. Up to 12.5% of the trips were changed to a cheaper period when the charge during the rush hour varied between DM 2 and DM 8. When the level of charging was varied on the different roads, there was a tendency to choose the cheapest one. There was no change in destinations contrary to the results of hypothetical questions in a questionnaire where 33% of respondents chose this. Alternative travel modes were used by 5% on weekdays and by 15% on weekends. Very few used the "park and ride" service. There was a remaining tendency to use public transport to a higher extent after the charging period compared to before. Car pooling increased and made up 7% of the trips independently of the price level. There was also an increase in trip chaining (about 3% of the trips on weekdays and 6% of the trips on Saturdays were chained). The most common chain included work trips and shopping trips.

Road user charges have also been investigated in a series of experimental studies in Newcastle and Leeds using a route choice simulator, a full scale driving simulator, surveys, and field trials (Bonsall & Palmer, 1997; Bonsall, Palmer, Cho, & Thorpe, 1998). In these experiments it was found that about 30% supported the use of some type of road user charging. High income respondents and respondents working part time tended to support road user charging more than others. The most acceptable type of charge was a "fixed" charge and the least acceptable were charges based on travel time or time spent in congested traffic referred to as stop-start conditions. These last two charge types, which entail more uncertainty (the charge varies from trip to trip), had less effect on trying to avoid the charge by driving different routes or driving at other times of the day (which otherwise was the primary response), but produced more risk taking in a driving simulator. A common response to a charge was simply to pay it; this tendency was stronger if respondents were told that traffic conditions would be improved (32%), and strongest among high-income drivers and women. The number of respondents who said they would use public transport was small. However, it doubled (from 6% to 12%) if revenues were said to be used to fund a reduction in public transport fares. Another conclusion from this research was that many people are unable to respond to the charges due to personal circumstances. This was above all true for work trips.

Road pricing has also been implemented in a few places around the world providing some opportunity to assess both acceptance and effectiveness. Current examples can be found in Singapore, Norway and the UK. In Singapore, the main aim has been to reduce traffic during peak hours, and the limited space on the island has made the expansion of infrastructure a non-feasible long-term solution. In addition to various policies that limit the possibility of owning and parking cars, different road pricing systems have existed since 1975 (Goh, 2002; Seik, 1997, 2000). The effect of the original cordon toll system, the Area Licensing Scheme (ALS), was an immediate decrease in traffic during the charging period and an increase before and after the charging period. The total decrease of traffic in the area was 20% and car pooling doubled. Between 1975 to 1995 Singapore managed to decrease traffic volumes by 45%, and double the speed in the CBD area to 36 km/h (Goh, 2002; Seik, 1997, 2000). Later, in 1998, an electronic road pricing system (ERP), using automatic toll collection via smart cards, was introduced (Goh, 2002; Seik, 2000). Compared to ALS, this is a technically superior and more sensitive instrument that allows differentiation depending on time of the day and traffic flow by charging each passage into the restricted zone. Overall, the charges are highest during the morning peak period (about USD 1.20). Car traffic into the CBD has been reduced about 20% and speed has increased, compared to before introducing the ERP. There has also been a considerable modal shift to a train service financed by the revenues, the Mass Rapid Transit, which was introduced in 1999.

In Norway cordon toll ring systems have been used for many years with the purpose of financing investments in new infrastructure rather than reducing car use (Odeck & Bråthen, 2002). The systems that have been mostly studied are the toll ring systems in Bergen that was introduced 1986, in Trondheim introduced 1991, and in Oslo introduced 1990. In Bergen no decreases in car use have been registered since the introduction. However, it can be noted that neither has an increase occurred. The fee per passage is NOK 5, which is considered as cheap. Another finding from Bergen worth mentioning is that the system using monthly passes increases car use for those who purchase such passes (Odeck and Bråthen, 1997). Surveys assessing attitudes conducted one year before and one year after the implementation showed a decrease in negative attitudes from 54% to 34%.

The cordon toll ring system in Oslo has existed since 1990. Ramjerdi (1995) found that it has had small effects on car use but favourable effects on revenues which have financed roads and tunnels (which was the intention with the system). The charge is relatively low (NOK 10) although it was considered high at the introduction. Discounts and monthly passes are available. It is also common practice for employers to pay for the toll charged to their employees. Odeck and Bråthen (1997) carried out a longitudinal study which started one year before the introduction of the toll ring and lasted for six years. The purpose was to find out if attitudes towards the toll ring changed over time. The results

showed a negative attitude for the majority both before the implementation (70%) and after five years (55%). Another reported tendency is that younger people are more positive towards the toll ring than are older people.

