Pro-environmental travel behavior:

The importance of attitudinal factors, habits, and transport policy measures

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Abstract

The aim of this thesis was to study determinants of a readiness for pro-environmental travel behavior in households. Four empirical studies were conducted examining reduction in car use (Study I), acceptability of transport policy measures (Study II and III), and behavioral adaptations in response to travel demand management (TDM) measures (Study IV). In Study I, the aim was to interrupt habitual car use by means of a deliberation intervention and to examine the importance of moral motivation (i.e., personal norm) for car use reduction. Results showed that, as a result of the intervention, car use was mainly reduced among car users with a strong car use habit and a strong moral motivation to reduce car use. The aim of Study II was to examine factors important for the acceptability of three TDM measures: raised tax on fossil fuel, improved public transport, and an information campaign. The results demonstrated the importance of general environmental beliefs (i.e., pro-environmental orientation, problem awareness, personal norm, and willingness to reduce car use) and policy specific beliefs (i.e., perceived impact on freedom to choose travel mode and own car use, perceived effectiveness, and perceived fairness) for the acceptability of the measures. Furthermore, personal norm was found to be particularly important for the acceptability of raised tax and the information campaign, whereas problem awareness was more important for the acceptability of improved public transport. Following up on Study II, the purpose of Study III was to examine the acceptability of single and combined transport policy measures, more specifically, raised tax on fossil fuel, improved public transport, subsidies of renewable fuel, a package of raised tax on fossil fuel and improved public transport, and a package of raised tax on fossil fuel and subsidies of renewable fuel. General environmental beliefs (i.e., pro-environmental orientation, problem awareness, personal norm, and willingness to act) and policy specific beliefs (i.e., perceived effectiveness and perceived fairness) were found to be important for the acceptability of the measures. Moreover, personal norm was particularly important for the acceptability of raised tax on fossil fuel and the packages, while problem awareness was more important for the acceptability of improved public transport and subsidies of renewable fuel. The aim of Study IV was to examine the behavioral adaptations, more specifically, the expected car use reduction, in response to three hypothetical TDM measures: raised tax on fossil fuel, improved public transport, and a package of raised tax on fossil fuel and improved public transport. Furthermore, factors important for the expected car use reduction were analyzed. Results showed that a combination of the measures was expected to lead to a larger car use reduction compared to the single measures, and the most commonly chosen reduction strategies were more efficient car use and changing travel mode. Moreover, internal motivational factors, such as personal norm, and the perceived personal impact of the measures were important for expected car use reduction in response to the measures.

Key words: value-belief-norm theory, car habit, policy specific beliefs, car use reduction, acceptability, behavioral adaptations, travel demand management measures, transport policy measures

Acknowledgements

Preface

This thesis contains four studies and these will be referred to by their roman numerals in the text.

I. Eriksson, L., Garvill, J., & Nordlund, A. M. (2008). Interrupting habitual car use: The importance of car habit strength and moral motivation for personal car use reduction. *Transportation Research Part F, Traffic Psychology and Behaviour, 11*, 10-23.

II. Eriksson, L., Garvill, J., & Nordlund, A. M. (2006). Acceptability of travel demand management measures: The importance of problem awareness, personal norm, freedom, and fairness. *Journal of Environmental Psychology, 26*, 15-26.

III. Eriksson, L., Garvill, J., & Nordlund, A. M. (2008). Acceptability of single and combined transport policy measures: The importance of environmental and policy specific beliefs. *Transportation Research Part A, Policy and Practice, 42,* 1117-1128.

IV. Eriksson, L., Nordlund, A. M., & Garvill, J. (2008). *Expected car use reduction in response to structural travel demand management measures.* Manuscript submitted for publication.

Contents

INTRODUCTION

Personal travel behavior – an environmental problem

In how many different locations have you been today? Many of us start the day in our home but we have often been to several locations before the day has ended. For example, during an ordinary day we may go to work, to the store, to perform various leisure activities, such as, going to the city centre or visiting friends, and we may take our children to different activities. A prerequisite for managing our daily life is that we travel in order to link these places and activities. Travel may be a derived demand, that is, we can travel in order to reach a destination to fulfill certain needs (see e.g., Axhausen & Gärling, 1992) or an end in itself, for example when we take a trip just for fun (see Mokhtarian, Salomon, & Redmond, 2001). Nevertheless, for most of us travel is an important part of our life.

Citizens in Sweden travel on average 70 minutes, or a distance of 40 km during one day (aviation not included), and the main errands are work related, trips to leisure activities, and service/shopping trips (SIKA, 2007a). Different travel modes are used for these trips, such as, car, public transport, cycle, and on foot. The car has the leading position among different travel modes in both Sweden and other Western countries. According to SIKA (2007a), citizens in Sweden make more than half of their trips by car, and for 64 % of the travel distance the car is used. The high level of car use is also evident at a European level, where on average 70 % of the travel distance is made by car (Eurostat, 2007). Moreover, car use has increased in Europe and the United States during the last decades (see e.g., Pucher, 1999; Krantz, 1999). The high level of car use is expected to continue in the future. According to a forecast made by SIKA (2005), car use is expected to increase until 2020, and the personal car will continue to be the dominant travel mode in Sweden.

Traffic however, causes both local and large scale environmental problems (Van Wee, 2007; see also Chapman, 2007, Miedema, 2007). In urban areas, emissions of particulate matter (PM), nitrogen dioxide (NO_2), volatile organic compound (VOC), and carbon monoxide (CO) are particularly important from a health perspective, while emissions of nitrogen oxides (NO_x) and sulphur dioxide (SO_2) contribute to the acidification of buildings (Van Wee, 2007). In addition, noise is a problem in urban areas. According to Miedema (2007), noise in residential areas may disturb communication, concentration, sleep, and cause negative emotional reactions. Large scale environmental problems caused by traffic include climate change as a result of carbon dioxide (CO_2) emissions, acidification of nature, agriculture, and the landscape, as well as large scale air pollution (Van Wee, 2007). In addition, the landscape

fragmentation as a result of the extensive infrastructure demanded by road traffic is a serious issue (Trocmé et al., 2003).

Political attempts to achieve an ecologically sustainable transportation

Since personal transportation is a significant contributor to environmental problems, there is an ongoing effort at a political level to strive for a more sustainable development, that is, a "development that meets the present needs without compromising the ability of future generations to meet their own needs" (Brundtland, 1987, p. 43). Even though the concept of sustainability has been criticized for being vague and ambiguous (see Lélé, 1991; Pretty, 1995), it is commonly used in policy documents as well as in the public debate. Moreover, there are several definitions of sustainability in relation to transportation (see Janic, 2006; VTPI, 2008a). Issues that should be addressed when striving for a sustainable transport are, for example; economic aspects, such as, affordability, resource efficiency, employment, and productivity; social aspects, such as, equity, human health, and quality of life, and; environmental issues, such as, pollution prevention, biodiversity, precautionary actions, and aesthetics (VTPI, 2008a). If these definitions are to be useful in practice, however, the operationalization is important, for example by specifying quantitative targets and a schedule for when the goals should be achieved (Janic, 2006).

Sustainable transportation is touched upon in various political documents at global, regional, and national levels. They vary in the extent to which they specify measurable targets as well as when and how the goals should be achieved. One agreement at a global level with important implications for the transportation sector is the Kyoto protocol from 1997. In this agreement, the participating countries decided to reduce greenhouse gas emissions by at least 5 % from the emission level in 1990 until 2008-2012 (UN, 1997). At the European level, the European Commission has developed a Common Transport Policy. In 1992, the European Commission proposed the first White Paper and the most recent White Paper appeared in the year 2001 suggesting 60 different measures to be implemented at the community level by 2010 (EU, 2001). A mid-term review was performed in 2006 stressing the need for a wide variety of policy tools in order to achieve a shift to more environmentally friendly transport modes as well as a striving for optimizing each transport mode (i.e., more environmentally friendly, more energy efficient, and safer) (EU, 2006). In Sweden, the overall goals for an ecologically sustainable development are expressed in 16 environmental objectives (e.g., reduced climate impact, clean air, and natural acidification only) (Gov. Bill 2000/01:130; 2004/05:150). Moreover, in the national transport policy, a

good environment is one of six sub-goals, and equally important to accessibility, high transport quality, safety, favorable regional development, and equality between men and women (Gov. Bill 1997/98:56, 2001/02:20, 2005/06:160). Although, some progress has been made in reducing the negative environmental effects of transportation, recent assessments indicate a need for vigorous policy measures in order to fulfill the aims stipulated in the environmental objectives (see SIKA, 2006, 2007b).

The present thesis

In sum, even though travel is necessary in our society, the way we travel leads to severe environmental problems. Hence, there is a need to reduce the negative environmental effects of households' transportation. In order to influence travel behavior in a pro-environmental direction, different transport policy measures may be implemented. Three broad strategies are land use management tools, such as planning for a more compact city (Litman, 2008), technological improvements, such as more energy efficient cars and cars fuelled by renewable fuel, and measures reducing the demand for car use, such as raising the cost for using the car or reducing the cost for using alternative travel modes (Gärling, Gärling, & Loukopoulos, 2002). Since technological innovations and changing the built environment are potentially effective only in a longer time perspective, several researchers advocate a need for changing travel behavior now (Hickman & Banister, 2007; see also Litman, 2005). However, given that contextual and psychological factors tend to facilitate the use of a private car, there are several difficulties associated with implementing transport policy measures and changing travel behavior. Moreover, if policy measures are to contribute to the solution of the environmental problems, it is important to consider both the acceptability and the behavioral effects of the measures (Banister, 2008; Viera, Moura, & Viegas, 2007).

The overall aim of the thesis was to study important determinants of a readiness for pro-environmental travel behavior in households. It is mainly focused on everyday travel behavior in a local context. In four empirical studies, reducing car use, acceptability of transport policy measures, and behavioral adaptations made as a result of policy measures were examined. The studies were conducted in four municipalities in Sweden: Piteå, Huddinge, Göteborg, and Växjö. The municipalities are situated in different parts of the country from the north to the south, and vary in population size (approximately 40,000-500,000 citizens). Even though sustainable transportation may include environmental, economic, and social aspects, the main concern in this thesis is on environmental issues. Travel behavior is expected to follow from the travel choices the individual makes and the

environmental impact of personal transportation is determined by how much the individual travels, the number of trips and distance traveled, and the travel mode choice, such as car or public transport. A more pro-environmental travel behavior is characterized by less environmental impact, for example traveling shorter distances by car, using public transport, cycling/walking instead of taking the car, or using a less environmentally harmful car. Hence, travel behavior may be described as more or less pro-environmental depending on the environmental impact.

The thesis is divided into nine sections. Following the introduction, travel behavior is analyzed as a social dilemma, important determinants of travel behavior are reviewed, and potential solutions, in the form of transport policy measures are described. Subsequently, an overview of a conceptual model is given and the specific research objectives of this thesis are presented. The four empirical studies on which the present thesis is based are described, and, finally, important findings are discussed, main conclusions are drawn, and theoretical as well as practical implications are provided.

TRAVEL BEHAVIOR – A SOCIAL DILEMMA

The travel behavior of individuals may be seen as the individual's own choice, for example using the car or public transport on a trip to work. However, the environmental consequences of households' transportation are dependent on how all individuals as a collective choose to travel. Hence, with regard to the environmental impact of travel behavior, the individual's travel choices are highly interrelated with the way others travel.

One approach, called the social dilemma framework, has been useful in highlighting the conflict of interests associated with changing travel behavior in a more pro-environmental direction (see e.g., Garvill, 1999; Van Lange, Van Vugt, Meertens, & Ruiter, 1998; Van Vugt, Van Lange, & Meertens, 1996). A social dilemma is a situation in which there is a conflict between the interests of the individual and the collective good. According to Dawes (1980), a social dilemma is a choice between defection and cooperation, that is, acting in one's own self-interest or acting in the collective's best interest. The core of the dilemma is that everyone has more to gain personally from a defective choice compared to a collective choice regardless of what others do. However, all individuals receive less if everybody defects rather than cooperates. A travel mode choice may more specifically be described as a social trap. The choice conflict is between an individual and a group of people, and whereas the individual gain is immediate, the loss of the group is long-term (see Komorita & Parks, 1994; Platt, 1973). For example, choosing public transport instead of

the car may be perceived as a cooperative choice since the collective will gain in the long term through a reduced environmental impact, whereas the individual will have to make certain immediate personal sacrifices, such as, longer travel time and a less flexible travel mode. In addition, since the negative effect on the environment caused by one individual's defective choice is rather insignificant (e.g., using the car to work on one occasion), a cooperative choice is further hindered. This analysis accentuates the dilemma of changing to a more pro-environmental travel behavior. In the following section, important determinants of travel behavior will be reviewed in order to get a more comprehensive understanding of travel behavior and the possibilities to change travel behavior.

IMPORTANT DETERMINANTS OF TRAVEL BEHAVIOR

Stern (2000) has proposed four types of causal variables important for pro-environmental behavior: personal capabilities, external or contextual factors, attitudinal factors, and habit or routine. These factors may provide a framework for explaining travel behavior.

The first type of factor, personal capabilities, consists of the individual's knowledge, available time and money, social status, and power. Often, sociodemographic variables (e.g., age, gender, education, occupation, civil status, and household composition) and personal resources (e.g., income, car ownership, and driving license) are taken as proxies for personal capabilities. In studies of travel behavior, various sociodemographic factors have been examined. For example, women tend to travel shorter distances and use the car less compared to men (Giuliano & Dargay, 2006 SIKA, 2007a; Steg, Geurs, & Ras, 2001). In addition, age is often negatively related to travel distance (Giuliano & Dargay, 2006; Hunecke, Haustein, Grischkat, & Böhler, 2007; Mokhtarian, et al., 2001), and older people tend to use their car less compared to younger people (Steg, et al., 2001). In relation to personal resources, studies have generally found a positive relation between income and travel distance as well as between income and car use, indicating that individuals with higher income tend to travel more and use their car more compared to those with lower income (Dargay & Hanly, 2007; Giuliano & Dargay, 2006; Mokhtarian, et al., 2001; Poortinga, Steg, & Vlek, 2004; Steg, et al., 2001). Furthermore, access to a car tends to be associated with traveling longer distances (Giuliano & Dargay, 2006; Hunecke, et al., 2007; Mokhtarian et al., 2001).

The second type of factor in Stern's (2000) framework, contextual factors, consists of physical, social, economic, and political variables. Various policy

initiatives, such as, regulations and monetary incentives, contribute to the political context. With regard to travel behavior, the physical context has been given a lot of attention. For example, studies have found that people in low density areas tend to travel longer distances, own a car to a larger extent, and travel more by car (Dargay & Hanly, 2007; Giuliano & Dargay, 2006), although Vilhelmson (2005) found a U-shaped relation between population density and travel distance, such that individuals living in a medium sized city (50,000-200,000 inhabitants) traveled on average the shortest distance. The social context has also been found to influence travel mode choice. For example, the extent to which others used public transport has been found to be a significant predictor of the individual's use of public transport (Heath & Gifford, 2002). Notably, Stern expects an interaction between contextual and other factors in the framework, such as attitudinal factors. According to Guagnano, Stern, and Dietz (1995), attitudinal factors and behavior are strongly related only when contextual factors are neutral (i.e., neither strongly inhibiting nor strongly facilitating), while Diekmann and Preisendörfer (2003) stipulate that the relation between attitude and behavior is stronger the more facilitating the context is.

The remaining two factors of Stern's (2000) framework may be classified as psychological factors. Attitudinal factors include environmental and non-environmental attitudes, beliefs, values, and personal norms, while habit represents the tendency to act without thoroughly considering the behavioral choice. In studies of travel behavior, the importance of psychological factors over and above sociodemographic and contextual factors has been demonstrated (see Hunecke et al., 2007; Steg et al., 2001). A more in-depth review of attitudinal factors and habits are given below.

Attitudinal factors and travel behavior

Theories and research on attitudinal structure, and the relation between attitude and behavior, are essential for an understanding of the choice to act pro-environmentally. The inter-attitudinal structure stipulates the relationship between attitudes and related constructs (Eagly & Chaiken, 1993). Often, attitudes are perceived to be part of a hierarchical structure from a more specific to a general level, that is, from attitudes on the most specific level, to beliefs, and values on the most general level (Eagly & Kulesa, 1997; Olson & Maio, 2003).

Even though the study of attitudes has continued to develop since the 1920s and different definitions of the concept have been proposed, one of the most well-established definitions of attitude is "a psychological tendency expressed by evaluating a particular entity with some degree of favor or disfavor" (Eagly & Chaiken, 1993, p. 1). The evaluation may be more or less

enduring and vary in valence (i.e., positive or negative) as well as in intensity (i.e., more or less positive/more or less negative). The object of attitudes may be anything that is discriminable, from concrete entities (e.g., a car), to policy initiatives (e.g., raised tax on fossil fuel), and behaviors (e.g., traveling pro-environmentally). In contrast, beliefs have been defined as the perceived probability of a relation between an attitude object and an attribute, and the evaluation of the attribute (see Eagly & Chaiken, 1993; Fishbein & Ajzen, 1975) or as the individual's cognitions representing the characteristics of the attitude object (Eagly & Kulesa, 1997). Within attitude theory, attitudes are perceived to be determined by beliefs. Hence, salient beliefs about the attitude object are important for the attitude. For example, the extent to which a car is perceived to be a flexible and comfortable travel mode may be important for the attitude toward car use. At a higher level, values transcend specific situations and have been described as concepts expressing a goal and guiding behavior (Schwartz & Bilsky, 1987). Based on a review of value definitions, Rohan (2000) describes value systems as stable cognitive structures with clear affective links. For example, the importance individuals attach to others' interests versus their own interests is one value dimension which may be important for environmentally relevant beliefs and attitudes.

Different theoretical perspectives have been employed to describe the relation between attitudinal factors and behavior. Two frequently applied frameworks in relation to travel behavior are the normative framework emphasizing altruistic moral motivation for traveling pro-environmentally and the rational choice framework stressing self-interest and utilitarian aspects when explaining travel behavior. The two approaches are described below.

Normative framework explaining travel behavior

The view of travel mode choice as a normative decision has originated from the theory of normative influences on altruistic behavior (Norm Activation Model, NAM) (Schwartz, 1977). The theory stipulates that altruistic behavior (e.g., a pro-environmental intention or behavior) is a result of a norm activation process. A personal norm, experienced as a perceived moral obligation to act, is activated if the individual is aware that somebody is in need, is aware of actions that could be helpful, perceives an ability to help, and ascribes responsibility to act to oneself. Subsequently, moral as well as non-moral costs and benefits of acting are evaluated and the situation may be re-evaluated during a defense phase. The process ends with a response; either acting altruistically or not. In an extension of this theory into the environmental domain, Stern, Dietz, Abel, Guagnano, and Kalof (1999) (see also Stern, 2000) proposed the value-belief-norm (VBN) theory of

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environmentalism based on several studies (e.g., Black, Stern, & Elworth, 1985; Guagnano et al., 1995; Stern & Dietz, 1994; Stern, Dietz, & Guagnano, 1995; Stern, Dietz, & Kalof, 1993; Stern, Dietz, Kalof, & Guagnano, 1995). The VBN-theory combines the norm activation theory (Schwartz, 1977) with the theory of values (Schwartz, 1992, 1994) and the New Environmental Paradigm hypothesis (Dunlap & Van Liere, 1978, 1984). According to the VBN-theory, a hierarchy of values, environmental beliefs (i.e., an ecological worldview, awareness of consequences, ascription of responsibility), and personal norms explain pro-environmental behavior. Recently, the causal order of relations in the VBN- theory, that is, a mediation model, has received empirical support (De Groot & Steg, 2007a; Steg & De Groot, 2007). The variables in the VBN-theory are described in more detail below.

At a general level, the norm activation process in the VBN-theory originates with the individual's personal values, particularly the extent to which the individual consider the needs of others to be important. This concern has been labeled self-transcendence values (Schwartz, 1992, 1994), or split into a concern for other human beings, labeled an altruistic value orientation, and a concern for other species and the natural environment, labeled a biospheric value orientation (Stern et al., 1993). The next part of the chain of variables proposed by the VBN-theory is awareness that the environment is threatened. Different terms have been used to describe individuals' views of the environment and environmental problems, such as, environmental concern (Dunlap & Jones, 2002; Fransson & Gärling, 1999), environmental worldviews (Dunlap & Van Liere, 1978), environmental values (Nordlund & Garvill, 2002, 2003), environmental beliefs (Dunlap, Van Liere, Mertig, & Jones, 2000), and environmental attitudes (Grunert & Juhl, 1995; Schultz et al., 2005). In addition, there are numerous different operationalizations of these concepts (see Dunlap & Jones, 2002). The New Environmental Paradigm scale (Dunlap & Van Liere, 1978), later revised into the New Ecological Paradigm (NEP) scale (Dunlap et al., 2000), has been employed repeatedly for assessing an ecological worldview. In the VBN-theory, NEP follows from values and expresses a general awareness of environmental problems, tapping ideas about, for example, limitations of continued growth, the delicate balance of nature, and rejection of anthropocentrism.

The next variables in the chain of predictors stipulated by the VBN-theory are awareness of adverse consequences of human behavior on the environment (AC) and ascription of responsibility to act to one self (AR). The AC may be assessed at different levels, for example the extent to which different environmental problems are threats to the individual, other human beings and/or the biosphere (Nordlund & Garvill, 2002; Stern et al., 1999; Stern, Dietz, & Guagnano, 1995) or the extent to which certain behaviors, such

as using the car, cause environmental problems (De Groot & Steg, 2007b; Nordlund & Garvill, 2003). Measures of AR vary and may concern perceived responsibility to act and/or the perceived individual contribution to environmental problems (see e.g., Steg, Dreijerink, & Abrahamse, 2005).