A recent review of road pricing in Norway (Odeck & Bråthen, 2002) concluded that residents in Bergen, Trondheim and Oslo have become less negative to tolls after the implementation of the systems. Thus, the general trend is that the number of people holding a positive attitude gradually increases over the years. However, as have been noted, the effectiveness in reducing car use is not well documented.

In the UK, London's congestion charging system is the most recent example. It was implemented in central London in February 2003. In this case the purpose was to ease congestion, and to increase this effect, as well as acceptance, the revenues are used to improve alternative transportation. The system uses a flat fee of £5 to enter into the priced area between 7 am and 6.30 pm on weekdays, and video cameras register non-payers who will receive a £80 fine by mail. The initial effect assessed after two months was a significant reduction of traffic congestion (20 %) and increase of average speed from 13 km/h to 17 km/h and improved taxi and bus services (Litman, 2003). Six months after the introduction of the congestion charging, Transport for London (2003) reported a 30% decline in congestion and that the number of motor vehicles entering the zone had been reduced by 17%. Since there are 50000 fewer cars but only 4000 fewer people coming into the zone during the charging hours, this indicates that car users switch to other modes rather than avoid the area. The report also refers to attitudinal surveys showing growing support for congestion charging since its introduction. More than 50% of all residents support or tend to support the scheme and 30% oppose or tend to oppose it.

Jones (2003) draws the conclusion from the Norwegian and other experience that there is a relation that remains to be studied further, namely between acceptance and time of implementation. When time of implementation is near, and the scheme has developed from a broad idea into a concrete proposal, attitudes become more negative than before; another change of increased acceptance can be noted immediately after the implementation. This process may be similar or parallel to the process of car-use reduction posited in this thesis. It is plausible that the arrow from *evaluation* to *motivation* in Figure 1, illustrating the feedback from evaluating experiences in the phase of implementation of a new behaviour and the influence on future motivation, may entail this attitude change.

Summary and Implications

It may be concluded that economic disincentives can be an effective tool for reaching the objective of raising funds for something that the public supports, for instance, new infrastructure as in the Norwegian case, or reduced

congestion as in Singapore or London. However, as Jones (1995, 2003) points out, the latter case needs better and more preparation to succeed, since people are used to paying for things they want rather than things they would like to avoid, especially if they see themselves as victims, and think that others rather than themselves cause the congestion. A first step towards acceptance of road pricing may be awareness of, and a high level of severity of problems, for example congestion (Jones, 2003), or the creation of social norms, which may be aided by strong political support as in Singapore, in order to make people change from being influenced by self interest, to taking into consideration the interest of the collective. However, even if car users give up their personal freedom, the norms concerning fairness remain and need to be taken into consideration when planning and trying to gain support for road pricing or other coercive TDM measures.

Finally, one has to consider that many cities in the world cannot be compared to Singapore or London. In Sweden, for example, the conditions are very different. So, what will happen if problems are less severe, but still urgent? Apart from acceptance of road pricing, their effectiveness is even more important. Little is still known about both the determinants of acceptance and about the car use changing process. To achieve stable and long-lasting changes then, in line with the theoretical framework in this thesis, there is a need to take into consideration both internal and external factors. The change in private car use is a process consisting of the stages of motivation, planning, implementation, evaluation and feedback. The greatest challenge in this process is to break old habits. To do this, new goals must be set and a plan for the necessary changes formed. Evaluating adaptation alternatives and consequences as well as monitoring discrepancies to the goal in order to make adjustments is also necessary. It is also important to take into account the possibility of crowding-out effects when formulating and introducing TDM measures. Otherwise, negative reactions leading to unchanged or even increased car use can be expected.

Summary of the Empirical Studies

Overview

The general aim of this thesis is to empirically investigate a number of issues related to economic disincentives targeting car-use reduction. These issues will be treated in the thesis with reference to the theoretical framework. They include (i) what the determinants are of a positive vs. negative attitude towards economic disincentives, (ii) whether economic disincentives will reduce car use, and (iii) whether other, more or less coercive, transport policies differ from economic disincentives in acceptance and effectiveness.

Study I (Jakobsson, C., Fujii, S., & Gärling, T. (2000). Determinants of private car users' acceptance of road pricing. *Transport Policy, 7*, 153-158.)