In the VBN-theory, altruistic and biospheric values, general and specific problem awareness, and acceptance of a responsibility to act activate a personal norm. The activated personal norm, also labeled moral norm (Schwartz, 1977; see also Kaiser & Scheuthle, 2003), is experienced as a feeling of moral obligation to act. A norm is concerned with the expectations of how one should act connected with threats of sanctions or promises of rewards (Schwartz & Howard, 1982). Schwartz (1977) makes a distinction between personal and social norms. Whereas the social group establishes and reinforces social norms, personal norms may develop in the social group but are subsequently internalized to the self. Hence, personal norms are sanctioned by the individual him- or herself. In Stern's (2000) framework, social norms are contextual factors, although the individual's perception of social norms (e.g., the perceived pressure to act pro-environmentally) and personal norms are part of attitudinal factors. In sum, an activated personal norm to reduce the negative environmental effects of car use is a morally based motivation to act for the sake of the environment when making decisions about how to travel.

Reasoned decision framework explaining travel behavior

A reasoned decision theory which put less focus on moral factors for explaining behavior is the theory of reasoned action (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975) and its extension into the theory of planned behavior (TPB) (Ajzen, 1988, 1991). The TPB is a general theory of the relation between attitude and behavior, and has been applied to a range of different social behaviors (e.g., health behavior, such as exercising, and pro-environmental behavior). According to the TPB, attitude toward the behavior, together with subjective norm and perceived behavioral control (PBC), determines an intention to act. In turn, intention and PBC are direct predictors of behavior. Attitude is the individual's appraisal of the expected outcomes of the behavior, that is, a favorable or unfavorable evaluation of the behavior. In contrast, the subjective norm concerns the social environment in which the individual acts and, more specifically, the perceived social pressure to perform or not to perform the behavior. PBC is the perceived possibilities to perform the behavior, that is, how easy or difficult the behavior is perceived to be and to what extent the actor has control over the behavior. Moreover, intention to act contains motivational factors important for the behavior, for example, the effort the individual is willing to put into performing the behavior.

In the TPB, factors, such as, personality, general attitudes, education, gender, and knowledge are believed to be more distal predictors of behaviors through the individual's beliefs. In turn, beliefs about the consequences of the behavior (i.e., behavioral beliefs) influence attitude, beliefs about the normative expectations of others (i.e., normative beliefs) influence subjective norms, and beliefs about factors facilitating or inhibiting the behavior (i.e., control beliefs) influence PBC. Overall, the TPB stipulates that an intention to travel pro-environmentally, for example using public transport, is a result of various considerations expressed mainly in an attitude, subjective norm, and PBC, rather than a perceived internal pressure to save the environment as stipulated in the normative approach.

Attitudinal factors explaining travel behavior

Both a normative and a reasoned decision approach have been used to explain travel behavior. Based on a normative approach, several studies have found personal norm to be a predictor of car use (Bamberg & Schmidt, 2003), willingness to reduce car use (Matthies, Kuhn, & Klöckner, 2002; Nordlund & Garvill, 2003), the use of transport modes other than the car (Harland, Staats, & Wilke, 1999; Hunecke, Blöbaum, Matthies, & Höger, 2001; Matthies, Klöckner, & Preissner, 2006; Matthies et al., 2002), and the acceptability of policy measures (Steg et al., 2005). Within a reasoned decision approach, the TPB constructs, and particularly intention, have been used as predictors of car use (Bamberg & Schmidt, 2003), restricting car use (Kaiser & Gutscher, 2003), changing travel mode (Bamberg, 2006; Bamberg, Hunecke, & Blöbaum, 2007), and the use of transport modes other than the car (Bamberg & Schmidt, 2001; Heath & Gifford, 2002). Comparing the two perspectives, Bamberg and Schmidt (2003) found that car use in a student sample was better explained by the TPB compared to the NAM, although a study by Wall, Devine-Wright, and Mill (2007) demonstrated that NAM explained slightly more variance in driver's intention to reduce or maintain car use for commuting compared to the TPB. Overall, the NAM/VBN-theory has mainly been used to explain a readiness for pro-environmental travel behavior, while the TPB has been used to explain both intention to change and current travel behavior.

Several researchers advocate a combination of the TPB and a normative model in order to explain travel behavior (Harland et al., 1999; Wall et al., 2007). This conclusion is supported by studies within the social dilemma framework, where travel behavior has been found to be motivated by a combination of self-interest and concern for others (Garvill, 1999; Van Lange et al., 1998; Van Vugt et al., 1996). One way of combining the two perspectives is to add personal norm as a predictor of intention together with attitude,

subjective norm and perceived behavioral control, and in turn to treat intention as a direct predictor of behavior (see e.g., a meta-analysis by Bamberg & Möser, 2007). Others have added personal norm as one of several direct predictors of behavior (Harland et al., 1999) or as a more distal predictor of behavior, for example through attitude (Kaiser & Scheuthle, 2003).

Habits and travel behavior

Although attitudinal factors may be used to explain travel behavior, the need for people to repeat the same trips in a stable context makes it doubtful whether deliberate choices are always made before traveling in an everyday context. Instead, it is reasonable to expect travel behavior to have habitual qualities. In the framework proposed by Stern (2000), habit or routine is one of the four causal factors influencing pro-environmental behavior.

The habit concept

In an early account of habits, James (1890) suggested that when a habit is developed our consciousness is only needed in the beginning and at the end of the behavioral process and not in order to maintain the behavior. Habit was also an important concept in the behaviorist tradition as a reinforced response to a certain stimulus (see e.g., Hull, 1950). More recently, taking motivational and cognitive factors into consideration, the interest for automaticity in behavior has increased (see Bargh & Ferguson, 2000). According to Verplanken and Aarts (1999), habits are characterized by automaticity (e.g., efficiency and lack of awareness), functionality, and situational constancy. Hence, a habit tends to develop if a behavior has rewarding consequences and is repeated in a stable context.

More specifically, according to one perspective, habit constitutes an automatic link between a goal or intention to act and a behavior (Aarts & Dijksterhuis, 2000; Verplanken & Aarts, 1999). The more frequently a goal and a certain behavior have been activated simultaneously in the past, the stronger is the link. Within a connectionist network model (see Wood & Quinn, 2005), a behavior and a supporting context may be represented in memory as connection weights between different elements, and the activation pattern of several of these units represents learning. A stable context may hence activate a certain behavioral response. In a slightly different view, habit has been perceived to be a behavioral script stored in memory and the habitual choice may then be retrieved with a minimum amount of information (Fujii & Gärling, 2003; Gärling, Fujii, & Boe, 2001). According to Fujii and Gärling (2007), the retrieval of the script is dependent on: a) the number of

habitual scripts from different situations stored in memory, and; b) the ease with which a certain script is retrieved. The habit strength increases if many scripts from different situations are stored in memory (e.g., if there is a car-use script for shopping, working trips, and for picking up children) and the script is easier to retrieve if there are no alternative scripts stored in memory (e.g., if there are no scripts for using the public transport).

Since the deliberate processing preceding habitual behavior is limited, the measurement of habits is a concern (Ajzen, 2002; Verplanken, Aarts, van Knippenberg, & van Knippenberg, 1994). Frequently, habits have been assessed with regard to past behavior frequency, that is, how often a certain behavior has been performed in the past has been used as an indicator of habit strength (see e.g., Bamberg, 2000; Ouellette & Wood, 1998). However, the use of past behavior frequency as an indicator of habit has been criticized, since a frequently performed behavior does not necessarily contain habitual qualities, such as, reduced attention and control (Ajzen, 2002; Verplanken, 2006). For this reason, alternative measures have been developed. The response frequency (RF) measure of habit reflects a script-based representation of a behavior, that is, an association between behaviors and goals (Verplanken et al., 1994). In contrast, the self-report index of habit strength (SRHI), a meta-judgmental measure, operationalizes habit as an automatic (characterized by a lack of awareness, hard to control, and efficiency) and repetitive behavior, reflecting a person's identity (Verplanken & Orbell, 2003).

Habits explaining travel behavior

According to one perspective, attitudes and intentions may influence routinized behavior automatically and outside awareness (see Ajzen, 2002; Ajzen & Fishbein, 2000, 2005). Hence, the effect of attitude and intention on behavior does not decrease with routinization. However, several studies have examined habit as an additional predictor of travel behavior. Since the car is the most frequently used travel mode for everyday trips, it is mainly the habit of using the car that has been examined in relation to travel mode. In some studies, habit has been added to the predictors stipulated in the TPB (e.g., attitude, PBC, and intention) (see Bamberg & Schmidt, 2003; Thøgersen, 2006b), while according to a different view, habit and attitudinal factors are perceived to interact in predicting behavior (see Triandis, 1980). For example, when a habit is strong the influence of various attitudinal factors, such as, intentions (Staats, Harland, & Wilke, 2004; Verplanken, Aarts, van Knippenberg, & Moonen, 1998), attitudes (Verplanken et al., 1994), and norms (Klöckner & Matthies, 2004; Klöckner, Matthies, & Hunecke, 2003) on travel behavior are weaker. Hence, a more deliberate choice may be explained

by some of the focal determinants of behavior specified in the TPB or the NAM/VBN-theory, while after a habit has developed the concepts in these theories are less important.

Since habit has been found to be a predictor of travel behavior, a strong habit to use the car may prevent car use reduction. Hence, there is a need to interrupt the habit in order to facilitate a change in travel behavior (see Fujii & Kitamura, 2003; Garvill, Marell, & Nordlund, 2003). Habits may be interrupted by changing the context in order to break the connection between the situational cues and the habitual response (see Wood, Tam, & Guerrero Witt, 2005) or by encouraging a deliberate process prior to behavior so that a deliberate decision can be made (see Verplanken et al., 1998). In several studies, contextual changes, such as, economic incentives and alterations of the physical environment, have been found to influence attitude, intention, habit, and/or travel behavior (Bamberg, Ajzen, & Schmidt, 2003; Bamberg, Rölle, & Weber, 2003; Bamberg & Schmidt, 2001; Brown, Werner, & Kim, 2003; Fujii & Kitamura, 2003; Matthies et al., 2006; Verplanken, Walker, Davis, & Jurasek, 2008). In addition, deliberate consideration has been found to increase the effect of intention on travel mode choice (see Verplanken et al., 1998), although the effects on travel behavior have been mixed. For example, Fujii and Taniguchi (2005) and Garvill et al. (2003) found effects of a deliberation intervention on travel behavior while Verplanken et al. (1998) did not. In addition to becoming aware of the possibilities for changing travel behavior, detailed planning for a new behavior may facilitate a behavioral change (see Aarts, Dijksterhuis, & Midden, 1999; Bamberg, 2000). Gollwitzer (1993) used the term implementation intention to describe a plan for where, when, and how a certain behavior will be performed. Forming implementation intentions has been found to have intellectual benefits (e.g., aiding in the decision about which strategy to use in order to reach a goal) as well as volitional benefits (e.g., helping to control and maintain a behavior) (Gollwitzer, 1996; see also Diefendorff & Lord, 2003).

SOLUTION STRATEGIES – TRANSPORT POLICY MEASURES

The foregoing overview reveals a complex account of how travel behavior is determined. In order to achieve a reduction of the negative environmental effects of car use, it is important to consider the different determinants of travel behavior. Transport policy measures may be used to target these determinants, and in turn, changes in travel behavior are to be expected.

Four main types of transport policy measure may be implemented, that is, legal policies, economic policies, measures changing the physical context, and informational/educational measures (see Gärling & Schuitema, 2007; Steg, 2003). Among the factors suggested by Stern (2000), both contextual factors and psychological factors (i.e., attitudinal factors and habit) may be susceptible to change. Correspondingly, two different solution strategies to a social dilemma have been suggested; structural and individual/psychological solutions (see Komorita & Parks, 1994; Vlek, 1996). Structural solutions, such as, increasing or decreasing the costs for traveling and changes in the physical travel context, aim to change the pay off structure of the dilemma so that defecting will be more costly for the individual while cooperation will be less costly. In contrast, individual/psychological solutions, such as, informational and educational measures, attempt to influence the individuals' perception of the situation and the choices individuals make. A classification based on the extent to which the measure is rewarding or punishing proposed by Steg and Vlek (1997) has also been proven useful. They distinguish between push measures intended to make car use less beneficial and pull measures aimed at improving alternative travel options. In addition, recent technological improvements in cars have highlighted the need to, not only consider measures with the objective to reduce the demand for car use, but also measures that aim to increase the use of less environmentally harmful technology (Gärling, Gärling et al., 2002). In the terms used by Gardner and Stern (2002), the use of more energy-efficient technology may be labeled efficiency behavior while making behavioral changes in order to restrain the use of energy have been referred to as curtailment behavior.

Policy measures aimed at dealing with the problems associated with transportation have been assigned different labels, including transport policy measures (Rienstra, Rietveld, & Verhoef, 1999), transportation control measures (Pendyala, Kitamura, Chen, & Pas, 1997), travel demand management (TDM) measures (Litman, 2003; Loukopoulos, 2005), and mobility management (Litman, 2003). Policy measures may have consequences for the environment, for the safety and accessibility of road-users, and the measures may vary in resource efficiency and financial feasibility (see May, 1991). In this thesis, however, the main focus is on how measures may have positive effects on the environment. The more encompassing term, transport policy measures, is used for all measures that attempt to reduce the negative environmental effects of car use, while the term TDM measures refers to measures that intend to change travel behavior. Overall, a range of transport policy measures may be implemented, including raised taxes on fossil fuel, increased parking prices, car free districts, improved public transport, improved facilities for cyclists and pedestrians, reduced prices on renewable fuel, general information campaigns,

personalized information, and work place travel plans (see Litman, 2003 for an overview of TDM measures).

In order to select appropriate policy measures, both soft factors, for example, levels of awareness of services offered, implementation experiences, and user satisfaction, as well as hard factors, for example, effects on trips, vehicle kilometer, and emission reduction, are important aspects to evaluate (MOST, 2001). Among the soft factors, the measure's acceptability is one key issue important for a successful implementation of transport policy measures. In addition, the behavioral adaptations made in response to transport policy measures is one hard factor necessary to consider if policy measures are to be effective tools for a more pro-environmental travel behavior.

Acceptability of transport policy measures

The public's positive or negative evaluation of transport policy measures has been examined as an attitude toward the policy measure (see Bamberg & Rölle, 2003; Schuitema & Steg, 2008), since the evaluation depends on the expected outcome of the policy (cf. Eagly & Chaiken, 1993). More specifically, Schade (2003) uses the term acceptability when referring to the degree of positive or negative evaluation of a measure that may be implemented in the future. Several researchers highlight the need for public acceptability of measures if they are going to be implemented successfully (see Banister, 2008; Vieira et al., 2007). According to a model proposed by Gärling and Loukopoulos (2007), the acceptability is essential for whether or not the measure will be politically feasible, which in turn is important for the measure's effectiveness.

To understand why certain policy measures are acceptable while others are not, it is important to examine factors important for acceptability. According to Steg and Schuitema (2007), both the attributes of the transport policy measure and the individuals' characteristics are important for acceptability. With regard to the attributes of the policy, Steg et al. (2005, 2006) found that pull measures were perceived to be more acceptable than push measures; using the revenues from push measures within the same domain were more acceptable than putting the revenues into the general public funds (see also Schuitema & Steg, 2008), and; measures targeting efficiency were more acceptable than measures targeting curtailment behavior. Particularly the distinction between push and pull measures has been found to be relevant for acceptability. For example, push measures, such as, strategies raising the cost for using the car, are generally not supported, while pull measures, such as, improved public transport, are supported to a large extent (see e.g., Jakobsson, Fujii, & Gärling 2000; Joireman et al., 2001; Schlag & Schade, 2000). In addition, a few studies have found a rather low level of acceptability

for packages combining push and pull transport policy measures (see Bamberg & Rölle, 2003; Schade & Schlag, 2003).

With regard to the individuals' characteristics, studies have found that background characteristics, such as, age, income, education level, and car use are important for the acceptability of transport policy measures (see e.g., Odeck & Bråthen, 1997, 2008), although attitudinal factors have often been found to be more important (Jaensirisak, Wardman, & May, 2005; Jakobsson et al., 2000; Rienstra, et al., 1999; Schade, 2003). For example, higher problem awareness has been found to be related to a higher level of acceptability (see e.g., Loukopoulos, Jakobsson, Gärling, Schneider, & Fujii, 2005; Poortinga et al., 2004; Steg & Vlek, 1997). In more detail, the multiattribute evaluation model (Samuelson, 1993; Samuelsson & Messick, 1995) stipulates that the evaluation of structural changes to social dilemmas (e.g., structural TDM measures) is based on at least four dimensions: the extent to which the strategy is perceived to be fair or not (i.e., fairness), the extent to which the strategy provides the resource without depleting it (i.e., efficiency), the extent to which the strategy influences freedom of choice (i.e., freedom), and the extent to which the strategy influences the individual (i.e., self-interest). How different strategies are evaluated in relation to these dimensions, and the importance the individual attaches to the different dimensions, are important aspects of the evaluation process. In studies of transport policy measures, perceived fairness (Ittner, Becker, & Kals, 2003; Jakobsson et al., 2000; Joireman et al., 2001), perceived effectiveness (Bamberg & Rölle, 2003; Rienstra et al., 1999; Schade & Schlag, 2003), perceived infringement on freedom to choose (Bamberg & Rölle, 2003; Jakobsson et al., 2000), and perceived effect of the measure on the individual (Joireman et al., 2001; Schade & Schlag, 2003) have been found to be essential for acceptability. Overall, the importance of attitudinal factors demonstrated in these studies points to the need for a more structured use of attitude theory, in particular the NAM/VBN-theory, to explain acceptability.

Behavioral adaptations in response to travel demand management measures

In addition to considering the acceptability of measures, which is a soft factor, there is a need to consider hard factors, such as the extent to which the measure actually reduces the environmental impact of transportation. Since TDM measures should be effective in reducing travel demand, detailed knowledge of the behavioral adaptations (e.g., reduced car use, increased use of alternative travel modes) made in response to different measures is needed for a successful implementation of transport policy measures.

At a general level, both internal and contextual factors are important for pro-environmental behavior (Stern, 2000; see also Komorita & Parks, 1994; Vlek, 1996). A more detailed specification of how TDM measures influence travel choices was proposed by Gärling, Eek et al. (2002). According to their framework, travel choices are determined by three factors: 1) individual factors (e.g., background factors and psychological factors) that influence the setting of adjustment goals which in turn influence travel choices; 2) trip chain attributes (e.g., costs, travel times) that influence both the setting of adjustment goals and travel choices, and; 3) situational factors (e.g., weather, time pressure) that influence travel choices. Different policy measures are expected to influence the trip chain attributes (e.g., increased costs for using the car as a result of increased fuel prices) and adjustment goals (e.g., through information). Furthermore, various psychological models, such as, the TPB and the NAM/VBN-theory may be used to explain the process by which psychological factors influence travel behavior.

The behavioral effects of TDM measures have been examined in a range of different studies. Here only key points are highlighted in relation to a selection of TDM measures, that is, economic incentives and disincentives, changes of the physical context, and informational strategies. With regard to economic TDM measures, results from field experiments have generally showed that when the economic costs of using different travel modes increase or decrease, travel behavior is affected (see e.g., Bamberg & Schmidt, 2001; Heath & Gifford, 2002; Jakobsson, Fujii, & Gärling, 2002). The extent to which travel demand is sensitive to price changes, so called elasticities, provide more information on the effect of different economic measures (see e.g., VTPI, 2008b). Reviews of fuel price elasticities demonstrate that in the short term an increase in fuel price by 10 % causes between 1-3 % car use reduction (see Dargay, 2007; Goodwin, Dargay, & Hanly, 2004; Graham & Glaister, 2002). With regard to bus fare, a 10 % increase has been found to result in a 4 % reduction in patronage in the short term (see Dargay & Hanly, 2002; Paulley et al., 2006; TRL, 2004), although, some studies have demonstrated slightly higher elasticities (Holmgren, 2007). Furthermore, larger behavioral effects in response to cost changes are generally found in the long term. Notably though, the reported elasticities are averages and vary depending on area type (e.g., population density), peak or off-peak, trip purpose, different types of travelers, distance, ticket type, and fare system (Paulley et al., 2006; TRL, 2004). In addition, the elasticities for a bus fare increase may not be equivalent to a fare reduction (Paulley et al., 2006). Physical change measures mainly concern different improvements of the public transport system. For example, service frequency elasticites have been estimated and in one review a 5 % ridership increase was found in response to a 10 % increase in service frequency (Evans, 2004). However, a field study of the introduction of a

circular bus route found that it did not lead to an increase in the use of public transport or reduced car use (Bamberg & Schmidt, 1999). In a meta-analysis of informational measures (e.g., awareness campaigns and personalized information about alternatives), Möser and Bamberg (2008) found a 5 % increase in the trips not made by car. Overall though, a larger effect is generally found for personalized campaigns compared to mass-market information (see e.g., Turnbull & Pratt, 2003).

In addition to examining single measures, studies have also compared and combined different types of measures. In a few studies, push measures, mainly different pricing policies, have been found to influence travel demand to a larger extent than pull measures, primarily improvements of the public transport system (Espino, de Dios Ortúzar, & Román, 2007; O'Fallon, Sullivan, & Hensher, 2004), although there are exceptions (see Schuitema, Steg, & Vlek, 2007). Studies of combinations of transport policy measures have generally shown a larger effect of the policy package compared to the measures assessed individually (Marshall & Banister, 2000; Wegener, 2004 as cited in May, Kelly, & Shepherd, 2006), and several researchers recommend a combination of measures in order to deal with the problems associated with transportation (see Banister, 2008; May et al., 2006; May & Roberts, 1995; Vieira et al., 2007). Overall, the studies of policy measures demonstrate an effect on travel behavior, although the magnitude of the effect is to a large degree influenced by the level of price and service changes. Furthermore, combinations of measures tend to increase the behavioral effects.