The aim of Study I was to test a model of acceptance of road pricing in order to disentangle key determinants. The selection of the key determinants was based on previous research (Baron, 1995; Baron and Jurney, 1993) showing that even if people are opposed to coercive reforms like tax increases, they may sympathize with the intended purpose, for example, reducing global warming. The most important reasons for opposing reforms appear to be social or moral norms of fairness and freedom of choice. Other research (Emmerink et al., 1995; Seale, 1993) suggests that unfairness due to income differences and giving up personal freedom are the fundamental reasons behind low acceptability of road pricing. Despite awareness of the negative effects of private car use, economic disincentives such as road pricing may therefore not be acceptable if they lead to higher costs and force car-use reduction.

We further hypothesized that income is positively related to acceptability, but negatively related to intention to reduce car use. This is because most people may agree with the environmental goals, but only those with a higher income can afford to continue to use their car when the costs increase. Thus, car users who do not need to reduce their car use will not perceive that the increased costs infringe on their freedom and they may not perceive the increased costs to be unfair. A low level of acceptability, on the other hand, is related to feelings of unfairness and infringement on freedom by those who are forced to cut their costs and decrease their car use.

Another key determinant is the expectation of how many others intend to reduce car use. This variable was assumed to be positively related to own intention due to social pressure or a social norm. Snyder and Stukas (1999) have shown that expectations of others' intentions to comply with a social norm, or anticipated social pressure, have an effect on one's own willingness to comply. We assumed that reducing car use is perceived by car users to be socially desirable, and their intention to do this may thus increase with how many others they believe will do the same.

Our hypotheses were expressed in the form of a structural model in which the assumed causal relations were represented as directed paths. Coefficients to be estimated express the strength and sign of these causal paths. An appropriate estimation technique is structural equation modelling (SEM) (Bollen, 1989). This technique, originally proposed by Jöreskog (1970), has frequently been applied in travel behaviour analyses (e.g., Fujii & Kitamura, 2000; Golob, 1998). SEM is implemented in the LISREL8 software (Jöreskog & Sörbom, 1993) which supplies full information maximum likelihood estimates based on covariances between the observed variables. In the estimation, hypothesized latent variables correspond to the theoretical constructs that in turn are related to the observed variables through measurement models.

A survey of 524 randomly selected car owners in greater Göteborg was carried out. Each theoretical construct in the model was measured by means of several indicators consisting of nine-point rating scales.

The results supported the hypothesized relationships. Thus, we found that acceptability of road pricing decreased with intention to reduce car use, decreased with perceived infringement on freedom and decreased with perceived unfairness. Intended reduction of car use decreased with income and increased with expectations about how many others would reduce car use.

Study II (Jakobsson, C., Fujii, S., & Gärling, T. (2002). Effects of economic disincentives on private car use. *Transportation, 29,* 349-370.)

Study II examined changes in private car use when households are faced with economic disincentives. We set out to study the effects of a short-term general charge on the motivation and intention to reduce car-use as well as on the actual reduction of car use. We were also interested in detecting whether households reduce certain types of trips rather than others. We assumed that routine and less flexible trips would be more difficult to change. Such trips may however be easier to alter if households are motivated to consciously plan such changes. The planning should consist of considering alternative modes, suppression, and coordination of trips. We expected that households who make such plans will be able to reduce their car use more than those who do not. We also expected that the duration of implementation of the economic disincentive would be important, because in order to establish new habits, these need to be frequently repeated over time. An economic disincentive may thus be assumed to yield longer-lasting effects, even after its removal, if it is used over a longer period of time. Three major hypotheses were tested: (1) that economic disincentives will lead to decreased car use; (2) that the car-use reduction would be related to the degree of deliberation or planning; and (3) that the effects of economic disincentives and planning may not be long-lasting unless enough time is allowed for the development of new activity/travel habits.

We tested the hypotheses in a field experiment. Participants were households with two adult members recruited among participants in Study I. The households were randomly assigned to four groups, three experimental groups and one control group. A total of 80 households participated in the field experiment running from spring 1999 until spring 2000.

All three experimental groups were given economic disincentives consisting of a charge of SEK 1 per kilometre, in two groups the duration was one week and in one group two weeks. The charge was deducted from a sum of money that was initially distributed to each household in proportion to their normal weekly driving distance. Two of the experimental groups were also asked to plan their car trips during the first week with the charge. The husband and wife in each household did this by filling out a prospective car log. In one of these experimental groups the charge was prolonged to two weeks. The control

group did not receive any economic disincentive and was not asked to fill out a prospective car log but was otherwise treated identically as the experimental groups.

The households kept three car logs, one before, one during and one after receiving the economic disincentive. Each car log was kept for seven days. A home visit was made to each household in order to give the instructions as well as to collect data. At the end of the charging period all participants filled out a questionnaire providing a subjective report of the charging period. In the questionnaire they were asked to state if they had tried to reduce their car use or not and to give reasons for this. Those who claimed to have reduced car use were also asked about the nature of any sacrifices they had experienced.