The behavioral adaptations car users make in response to TDM measures may be more fully understood by examining how those adaptations are made. In a long time perspective, car users may adopt strategies such as moving closer to the work place (see Cao & Mokhtarian, 2005). However, in the short term, car users are confined to strategies, such as, trip chaining, car pooling, switching travel mode to public transport or cycle/walk, choosing closer locations, and doing the activity at home (see e.g., Gärling, Gärling, & Johansson, 2000). Trip purpose, trip length, and type of TDM measure are important for what kind of car reducing strategy that is chosen, although in general, more efficient car use (i.e., trip chaining) and to some extent changing travel mode have been found to be among the most commonly chosen strategies (see Gärling et al., 2000; Loukopoulos, Jakobsson, Gärling, Meland, & Fujii, 2006; Schuitema et al., 2007). The cost-minimization principle stipulates how car users attempt to reduce car use (Loukopoulos et al., 2006). According to this principle, car users employ the least costly adaptation followed by more costly alternatives if the reduction goal is not achieved or if the reduction goal increases.

CONCEPTUAL MODEL AND RESEARCH OBJECTIVES

The reviewed theories and empirical studies provide the basis for examining important determinants of a pro-environmental travel behavior. At a general level, the analysis of travel behavior as a social dilemma (see e.g., Van Vugt et al., 1996) explains the nature of the difficulties associated with changing travel behavior. In addition, Stern's (2000) distinction between four causal factors provides a general framework for understanding pro-environmental behavior. With specific regard to travel behavior, personal capabilities assessed by sociodemographic factors and personal resources, and contextual factors, specifically the physical and social travel context, are important. In this thesis, however, the main focus is on psychological factors, which in Stern's terminology are labeled attitudinal factors and habits. In addition, car users' reactions toward policy measures is a central theme since transport policy measures are important tools to induce changes in travel behavior.

In more detail, different theoretical perspectives may be used to clarify how psychological factors are related to pro-environmental behavior. In the model proposed by Gärling, Eek et al. (2002), structural TDM measures influence travel adjustment goals by changing trip chain attributes (e.g., the cost for using the car, travel time) which in turn influence the individual's adjustment goals and travel choices. In addition, individual factors (e.g., attitudes) are important for setting an adjustment goal according to the model. Attitude theory, including the inter-attitudinal structure (e.g., Eagly & Chaiken, 1993; Olson & Maio, 2003), and theories explaining the relation between attitudinal factors and behavior, for example the VBN-theory (Stern et al., 1999; see also Stern, 2000) and the TPB (Ajzen, 1988, 1991), are valuable for explaining how individual factors become important for travel behavior as well as how transport policy measures should be evaluated. Furthermore, literature on habit (see e.g., Verplanken & Aarts, 1999) may increase the understanding of habitual travel behavior and explain how attitudinal factors and habit interact in order to predict behavior (see e.g., Triandis, 1980).

Facilitating pro-environmental travel behavior demands knowledge of not only factors important for pro-environmental travel behavior per se, but also of how policy measures would be received by car users (see Banister, 2008; Vieira et al., 2007). In this thesis, three aspects reflecting a readiness to adopt a pro-environmental travel behavior were examined, that is, reduction of car use, acceptability of transport policy measures, and behavioral adaptations in response to TDM measures. Several factors are important for an understanding of a readiness for pro-environmental travel behavior. These factors and the relations among them are summarized in Figure 1. Important psychological factors are general attitudinal factors, as suggested by the

normative and reasoned decision frameworks, as well as habits. Moreover, when examining consequences of policy measures there is also a need to consider how car users evaluate the measures, that is, beliefs about the examined policy measure. Dimensions important for responses toward measures are, for example, perceived fairness, perceived effectiveness, and perceived personal impact of the measure. General psychological factors may have a direct influence on the readiness for pro-environmental travel behavior and/or an indirect influence through beliefs about transport policy measures.

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┌─────────────────────────────────────────────────┐
│          General psychological factors          │
│        General attitudinal factors (Study I-IV) │
│                Habits (Study I)                 │
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┌─────────────────────────────────────────────────┐
│     Beliefs about transport policy measures     │
│        Perception of fairness (Study II, III)   │
│      Perception of effectiveness (Study II, III)│
│     Perception of personal impact (Study II, IV)│
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┌─────────────────────────────────────────────────┐
│   Readiness for pro-environmental travel behavior│
│            Car use reduction (Study I)          │
│   Acceptability of transport policy measures (Study II, III)│
│  Behavioral adaptations in response to TDM measures (Study IV)│
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Figure 1. Model of psychological determinants of a readiness to adopt a pro-environmental travel behavior.

In the present thesis, various parts of this model have been studied. The reduction of car use was examined in Study I. In Study II and III, the acceptability of transport policy measures was analyzed. Moreover, the focus of Study IV was on behavioral adaptations in response to TDM measures. In all four studies, the importance of different general psychological factors was

analyzed. In Study I, both a general attitudinal factor and habit were examined, while in Study II, III, and IV general attitudinal factors and beliefs about transport policy measures were studied. More specifically, the aim of Study I was to examine the interruption of habitual car use and to analyze the importance of one attitudinal factor, that is, moral motivation, for reducing car use. In Study II, the focus was on examining factors important for the acceptability of different TDM measures. More specifically, the aim was to analyze general attitudinal factors (i.e., normative factors) and various beliefs about TDM measures (i.e., perception of fairness, effectiveness, and impact on the car users' own car use, and on the car users' freedom to choose travel mode) as determinants of acceptability. Following up on the results from Study II, the purpose of Study III was to analyze the acceptability of single and combined transport policy measures. General attitudinal factors (i.e., normative factors) and various beliefs about transport policy measures (i.e., perception of fairness and effectiveness) were examined as predictors of acceptability. The aim of Study IV was to examine the behavioral adaptations made in response to different TDM measures. In particular, the extent to which car users expected to reduce their car use in response to TDM measures and how they would achieve this reduction was examined. In addition, the importance of background factors, general attitudinal factors (i.e., personal norm and general intention), and the beliefs about TDM measures (i.e., perception of personal impact of the measure) for the expected car use reduction were analyzed.

Hence, the three overall aims of the thesis were as follows: 1) to examine the interruption of habitual car use and analyze the importance of moral motivation for car use reduction; 2) to examine the importance of normative factors and policy specific beliefs for the acceptability of transport policy measures, and; 3) to analyze behavioral adaptations, that is, the expected car use reduction, in response to different TDM measures, and to examine factors important for the expected car use reduction.

Different types of transport policy measures were examined in this thesis, that is, a general information campaign, raised tax on fossil fuel, improved public transport, and subsidies of renewable fuel, as well as two packages, that is, raised tax on fossil fuel combined with improved public transport and raised tax on fossil fuel combined with subsidies of renewable fuel. Table 1 provides an overview of the examined measures using different categorization schemes. The acceptability of the four single and the two combined measures were examined in Study II and/or III. In Study IV, the estimated behavioral effects of two structural TDM measures (i.e., raised tax on fossil fuel and improved public transport), separately, and combined into a package were examined.

Table 1. Classifications of transport policy measures examined in this thesis.

Transport policy measures	Type of measure [a]	Structural vs. psychological measures [b]	Push vs. pull measures [c]	Measures targeting efficiency vs. curtailment behaviors [d]	Study in which the measure is examined
Information campaign	Information/ education measure	Psychological	Pull	Curtailment	Study II
Raised tax on fossil fuel	Economic policy	Structural	Push	Curtailment	Study II, III, and IV
Improved public transport	Economic and physical change policy	Structural	Pull	Curtailment	Study II, III, and IV
Subsidies for renewable fuel	Economic policy	Structural	Pull	Efficiency	Study III
Raised tax on fossil fuel and improved public transport	Economic and physical change policy	Structural	Push and pull	Curtailment	Study III and IV
Raised tax on fossil fuel and a subsidy of renewable fuel	Economic policy	Structural	Push and pull	Efficiency	Study III

[a] Different types of measures (see Gärling & Schuitema, 2007; Steg, 2003).
[b] Structural vs. psychological measures as solutions to social dilemmas (see Vlek, 1996).
[c] Punishing, push, vs. rewarding, pull, TDM measures (see Steg & Vlek, 1997).
[d] Measures targeting different types of behaviors; efficiency vs. curtailment behaviors (see Gardner & Stern, 2002).

OVERVIEW OF STUDIES

Study I

Eriksson, L., Garvill, J., & Nordlund, A. M. (2008). Interrupting habitual car use: The importance of car habit strength and moral motivation for personal car use reduction. *Transportation Research Part F, Traffic Psychology and Behaviour, 11*, 10-23.

Changing travel behavior requires that the individual deliberately consider how the change will be carried out. For this reason, habitual car use is a barrier for change. Several studies have shown an interaction between habit and deliberate processing indicating that when the habit is strong the effects of intention, attitude, and norms on behavior are weaker (see Klöckner & Matthies, 2004; Klöckner et al., 2003; Staats et al., 2004; Triandis, 1980; Verplanken et al., 1998; Verplanken et al., 1994). Furthermore, if a change is going to be realized, it is not sufficient to interrupt the habitual car use since the car user also needs to be motivated to change travel behavior.

In Study I, an intervention aiming to encourage a deliberate consideration to reduce car use was used to interrupt habitual car use. Subsequently, the importance of car habit strength and moral motivation (i.e., personal norm) for a reduction in car use was examined. Based on previous research, three hypotheses were formulated. The first hypothesis concerned the extent to which the intervention was successful in interrupting the habitual car use. It stipulated that the association between car habit strength and car use would weaken, while at the same time the association between personal norm and car use would strengthen as a result of the intervention. Hypothesis 2 stated that no change in car habit strength and personal norm would take place. Since habits develop over time, the short duration of the study made it unlikely for a change in habit strength to occur. In addition, the intervention aimed at interrupting habit and no attempt was made to strengthen the motivation to reduce car use. The third hypothesis stipulated a larger car use reduction for individuals with a strong car habit and a strong personal norm. The reason for this expectation was that the intervention would only influence those with a strong car habit and only car users with a motivation to reduce car use would actually attempt to reduce car use.

The hypotheses were tested in a field experiment in which 71 car users in two municipalities in Sweden (Piteå and Huddinge) were recruited by telephone to either an experimental group ($n = 27$) or a control group ($n = 44$). The car users in both groups filled in a pre-intervention questionnaire, followed by a pre-intervention car diary for one week. After the intervention in the experimental group, both groups filled in a post-intervention car diary for

one week and a post-intervention questionnaire. In the pre-intervention questionnaire, background characteristics, car habit strength, and personal norm were assessed and in the post-intervention questionnaire car habit strength and personal norm were measured for the second time. Car habit strength was assessed with the 12 items in the self-report index of habit strength (SRHI) (Verplanken, Myrbakk, & Rudi, 2005) (pre-intervention α = .94 and post-intervention α = .94) and personal norm was assessed by a single item. In the car diaries pre- and post intervention, the number of car trips were recorded as driver and as passenger and both the number of trips as driver and in total (driver and passenger) were used as measures of car use. The intervention in the experimental group was intended to make participants consider a car use reduction and form implementation intentions (see Gollwitzer, 1993) for a new travel behavior. During a home-visit, the participants filled in a prospective car diary including the car trips they were planning to make the following week, and subsequently they considered the possibility to reduce car use on each trip.