Travel distances in kilometres as well as trip frequencies obtained from the car logs were analysed. In support of hypothesis (1) the three experimental groups reduced travel distance and trip frequencies during the charging period compared to the pre-charge period. The trip frequencies differed for the first treatment week and the total driving distance differed the last treatment week. This reduction of car use was not observed in the control group. Although the largest differences were observed between the three experimental groups and the control group, there were several indications that the two experimental groups that were requested to also fill out a prospective car log reduced car use more than the group that was only charged. This finding supported hypothesis (2) that making a plan would increase car-use reduction. The results of the third car log that was collected after the treatment period failed to support hypothesis (3) that the experimental group with extended charge would continue to drive less the week after the treatment.

When analysing different trip purposes and characteristics, the strongest reduction was found for shopping trips in the experimental groups compared to the control group. Reduction was also observed for trips where the husband drove alone without passengers (solo-driving), trips outside the central business district, and trips during weekdays (both peak and off-peak hours).

The subjective reports supported the results from the car logs. Participants in the two planning groups indicated that they had taken measures to reduce their car use to a larger extent than the charge only and control groups. The former groups also stated more reasons for reducing car use. These reasons were mainly economic and environmental. The control group gave similar reasons, but added another frequent explanation for their reduction, namely unplanned events like temporary illness or weather conditions. This was also the most frequent reason in the charge only group. Reported sacrifices due to car-use reduction were mainly related to increased travel times and suppression of trips to different activities. More reasons were provided against than reasons for reduction of car use. The overall most frequent reason was that the household already had reached a minimum car-use level and that further reduction would

be impossible or at least very inconvenient. Another frequent reason was lack of transport alternatives.

Study III (Jakobsson, C. (2004). Accuracy of household planning of car use: Comparing prospective to actual car logs. *Transportation Research F*, 7, 31-42.)

Study III investigated the correspondence between how much households in two of the experimental groups in the field experiment in Study II (the prospective car log) planned to use the car the first week and their actual car use reported in the car log during that week. Since some types of car trips were reduced more than others, the question was raised regarding how much volitional control households have over different types of trips. It was posited that the degree of volitional control is directly related to the correspondence between the prospective and actual car logs. Car trips for which volitional control is high may more easily be changed if a motivation to do so is evoked. Different households may also differ in their degree of volitional control. Correspondence was therefore related to both trip purposes and household characteristics. It was predicted that underestimation of frequencies would primarily be observed for shopping, chauffeuring, and leisure trips, all of which arguably are prone to be made in an impulsive manner compared to habitual types of trips (work) or trips usually planned in advance (personal service and social visit). It was further predicted that there are more barriers for some households to execute their plans, in particular those with greater needs to participate in activities, that is, households with two adults who work and households with children. Also, the availability of an additional car in households with more than one car may reduce the felt need for planning, thus leading to less correspondence.

The results revealed that many more trips were executed by the households than were planned. Expected larger discrepancies were found for *shopping* and *chauffeuring* trips whereas, as expected, the discrepancy was smaller for *work* trips. *Personal service* and *social visit* trips were not as accurately planned as they were expected to be. Furthermore, the results showed that the number of actual shopping trips exceeded the planned number if the household had more than one car, that the number of actual chauffeuring trips exceeded the planned number if the household had children, and that the number of actual leisure trips exceeded the planned number if the household had a higher income.

Questionnaires distributed at the end of data collection revealed the participants' stated reasons for the observed discrepancies. Activities that had been cancelled was a reason for not making a planned car trip due to, for example, illness or weather conditions. Another reason for not making a planned car trip was switching of mode from car to other modes. The reason for making additional trips by car was primarily unplanned activities, most often shopping, chauffeuring, and personal service, or switching mode to car from other modes due to weather conditions or time pressure. In conclusion, the discrepancies

were produced to a large extent by events outside the households' control. Consequently, a new categorization of car trips into planned, habitual, impulsive, and compulsive was proposed.

Study IV (Loukopoulos, P., Jakobsson, C., Gärling, T., Schneider, C., & Fujii, S. *Car-user responses to travel demand management measures: Goal intentions and choice of adaptation alternatives.* Manuscript submitted for publication.)

In Study IV economic disincentives such as congestion charging are compared to two other TDM measures, car-free zones in the city centre (prohibition) and individualised marketing. The prohibition of car use is assumed to be the most coercive from the view of the car user, followed by congestion charging, where driving still is an option albeit at a higher cost or at other hours, and individualised marketing that is non-coercive since it is based on voluntary change. We hypothesized that the coercive measures make car users set larger reduction goals compared to non-coercive measures. In addition we wanted to know how car users choose to adapt given that they have set a car-use reduction goal.

A focus group study was first conducted with the main purpose being to assess households' car-use reduction goals and to see which adaptation alternatives they would conceive of and consider were the three different TDM measures to be implemented where they live. A screening questionnaire was sent to 600 technical and administrative staff at Göteborg University using electronic mail. The purpose was to select car users who used the car at least 3-4 times a week for at least two out of three purposes (work, shopping, and leisure). Twenty participants (7 men and 13 women) were recruited and divided into five groups, each meeting for about 90 minutes. Examples of TDM measures were taken from the car-free zone in the city centre of Cambridge, UK, the electronic congestion charging system in Singapore and Individualised Marketing in Perth, Australia. These were presented verbally as well as by means of pictures and maps. Participants were also encouraged to ask clarifying questions. After each presentation of a TDM the groups were prompted to discuss issues following a questioning route. This consisted of issues relating to general evaluation, car-use reduction goals and adaptation alternatives. The discussion was led by a moderator.

An analysis of the focus-group discussions indicated that the car users had mixed feelings towards the three types of TDM measures. They would set small reduction goals (unless the congestion charge would be much higher than in the example), and they could think of few adaptation alternatives. The trips to and from the work place were primarily considered when discussing adaptation alternatives except in relation to prohibition. To avoid hours with the highest charge was the most common response to congestion charging, while switching to public transport was frequently mentioned for all three measures. To drive to other destinations in order to avoid the charged or closed area was an adaptation

mentioned by some participants that may increase rather than decrease current car use. Finally, participants stressed that combinations of the three TDM measures, preferably with the addition of an improved public transport service, would be the best motivator for them to reduce their car use.

The focus groups were followed by an internet-based questionnaire study in an attempt to further investigate responses to the three TDM measures. The aim was to obtain quantitative estimates of the size of car-use reduction goals as well as how they relate to the frequency of choices of nine adaptation alternatives. The sample this time consisted of 600 employees from all areas of duty at Göteborg University. In the analyses only those 199 with a driving licence and access to a car were included. All respondents were presented with the three TDM measures (as texts, maps and pictures) in the same order (from more to less coercive). There were several modules related to attitudes towards the measures included in the questionnaire that are reported elsewhere (Loukopoulos, Jakobsson, Gärling, Schneider, & Fujii, 2004). Relevant to this study was sociodemographic information, current car use, awareness of problems related to the level of car traffic in Göteborg (problem awareness), expected car use for the implementation of each TDM measure, and frequency of adoption of the nine adaptation alternatives in response to the TDM measure. The adaptation alternatives were grouped in three main categories: More efficient car use, trip suppression and mode switching. Two adaptation alternatives fell outside these categories which were both mentioned in the focus group discussions: Driving to other destinations and changing the time at which the trip is made.

In line with the focus group results, the results revealed, an overall (across all three TDM measures) small intention to reduce car use. Also in line with these results, individualised marketing resulted in smaller car-use reduction goals than the more coercive measures. However, neither coerciveness for the other two TDM measures, the type of trip undertaken, nor the interaction between these two factors played a large role in determining the size of the stated reduction goals. Instead, a large proportion of the variance was due to individual differences that to some extent were related to problem awareness and sociodemographic factors.

The results concerning the choices of adaptation alternatives again revealed the importance of individual differences. In addition there were expected effects linking reduction goal and adaptation alternatives. The three adaptation alternatives more efficient car use, trip suppression, and mode switching all correlated with the car-use reduction goal. Furthermore, the correlation increased as the adaptation alternatives varied from less to more costly, indicating a relationship in line with the proposed hierarchy. In the regression analyses more efficient car use was found to be related to smaller reduction goals and was more frequently chosen by car users for the more coercive TDM measures compared to the non-coercive. Trip suppression did not yield any clear

results in this respect. In general, work trips were most likely to be suppressed, whereas shopping trips were least likely to be suppressed. Switching to another mode as an adaptation was, as expected, found to be related to a larger reduction goal. It was most likely to occur for shopping trips. Changing the time of the journey was not chosen to any significant extent, implying that this is not a general adaptation for commuters. To change destination, however, in order to avoid either paying a fee or facing the inconvenience of a prohibition of car use, was frequently chosen as a response to the coercive measures.