Results showed that the experimental and control groups did not differ significantly with regard to personal norm, car habit strength, or car use prior to the intervention. In line with Hypothesis 1, personal norm but not car habit strength was more strongly related to car use after the intervention compared to before the intervention in the experimental group. Furthermore, as stipulated by Hypothesis 2, the intervention did not influence car habit strength and personal norm. One main objective of Study I was to examine the importance of car habit strength and personal norm for car use reduction. In line with Hypothesis 3, regression analyses revealed significant three-way interactions (intervention x car habit strength x personal norm) for car use as driver (R^2 = .16) and total car use (R^2 = .18) (see Figure 2). The results indicated that particularly individuals with a strong car habit and a strong personal norm reduced their car use as a result of the intervention. Overall, the results demonstrated the need to unblock the effect of a strong car use habit on car use, making it possible for motivational factors, such as moral motivation, to influence travel behavior (cf. Klöckner & Matthies, 2004).
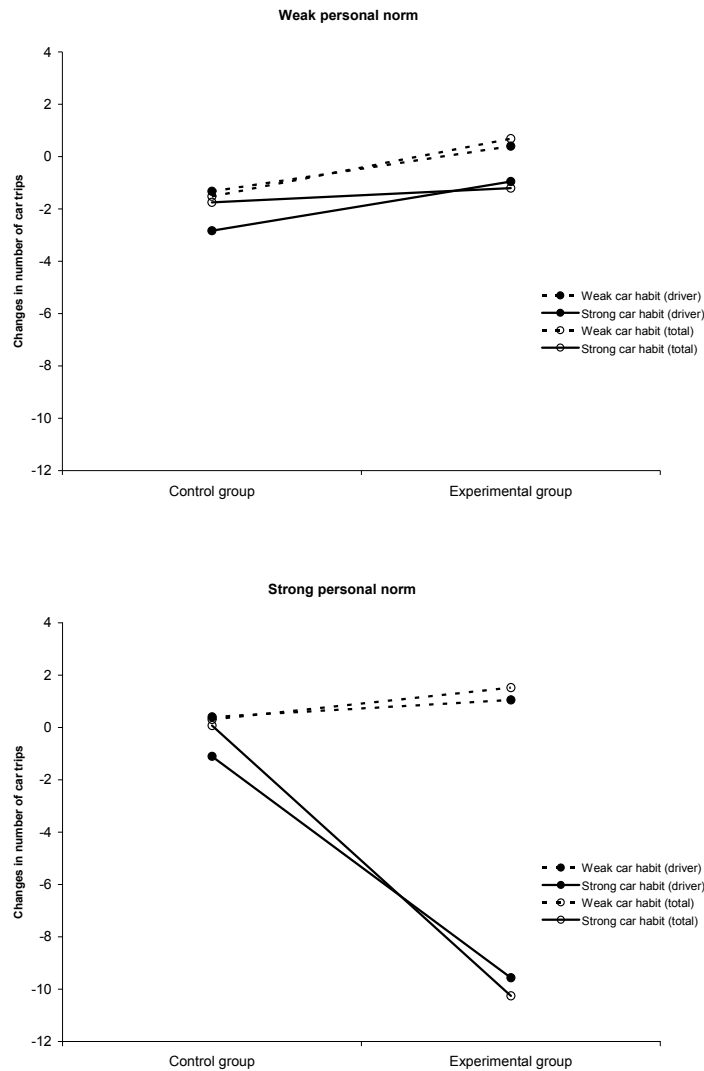
Figure 2. The three-way interaction: Changes in number of car trips as driver and total car use as a function of intervention, car habit strength, and personal norm. Upper panel: weak personal norm. Lower panel: strong personal norm.

Study II

Since the acceptability of transport policy measures is important for political feasibility and the effectiveness of the measure (see Gärling & Loukopoulos, 2007; Schade, 2003), it is important to know why some measures are accepted while others are not. For example, while acceptability tends to be high for pull measures (see Joireman et al., 2001; Rienstra et al., 1999), push measures are often perceived to be unacceptable (see Rienstra et al., 1999; Steg & Vlek, 1997). Previously, general environmental beliefs have been found to be important for the acceptability of TDM measures (Steg & Vlek, 1997). In more detail, the VBN-theory (Stern et al., 1999) stipulates the relation between different general environmental beliefs. Furthermore, policy specific beliefs have been found to determine whether or not a TDM measure is perceived to be acceptable (Schade & Schlag, 2003; Steg, 2003). The aim of Study II was to test a two-part hierarchical model of factors important for the acceptability of TDM measures (see Figure 3). In the first part of the model, pro-environmental orientation, problem awareness, and personal norm, are related to a willingness to reduce car use. These general environmental beliefs are in the second part of the model linked to different policy specific beliefs, that is, the extent to which the TDM measure is expected to influence freedom to choose travel mode, own reduction of car use, perceived effectiveness, perceived fairness, and subsequently acceptability. The hypothesized model was tested in relation to three TDM measures: improved public transport (PUB), an information campaign (INFO), and increased tax on fuel (TAX).

GENERAL ENVIRONMENTAL BELIEFS   TDM SPECIFIC BELIEFS
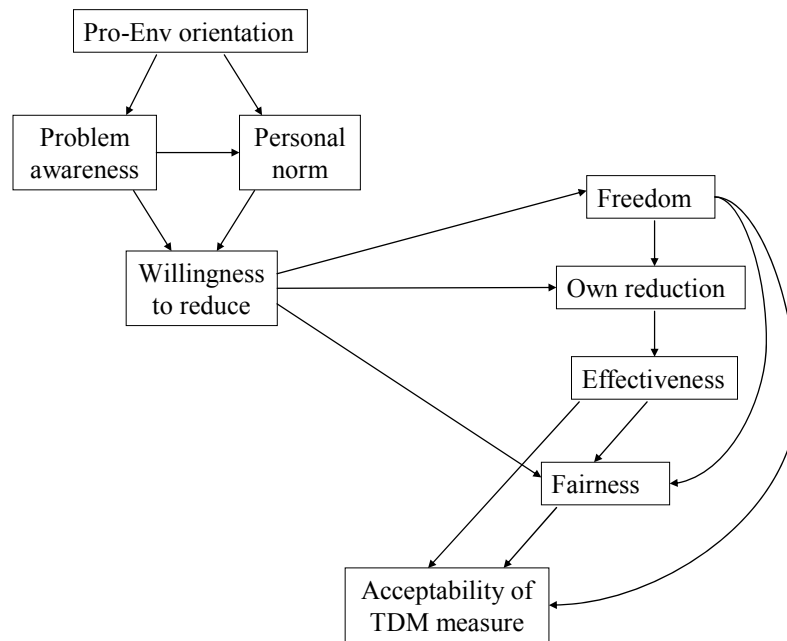
Figure 3. Proposed model of factors predicting acceptability of TDM measures.

A questionnaire with items for background characteristics, general environmental beliefs, and policy specific beliefs was sent to a randomly selected sample of 4000 citizens in four municipalities in Sweden (Piteå, Huddinge, Göteborg, and Växjö). The response rate was 31 % and the model was tested on the group of car users (N = 922). Pro-environmental orientation was measured with the 15 items in the New Ecological Paradigm (NEP) scale (α = .77) (Dunlap et al., 2000). Problem awareness was assessed with five items expressing the perceived threat associated with air pollution from private car use globally (2 items), locally (2 items), and personally (1 item) (α = .95). Personal norm and willingness to reduce car use was measured with single items. The three TDM measures were described as scenarios and evaluated on different dimensions: the extent to which the measures were perceived to be fair (i.e., fairness), the amount of the current driving distance they expected other car users to reduce their car use if the measures were implemented (i.e., effectiveness), the amount of the current driving distance they expected they would reduce their car use if the measures were implemented (i.e., own reduction), the extent to which the measures

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influenced freedom to choose travel mode (i.e., freedom), and finally, the extent to which the respondent was in favor of or against the measures (i.e., acceptability).

Descriptive analyses showed that improved public transport was perceived to be acceptable, the information campaign was perceived as neither acceptable nor unacceptable, and the raised tax was perceived to be unacceptable. To examine the predictors of acceptability, the model evaluation was made in two steps using AMOS 5.0 (Arbuckle & Wothke, 1999). The model was first tested and modified for the three TDM measures on a randomly selected sub-sample (n = 462). The models were then validated on the remaining sub-sample (n = 460). After minor modifications, the goodness-of-fit measures of the proposed model were acceptable and the explained variance of acceptability was approximately 50 % for the three TDM measures. Overall, pro-environmental orientation and problem awareness were related to personal norm which in turn was associated with a willingness to reduce car use. In general, the TDM specific beliefs mediated between the general environmental beliefs and acceptability with particularly strong effects of fairness on acceptability. However, personal norm was found to be directly related to the acceptability of TAX and INFO, while problem awareness was found to be directly associated with the acceptability of PUB. Hence, the present study confirms that general environmental beliefs, as stipulated by the VBN-theory, may be seen as a basis for evaluation of TDM measures, and different TDM specific beliefs were found to be important for acceptability.

Study III

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To overcome difficulties associated with implementing push measures, several researchers advocate a combination of supportive measures, such as, improved public transport together with pricing measures (e.g., Gärling & Schuitema, 2007; May et al., 2006; May & Roberts, 1995; Steg, 2003). In Study III, factors important for the acceptability of single as well as packages of transport policy measures were examined. A model including general environmental beliefs and policy specific beliefs as predictors of acceptability comparable to the model tested in Study II was proposed. According to the model, pro-environmental orientation, problem awareness, personal norm, and willingness to reduce the negative environmental effects of car use are linked to policy specific beliefs, namely perceived effectiveness, perceived fairness, and subsequently acceptability. In addition, we examined whether

problem awareness or personal norm had a direct association with acceptability (see Figure 4). The proposed model was tested in relation to three single transport policy measures: raised tax on fossil fuel (TAX), improved public transport (PUB), and subsidies of renewable fuel (RENEW), as well as two policy packages: raised tax on fossil fuel used to improve public transport (TAX and PUB), and raised tax on fossil fuel used to subsidize renewable fuel (TAX and RENEW). Based on the results from Study II, we expected a direct relation between problem awareness and acceptability for the pull measures (i.e., model A) and a direct relation between personal norm and acceptability for the push measure (i.e., model B). If the packages, including one push and one pull measure, were perceived to be effective, fair and acceptable (i.e., like a pull measure), we expected a direct relation between problem awareness and acceptability. However, if the packages were perceived to be ineffective, unfair, and unacceptable (i.e., like a push measure), we anticipated a direct association between personal norm and acceptability.
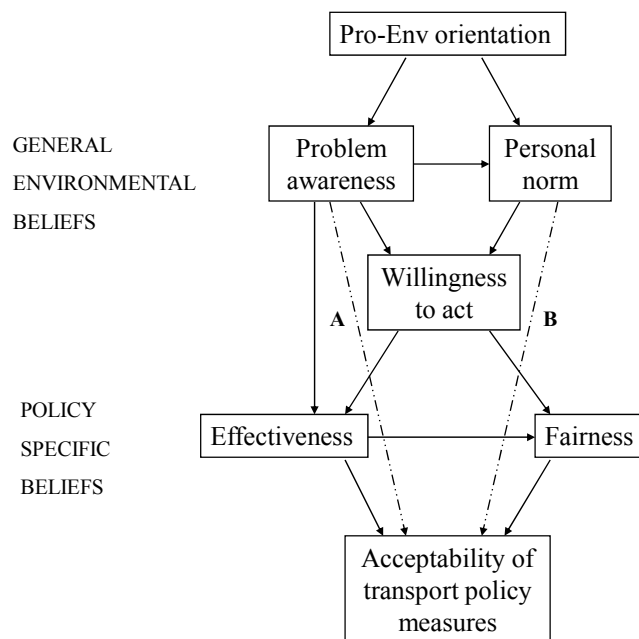

Figure 4. Proposed model of factors predicting acceptability of transport policy measures (the original model, model A, and model B).