Conclusions and Discussion

The empirical studies in this thesis examined different aspects of the motivational and volitional control of car use laid out in the theoretical framework. Study I focussed on the key determinants of the acceptability of economic disincentives relevant to goal setting, while Studies II, III, and IV focussed on the planning and implementation of changes in car use. In addition, the results of the post-experimental questionnaires reported in Studies II and III illuminated the evaluation phase. The studies also used a range of methodologies: mail and internet surveys, focus groups, and field experiments. This mix of quantitative and qualitative research makes the studies complementary in providing insights about the process of changing car use.

The three main issues investigated in the thesis were: (i) what are the determinants of a positive vs. negative attitude towards economic disincentives, (ii) whether economic disincentives will reduce car use, and (iii) whether other more and less coercive transport policies differ from economic disincentives in acceptance and effectiveness.

Issue (i) was the primary focus of Study I. In this study we found support for a proposed model of the determinants of acceptance of road pricing. Perception of fairness, personal freedom, income, expectations about others' car use and intentions of own car use were found to be key determinants. Perceived infringement on freedom and perceived fairness had significant direct influences on acceptance, the latter to a greater extent than the former. Largely similar results have been found in a German sample (Bamberg & Rölle, 2003) and in Japanese and Taiwanese samples (Fujii, Gärling, Jakobsson, & Jou, in press). In the focus group discussions in Study IV, fairness was not a main issue. Yet, indirectly confirming the results of Study I, fairness was mentioned frequently as a main concern and argument against road pricing. These concerns were related both to concrete practical matters (e.g., the levels and area of charging, the main purpose of the charging, and how the revenues were to be distributed), as well as to more abstract concepts (e.g., resentment of the possibility that those with the financial means would be able to drive to a larger extent and even more comfortably than today). This latter point is also consistent with the finding in Study I that higher income influences intention of car-use reduction negatively,

that is car users with a higher income stated that if road pricing is implemented, they would continue to drive to a larger extent than those with a lower income. Those with a lower income are likely to be aware of the strain an additional charge will have on their budget, they perceived this as unfair as well as infringing on their freedom, and they had therefore less positive attitudes towards road pricing schemes.

There was an even stronger influence on intended car-use reduction of the expectations of others' intentions when facing the charge. This may be interpreted as a strong indication of the importance of social pressure or social norms, as posited in previous research using a social dilemma approach to car-use reduction (Gärling & Sandberg, 1997; Kitamura et al., 1999). Additional support for this was found by Bamberg and Rölle (2003). In their study social norm was measured as perceived social support of non-car use and had a positive relation with intention of non-car use. Studies II and III did not directly aim at measuring determinants of attitudes; however, the results of the subjective reports obtained from the participants after the charging period hint at other possible factors that should be considered in future research. In the questionnaires the participants gave reasons for reducing or not reducing car use, sacrifices they experienced due to a reduction and reasons for not being able to adhere to a planned reduction. Important reasons for negative attitudes may be the stated lack of transport alternatives and increased travel times associated with car-use reduction and the unwillingness to give up the comfort and activities associated with car use. In addition, those who in Study III failed to achieve a planned reduction due to circumstances outside their control may in the evaluation phase reconsider the reduction goal and adjust it into a smaller goal or even give up the idea of being able to reduce their car use. Therefore, they would become more negative to economic incentives that, in their view, force them to achieve what they consider impossible. A substantial number of participants also stated that they already used the car to a minimal degree. It is likely that these low-frequency car users will react negatively if further pressure is put on them to do something they consider that they already do.

Environmental concern has received little attention in this thesis. Initially, in Study I environmental concern was measured (Gärling, Fujii, Gärling, & Jakobsson, 2003) expecting it to influence intentions to reduce car use. However, it was later omitted from the model when this failed. Yet, Fujii et al. (in press) report a possible influence of environmental concern on fairness rather than directly on acceptability or intentions to reduce car use. Also, in Japan and Taiwan a stronger effect of environmental concern was found, although still not a direct effect. It was thus concluded that fairness may mediate the effect of environmental concern on acceptability of road pricing. Bamberg and Rölle (2003) extended the model of acceptance in Study I by adding two factors: (1) problem awareness measured as awareness of environmental problems associated with car use, and (2) effectiveness of road pricing measures in terms

of reducing these problems. The importance of these two factors is highlighted by Study IV in this thesis, where problem awareness was found to influence the size of set car-use reduction goals, possibly through the creation of a positive attitude. In addition, perceived effectiveness, assumed to increase with the coerciveness of the TDM measures, also had some influence on the reduction goal and choice of adaptation alternatives.

In general a majority of car users express negative attitudes towards road pricing. In Study I 49% were negative to a relatively small distance-based charge (5% above the cost of car use today) and 95% were negative to a fairly large distance-based charge (80% above the cost of car use today). Do the negative attitudes imply that car users evaluate the consequences of road pricing negatively, or that the consequences are unclear or uncertain? The question still remains as to why car users on the one hand are aware of the problems with car use but on the other hand are negative towards measures like road pricing. Is it because they believe car use will not be reduced, or is it because they believe there will be other negative consequences such as additional costs or that it is unfair? Or is it simply a problem of removing situational and personal obstacles rather than lack of motivation? One may speculate that acceptability may increase once a car-use reduction has been accomplished. The attitude towards the toll rings in Norway became more positive after the introduction (Odeck & Bråthen, 2002). One may however also note that the toll rings have had virtually no effect on car use.

This leads to issue (ii) whether economic disincentives will reduce car use? The general conclusion of Study II was that economic disincentives alone will not make car users reduce their car use. Instead, the results indicated that conscious planning of the households' travel is the missing link between motivation and implementation. This link was also further investigated in Study III by comparing the plans with the actual car use.

By analysing trip purpose separately, we found that shopping trips were reduced most despite the fact they were less planned (largest difference between number of planned trips and number of actual trips). Considering what has been said about the importance of motivational and volitional control for reducing one's car use, this somewhat contradicting result is in line with previous research (Gärling et al., 2000) indicating that shopping trips are both most easily changed and to a large extent unplanned. The explanation may be that shopping trips are impulsive, that is less habitual, and may therefore be changed in time or space or combined with other trip purposes. Still, as Study III showed, even though the number of shopping trips may be possible to control to a certain extent for some households, for others (households with more than one car), a considerable amount of unplanned shopping trips are added during the course of the week. This may partly be due to the lack of control over situational factors, with some support for this being found in study III. The participants commonly explained their unplanned trips as being due to unexpected events and activities.

Whether TDM measures can target shopping trips perhaps remains to be seen. Study II showed a decrease from an average of 5.6 trips per week before the implementation of economic disincentives to 4.2 trips after implementation (1.4 of these trips were planned). Considering the substantial number of shopping trips that are being made, it would of course be valuable if they could be reduced. In Study II shopping trips accounted for 23% of all trips, about the same number as work trips (27%). It is hard to predict what the environmental consequences would be in the future, but if many shopping trips can be reduced, perhaps replaced by electronic shopping, it would certainly contribute to a more positive picture than today.

The subjective reports in Study II provided some valuable information about how people evaluate a car-use reduction, as well as clues to obstacles to changing car use. This is relevant for both issues (ii) and (iii), because it can be applied to economic disincentives as well as to other TDM measures. A majority of those who did not reduce car use argued that they already had reduced it to a minimum level. It is hard to tell if this is a general tendency among car users due to high gas prices or the result of a sampling bias leading to the exclusion of those with a high level of car use. Other less surprising obstacles were lack of transport alternatives and time pressure, both possibly indicating the importance to society of recognizing that improving public transport is necessary if commuters are going to reduce their car use. In Study III, however, the line of argument is that in addition to providing alternatives, society must also recognize different households' needs, for example households with children, and take into account car users lack of motivational and volitional control over their car use. Lack of motivational and volitional control is due to habits and impulses and affects all car use that is not planned in advance. Motivational and volitional control are also related to other concepts and factors, such as affective motives as well as unforeseen needs (usually related to situational factors) for using the car, which may explain why households fail to execute their plans. The findings in Study III indicate that such lack of motivational and volitional control exists, and this may be a serious barrier to car-use reduction. Even if acceptability is achieved, the impact of TDM measures such as, for example, pricing schemes or improvement of public transportation may therefore not be successful. In the theoretical framework, it is argued that there needs to be a certain level of consciousness for the change in behaviour to take place. This is referred to as goal setting and planning. I have found some indication for the importance of a planning phase in order to obtain a change in behaviour.

Returning to Study II and those who did reduce their car use, how did they evaluate their reduction? They reported insufficient alternative transport alternatives resulting in increased travel times and suppression of activities. Both of these consequences were perceived as sacrifices, and may contribute to negative attitudes, as already discussed above, as well as to a failure to reduce car use in the longer term. Those in Study II who made an effort to reduce their

car use gave not only economic reasons, which is natural given that they faced the economic disincentives, but also environmental reasons for doing so. It suggests that environmental concern as well as economic disincentives may motivate a car-use reduction. This was partially supported in Study IV where the findings highlight the importance of problem awareness and other individual differences, which reflect perceived social norms, for setting car-use reduction goals.