A questionnaire was sent to a randomly selected sample of 2800 citizens in four municipalities in Sweden (Piteå, Huddinge, Göteborg, and Växjö) and the response rate was 30 %. The model was tested on the group of car users ($N = 616$) who had answered items concerning background characteristics, general environmental beliefs, and policy specific beliefs. The 15 items in the NEP-scale (Dunlap et al., 2000) were used to assess pro-environmental orientation ($α = .76$) and problem awareness was measured by means of four items expressing the perceived threat associated with air pollution from private car use globally, nationally, locally, and personally ($α = .94$). Personal norm to reduce the negative effect of personal car use was assessed with two items ($α = .83$) and willingness to act was measured with one item. The transport policy measures were described as scenarios and evaluated with regard to the extent to which the measures were perceived to be fair (i.e., fairness), the extent to which the measures were perceived to be effective and leading to an improved environment (i.e., effectiveness), and the extent to which the respondent was in favor of or against the implementation of the measures (i.e., acceptability).

Analyses showed that the pull measures were perceived to be acceptable, while the push measure was perceived to be unacceptable. The packages including one pull and one push measure were perceived as a mix of the included measures although more similar to the push measure (i.e., rather ineffective, unfair, and unacceptable). With the aim of examining predictors of acceptability, the original model, model A, and model B were evaluated using AMOS 7.0 (Arbuckle, 2003). The results demonstrated that both model A and model B were better compared to the original model except for the package including TAX and RENEW. However, different goodness-of-fit measures indicated that for the pull measures, model A was slightly better, while for the push measure and for the two packages, model B displayed a better fit. The explained variance of acceptability was between 58 and 70 % for the examined transport policy measures. Hence, in line with Study II, the results showed that general environmental beliefs and policy specific beliefs were important for the acceptability of different single and combined transport policy measures. In addition, personal norm was found to be particularly important for the acceptability of the push measures and the packages combining push and pull measures, whereas for the acceptability of pull measures, problem awareness was more important.

Study IV

Since TDM measures intend to change travel behavior in a more pro-environmental direction, it is important to examine the behavioral effects of these measures. In previous studies, minor behavioral effects of structural push and pull measures have been demonstrated (see Schuitema et al., 2007). Furthermore, combinations of different measures are often thought to lead to larger behavioral effects (see Marshall & Banister, 2000), although there is a lack of experimental studies examining the effect of packages of push and pull measures compared to individual measures. For an understanding of the behavioral adaptations in response to TDM measures, it is also important to know how the reduction would be achieved, that is, which car reducing strategies are employed, and factors that are important for changing travel behavior.

In Study IV, the expected car use reduction in response to three structural TDM measures was examined in a scenario based study in which three groups of car users evaluated one TDM measure each. The examined measures were: improved public transport (PUB), raised tax on fossil fuel (TAX), and a combination of the two measures (TAXPUB). The study had three aims. First, the expected car use reduction in response to the three measures was compared. Based on previous studies, we expected the combined measure TAXPUB to lead to a larger expected reduction compared to the measures evaluated individually. However, no difference between the individual measures was anticipated. Second, the car reducing strategies used to achieve this reduction were examined. Although, different strategies tend to be preferred depending on, for example, trip purpose, trip length, and examined TDM measure, as previous studies have demonstrated, we expected that more efficient car use (i.e., trip chaining) and change of travel mode would be the most commonly chosen strategies. Third, factors important for an expected car use reduction in response to different TDM measures were analyzed. Based on previous studies, we examined the importance of background factors (i.e., gender, age, income, and number of cars in the household), internal motivational factors (i.e., personal norm to reduce car use and intention to reduce car use), and perceived personal impact of the TDM measure (i.e., impact of raised cost for car use in response to TAX and TAXPUB and impact of improved public transport in response to PUB and TAXPUB) for expected car use reduction. We anticipated that, in particular, car users' internal motivation to reduce car use and the perceived personal impact of the TDM

measure would be important for how much car users expected to reduce their car use in response to the TDM measures.

The study was conducted in two steps. First, a pre-questionnaire was sent to a randomly selected sample of car owners in one municipality in Sweden (Växjö). Second, those who had answered the pre-questionnaire and agreed to participate were randomly assigned to three groups and received a questionnaire concerning one TDM measure each. In total, 274 car owners filled in both questionnaires (PUB n = 96, TAX n = 92, TAXPUB n = 86). The pre-questionnaire included questions concerning background factors and internal motivational factors. Personal norm to reduce car use and intention to reduce car use were assessed with three items each and the index variables displayed a reasonable high reliability (α = .75 and α = .79, respectively). In the second questionnaire, after the detailed description of the TDM measure, the respondents in the groups evaluating TAX and TAXPUB stated the extent to which the raised cost for using the car would force them to reduce other expenses in order to afford a continued car use (1 item) and in the groups evaluating PUB and TAXPUB the respondents stated the extent to which the improved public transport would facilitate the use of public transport for them (1 item). Subsequently, the respondents filled in a retrospective car diary where they considered whether they would reduce car use on the trips they had made the previous week. In addition, an estimation of the annual expected car use reduction was stated in percentage of current car use. A measure of expected car use reduction was calculated based on both these sources and the reliability of the resulting composite measure was reasonable (α = .69). In the car diary, the groups evaluating TAX and TAXPUB stated a car reducing strategy for each of the trips they expected to reduce car use. In addition, these groups stated how likely it would be that they chose each of twelve different strategies (e.g., trip chaining, changing travel mode to cycle/walk or to public transport) on an annual basis. In order to control for differences between the groups, age and number of cars were included as covariates when the groups were compared.

Results showed no significant differences between the groups with regard to intention, personal norm, or car use measured in the pre-questionnaire. In relation to the first aim, comparisons of expected car use reduction in response to the examined TDM measures showed that the combined measure, TAXPUB led to a larger estimated car use reduction compared to the individual measures (28 % reduction, compared to 19 % for PUB and 21 % for TAX). Although the exact level of estimated reduction should be interpreted with caution, the results indicate a need for the implementation of packages of TDM measures rather than individual measures. Furthermore, as anticipated, more efficient car use (i.e., trip chaining) and changing travel mode were the most commonly chosen car use reduction strategies. In the car diary (where

trip chaining was not an option), changing travel mode was chosen for approximately 80 % of the trips where a change was anticipated in response to TAX and TAXPUB. However, in response to TAX, cycle/walk was mainly chosen on short trips and in response to TAXPUB public transport was chosen on both shorter and longer trips. On an annual basis, the most likely car reducing strategies in response to TAX and TAXPUB were trip chaining and changing travel mode, followed by car pooling, and the least likely strategies were changing destination and refraining from traveling. Differences between the groups were found for two of the strategies. To refrain from traveling was more likely in the group evaluating TAX compared to TAXPUB and changing to public transport was more likely in the group evaluating TAXPUB compared to TAX.

With regard to the third aim, hierarchical regression analyses were performed in order to analyze factors important for changing travel behavior in response to the three TDM measures with personal norm and intention entered into separate analyses. As expected, results showed that after including the psychological variables, background factors were less important. Personal norm was a significant predictor of expected car use reduction in response to all TDM measures, while the general intention to reduce car use was only important for expected car use reduction in response to TAX. For all TDM measures, the perceived impact of the measure was important, particularly the perception of the facilitating effect of improved public transport in the groups evaluating PUB and TAXPUB. After the inclusion of all variables the explained variance was approximately 55 % in response to TAXPUB regardless of whether personal norm or intention was analyzed. With regard to the single measures, entering personal norm into the analyses resulted in an explained variance of 33 % in response to PUB and 17 % in response to TAX, whereas the inclusion of intention resulted in an explained variance of about 30 % in response to both PUB and TAX.

DISCUSSION

Even though car use has many advantages for the individual car user (e.g., flexibility, speed, and comfort), the environmental problems associated with personal car use makes it necessary to change households' travel behavior. One way of dealing with this conflict between the individual's and the collective's interest is to implement transport policy measures intended to influence contextual and/or psychological factors. Because of the complexities associated with attempting to change travel behavior, different aspects of a readiness for pro-environmental travel behavior were studied in this thesis.

Reducing car use (Study I) and assessing policy measures that may be implemented in the future with regard to acceptability (Study II and III) or behavioral adaptations (Study IV) are very different expressions of a pro-environmental stance. The present thesis studied these different expressions, guided by a conceptual model (see Figure 1). This approach made it possible to cover a broad range of issues important for achieving a more pro-environmental travel behavior.

Important determinants of a readiness for pro-environmental travel behavior

In this thesis, the first aim was to study the interplay between habit and moral motivation for reducing car use. Even though the focus was limited to behavioral change in the short term, Study I highlights the importance of both interrupting habitual car use and the need for a strong moral motivation in order for car use reduction to occur. Adding to previous studies (see e.g., Matthies et al., 2006), moral motivation without external endorsement was found to be important for car use reduction after a car use habit had been interrupted by means of a deliberation intervention. As a result of the intervention, mainly car users with a strong car use habit initially and a strong moral motivation reduced their car use.

The second aim of this thesis was to examine the importance of normative factors and beliefs about transport policy measures for the acceptability of different policy measures. Although one should be careful in drawing definite conclusions about the causal order of relations since the studies were correlational, both Study II and III support normative factors as a basis for the acceptability of policy measures. In addition, the results clearly demonstrated that perceived fairness, perceived effectiveness, and to some extent perceived personal impact were significantly related to acceptability. Furthermore, personal norm was found to be particularly important for the acceptability of push measures, packages of push and pull measures, and a general information campaign, whereas problem awareness was specifically important for the acceptability of different structural pull measures. Although previous studies have demonstrated the importance of, for example, problem awareness (Steg & Vlek, 1997), and some policy specific beliefs, such as, perceived fairness, effectiveness, and infringement on freedom to choose travel mode (Bamberg & Rölle, 2003; Jakobsson et al., 2000), the present studies provide a more structured examination of attitudinal factors important for acceptability.

The third aim of this thesis was to study the behavioral adaptations in response to different TDM measures. In Study IV, a package of structural push and pull TDM measures was found to lead to a larger estimated

behavioral effect compared to the measures examined individually. In order to achieve this reduction, the most commonly chosen car use reduction strategies were more efficient car use and changing travel mode. Even though the specific level of reduction should be interpreted with caution since it may be an overestimate, the present study adds to previous studies (see e.g., Marshall & Banister, 2000) in offering experimental evidence of the expected behavioral effects of a policy package compared to individual measures. In Study IV, factors important for expected car use reduction in response to TDM measures were also examined. The car users' internal motivation to reduce car use, such as personal norm, was found to be important for the expected reduction. In addition, the evaluation of how the TDM measure would influence the individual car user was found to play a significant role in explaining expected car use reduction, more so in response to the policies containing a pull measure.

Overall, this thesis clearly demonstrates the importance of considering both general psychological factors and beliefs about transport policy measures in order to understand a readiness for pro-environmental travel behavior.

General psychological factors

Further support for referring to a norm activation process to explain different aspects of a readiness for pro-environmental travel behavior was provided by the studies in this thesis. Hence, perceiving an internal pressure to act for the environment is an important internal motivator for reducing car use, accepting transport policy measures, specifically push measures restraining car use, and expected car use reduction in response to different TDM measures. Consequently, it may be important to build up, activate, and stabilize personal norms in order to facilitate a pro-environmental travel behavior (see Matthies & Blöbaum, 2007). A more general motivation, an intention to reduce car use, was only examined in relation to expected car use reduction in response to TDM measures. It was found to be important for expected car use reduction in response to raised tax on fossil fuel but not in response to improved public transport or a package of raised tax and improved public transport.

The relation between different motives (e.g., to reduce car use for economic, health, or environmental reasons) and changes toward a more pro-environmental travel behavior needs to be examined further. For example, morally based environmental motives may be particularly effective in facilitating a change in travel behavior. Although, in line with the present thesis, a policy measure, such as, raised tax on fossil fuel, may trigger a larger car use reduction if the individual holds a general intention to reduce car use rather than a morally based environmental motivation. In addition, different

types of motivation may be important to consider. For example, intrinsic motivation, that is, finding the activity enjoyable or interesting in itself (see Deci & Ryan, 2000), also labeled an integrated norm (see Thøgersen, 2006a), may be an additional type of motivation important for pro-environmental travel, for example when deciding to use the bicycle to work on a sunny day. However, when pro-environmental travel behavior is experienced as a sacrifice by the individual, for example when using an inferior public transport, there is still a need for personal and social norms to encourage such behavior. Overall, considering different types of motivation may improve the understanding of the underlying reasons for pro-environmental travel behavior.

Although a motivation to change travel behavior is important for a behavioral change to occur, the car user also needs to be aware of how this reduction may be achieved, that is, the car user needs strategic or intellectual knowledge. Furthermore, changing a difficult behavior often involves overcoming various volitional problems, such as, problems with getting started and difficulties with continuing to strive for a reduction despite distractions (see Gollwitzer, 1996). For these reasons there is often a need to plan where, when, and how the behavior will be performed if the motivation to change travel behavior is going to result in an actual behavioral change (Gollwitzer, 1993). The benefit of planning a changed travel behavior when a car use habit had been interrupted and the car user was morally motivated to reduce car use was demonstrated in this thesis.

Clearly, there is a need to consider various motivational, intellectual, volitional, and habitual factors when attempting to change car users' travel behavior. Process models of behavioral change include, for example the model of action phases (Gollwitzer, 1990; Heckhausen & Gollwitzer, 1987), the transtheoretical model of change (Prochaska & DiClemente, 1983, 1984), and changing habitual behavior (Dahlstand & Biel, 1997). These models provide a more detailed description of the stages of behavioral change and specify when different factors are important, for example when motivational or volitional issues are more important. Even though the usefulness of these models with regard to travel behavior is still uncertain (see Bamberg, 2007) they may increase understanding of the change process. In addition, the models point to the importance of considering the evaluation after a new behavior has been tested for the first time. If a pro-environmental travel behavior is going to be maintained in the future the individual needs to have an overall positive evaluation of the behavior.

Beliefs about transport policy measures

Since travel behavior is performed in a physical and social context, changes in travel behavior may be difficult even with a strong motivation to reduce car use. For example, the possibilities for using public transport may be poor and expectations from family and friends may encourage the use of private car. As suggested by several researchers (see e.g., Diekmann & Preisendörfer, 2003; Guagnano et al., 1995), the context may establish boundaries for when attitudinal factors influence travel behavior. However, different transport policy measures may be used to remove various barriers hindering pro-environmental travel behavior. For example, public transport may be improved to increase the possibilities for traveling more pro-environmentally, and the cost for using the car may be increased in order to interrupt habitual car use (see Fujii & Gärling, 2007) or to enhance the motivation to reduce car use (Jakobsson et al., 2002).

The results in this thesis demonstrate the importance of car users' evaluation of policy measures in order to understand the reactions toward policy. For example, if car users fail to see how a pull measure would be beneficial for them, the consequence may be a continued use of the car, as was shown in this thesis. In addition, habitual car users may not even notice the implementation of a pull measure (see Fujii & Gärling, 2007). On the other hand, push measures, such as different pricing strategies, are likely to be noticed if they are large enough. However, as was demonstrated in the present thesis, push measures are generally perceived to be unfair, to some extent ineffective, and unacceptable, making them difficult to implement. The results indicate that reasons for why policy measures are ineffective and/or unacceptable may be found by examining car user's policy specific beliefs. Although particularly the relation between car users' evaluation of policies and their behavioral reactions needs to be examined further, this thesis demonstrates that combining push and pull measures may increase the acceptability of push measures to some extent as well as increase the behavioral effects compared to the individual measures. Since the effects of different measures may vary depending on, for example, the characteristics of the measure, the area type, and the travelers affected (Anable, 2005; Paulley et al., 2006), future studies need to examine the effects of different combinations of measures (e.g., different pricing measures combined with different changes of the physical context) in different contexts (e.g., small, medium, and large towns), and in relation to different groups of travelers (e.g., those who sometimes travel pro-environmentally and those who always go by car).

Methodological considerations

To examine different aspects of a readiness for a pro-environmental travel behavior in this thesis, different methods and designs were used. Cross-sectional questionnaires with a large number of respondents were complemented by field experiments carried out in smaller groups of car users. The concepts of interest were assessed with conventional measures often employed in previous studies. Although the reliability of some single-item measures may be questioned, the measures seemed to have captured the intended concepts and expected relations with other concepts were found. In each of the four studies, the respondents were recruited from randomly selected samples of citizens or car users. However, the high level of attrition makes it difficult to generalize the results to the population of car users in the examined municipalities, even though no large discrepancies between the samples and the attrition groups were found when the attrition was analyzed in more detail. When assessing the validity of the results in this thesis it is also important to consider the possibility of social desirability biases (see e.g., Krosnick, 1999). It is for example possible that respondents in the questionnaires exaggerated the extent to which they were pro-environmental in order to comply with what they perceived to be socially desirable. The large attrition and possible effects of social desirability point toward the need to be cautious about drawing far-reaching conclusions based on the descriptive analyses reported in this thesis. However, the focus has been on relations between relevant factors which make the mentioned limitations less challenging to the main findings. Furthermore, the results in this thesis are in line with previous studies, and tend to corroborate and extend the results found in studies carried out in Sweden and in other western countries.

CONCLUSIONS

In order to achieve a change in travel behavior, there is a need to consider the complex interplay of factors important for pro-environmental travel behavior. The present thesis demonstrates the usefulness of attitude and attitude-behavior theories, as well as the interplay between deliberate attitudinal factors and habits, for an understanding of pro-environmental travel behavior. More specifically, with regard to the three aims of the thesis, the following conclusions can be drawn. First, the interplay between car habit strength and moral motivation in order to explain car use reduction as a result of a deliberation intervention was demonstrated. Car users with a strong car use habit and a strong moral motivation reduced their car use the most.

Second, normative factors, such as, problem awareness and personal norm, in combination with policy specific beliefs, such as, perceived fairness, perceived effectiveness, and perceived personal impact, were found to be important for the acceptability of transport policy measures. In addition, personal norm was found to be particularly important for the acceptability of push measures and packages containing a push and a pull measure, while problem awareness was particularly important for the acceptability of pull measures. Third, a package containing a push measure and a pull measure was expected to lead to a larger car use reduction compared to the individual measures. Using the car more efficiently and changing travel behavior, were the most commonly chosen car reducing strategies. Moreover, both internal motivational factors, such as personal norm, and the perceived personal impact of the measure, were found to be important for the expected car use reduction in response to different TDM measures.

IMPLICATIONS

The results presented in this thesis have some theoretical implications worth noting. In contrast to researchers disregarding the usefulness of the habit concept (see Ajzen, 2002), the present thesis adds to the perspective where deliberate and habitual factors are expected to interact in order to predict behavior. In line with the model presented by Klöckner and Matthies (2004), the interaction between habit and moral motivation in predicting car use reduction was supported. In addition, this thesis connects studies within environmental psychology and transportation research with regard to the acceptability of policy measures. Previously, studies have often examined either the importance of values, beliefs, and norms for the acceptability of environmental policy measures (see e.g., Stern, Dietz, & Guagnano, 1995) or the importance of policy specific beliefs for the acceptability of transport policy measures (see e.g., Schade & Schlag, 2003). The present thesis provides a more coherent view of how the relation between general environmental beliefs and policy specific beliefs may jointly be important for acceptability. Finally, the present thesis attempts to improve the understanding of the behavioral reactions in response to different transport policy measures. The results point toward the usefulness of drawing on general factors important for travel behavior, such as, individual factors and trip chain attributes (cf. Gärling, Eek et al., 2002) as well as, more specifically attitudinal theory, in order to understand behavioral responses to TDM measures.

Moreover, the results in the present thesis may also have implications for practitioners. In dealing with the negative environmental effects of

transportation, researchers generally agree that different broad strategies, such as, land management, improved technology, and TDM measures are needed (see Chapman, 2007; EEA, 2007; Litman, 2008). One important implication of this thesis is that it is valuable to combine structural push and pull measures in order to remove barriers for the implementation of transport policy measures and to increase the behavioral effects of measures. In addition, different psychological measures should be implemented in order to complement the structural measures. The packages of transport policy measures need to be designed carefully, for example with personalized rather than general information, and in combination with appropriate structural push and pull measures. In addition, the measures need to be adjusted to fit the context and a great deal of consideration should be given to the implementation process.

The many difficulties associated with changing travel behavior call for continued research within this area. It would for example be valuable to approach the topic from a broader perspective. Future studies could examine pro-environmental travel behavior in relation to the individuals' whole life situation, for example positive and negative experiences associated with not using the car and relations between important life decisions, such as where to live and work, and pro-environmental travel behavior. In addition, studies should to a larger extent focus on behavioral change in a long term perspective in order to get a more comprehensive view of how a transition to a more pro-environmental travel behavior can be achieved.

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