Issue (iii), whether other more or less coercive transport policies differ from economic disincentives in acceptance and effectiveness remains to be discussed. Study IV has the most to contribute to any conclusion regarding this issue, since in this study we compared three different TDM measures. However, analyses of the data on attitudes to the various TDM measures is not reported in Study IV (see Loukopoulos et al., 2004). We compared road pricing to the non-coercive individualised marketing and to the coercive prohibition of car use in the city centre. The results showed the strongest support among participants for the most coercive TDM measure and the least support for road pricing. Respondents believed that the most coercive measure restricting car accessibility would be the most effective in reducing car use and thus improve the quality of the urban environment more than the other measures. It was also found that effectiveness was small in terms of the size of the car-use reduction goals that were set. The two coercive TDM measures activated larger reduction goals than did non-coercive individualised marketing, thus suggesting a need for coerciveness to make a change. However, depending on the purpose of the TDM measure, they may still be considered effective. If the purpose is to relieve congestion or to target attitudes, rather than a general reduction of car use, all three TDM measures may make important contributions. Prohibition would force everyone, not just some, to not use the car in a certain area, which is considered fair. The coercive TDM measures, particularly prohibition, were also found to make respondents inclined to change their travel patterns (e.g., driving to other destinations or changing time of travel) thereby possibly reducing congestion. Finally, even if individualised marketing only makes people start thinking about a change, it may prompt them to acquire more information about how to make a change, and eventually this may lead to a more positive assessment of alternatives to the car. From the focus group discussions in Study IV, it was clear that a combination of at least one coercive and one non-coercive measure would be the best solution both in terms of acceptability and effectiveness. In a similar vein, Jones (1995) proposed improvement of public transport, which is considered as the most acceptable but not very effective TDM measure, as a means for achieving acceptance of road pricing.

On a final note, the solution to the problems caused by car use in urban areas is presumably a combination of stimulating collective thinking, emphasizing environmental awareness and activating norms of responsibility, and implementing simple, fair, and well-functioning coercive TDM measures

forcing changes as well as non-coercive TDM measures that will make the alternatives to the car more attractive and accessible. Furthermore, in order to influence the decision process, the TDM measures need to increase people's motivational and volitional control. Thus, they need to be easy to grasp, comprehensible, and directly connected to the behaviour. If the measure is a road pricing scheme, individuals must be able to calculate the cost for a trip in order to plan it. There are however many barriers to car-use reduction. Among the most serious are the positive qualities of the car in combination with the existence of impulsive and habitual behaviours. Any effort to motivate individuals to change their travel behaviour will be strongly counteracted by these factors.

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APPENDIX

I. Jakobsson, C., Fujii, S., & Gärling, T. (2000). Determinants of private car users' acceptance of road pricing. *Transport Policy, 7*, 153-158.

II. Jakobsson, C., Fujii, S., & Gärling, T. (2002). Effects of economic disincentives on private car use. *Transportation, 29,* 349-370.

III. Jakobsson, C. (2004). Accuracy of household planning of car use: Comparing prospective to actual car logs. *Transportation Research F, 7,* 31-42.

IV. Loukopoulos, P., Jakobsson, C., Gärling, T., Schneider, C., & Fujii, S. *Car-user responses to travel demand management measures: Goal intentions and choice of adaptation alternatives.* Manuscript submitted for publication.

På grund av upphovsrättsliga skäl kan vissa ingående delarbeten ej publiceras här.
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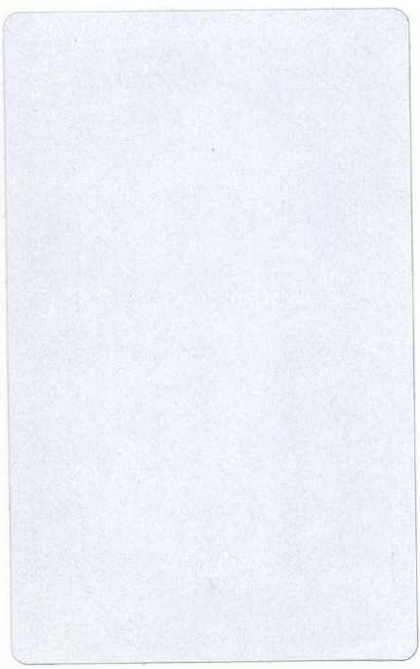

GÖTEBORGS UNIVERSITET
Psykologiska institutionen

ISSN 1101-718X
ISRN GU/PSYK/AVH/—129—SE

Kompendiet, Göteborg 2004