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Acceptability of travel demand management measures: The importance of problem awareness, personal norm, freedom, and fairness

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Abstract

Acceptability of travel demand management (TDM) with the aim of reducing private car use is modeled following a hierarchical set of beliefs. In a two-part model, pro-environmental orientation, problem awareness, personal norm, and willingness to reduce car use are linked to beliefs about to which extent the specific TDM measure is perceived to influence freedom to choose travel mode, own reduction of car use, effectiveness, fairness, and subsequently acceptability. Data were collected through a mail survey in Sweden, and the model was tested in a sample of car users for three TDM measures; improved public transport, an information campaign, and increased tax on fuel. First, the models were tested and modified in a randomly selected sub-sample ($N = 462$), then the modified models were validated in the remaining sub-sample ($N = 460$). We conclude that problem awareness and personal norm, in combination with evaluations of specific TDM measures, are underlying the acceptability of TDM measures. Moral considerations and perceived fairness were important for the acceptability of increased tax on fuel, while freedom aspects and problem awareness were of importance for the acceptability of improved public transport. Because acceptability often is important for the implementation of TDM measures, policy makers may draw on these results when attempting to increase the acceptability of various TDM measures.

1. Introduction

Car use constitutes an environmental problem in several ways. Air pollution through emissions, the use of nonrenewable fuels, congestion, and extensive land use are evident. Gradually, long-term sustainable transport can be achieved if households reduce their use of private cars, for example by traveling shorter distances, combining single trips into trip chains, traveling together with others in a car pool, or using more environmentally friendly travel modes (e.g. public transport, cycle or walking). Different policy strategies may influence households to change their travel behavior. Since the context sets boundaries for household traveling, policy measures such as laws and regulations, economic incentives and disincentives, as well as changes of the physical environment, may facilitate a reduction in car use. Vlek (1996) labels these strategies structural or hard strategies. In contrast, psychological or soft strategies, such as information and education, aim to influence individuals' awareness of the problem with cars, and/or increase their knowledge of more sustainable travel options. Another categorization differentiates between push measures, aiming to reduce the advantages of car use (e.g. increased fuel taxes), and pull measures, where alternative travel options are improved (e.g. improved public transport) (Steg & Vlek, 1997). In general, measures that are coercive are categorized as push measures, while less coercive measures are grouped among pull measures (Loukopoulos, 2005). Collectively, strategies aiming to change travel behavior are often referred to as travel demand management (TDM) measures. The main purpose of this study is to test a model of the relations between factors expected to influence the acceptability of TDM measures. In addition, comparisons between car users'

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evaluations of coercive and noncoercive TDM measures will be made.

1.1. Acceptability of TDM measures

The acceptability[1] of a TDM measure, is important for whether or not it will effectively modify travel behavior (see e.g. Schade, 2003). However, TDM measures are rarely considered to be both effective in a more objective sense, and perceived as acceptable by car users (see e.g. Steg, 2003). In studies from several countries, push measures are perceived as less acceptable compared to pull measures (e.g. Hölzer, 2003; Rienstra, Rietveld, & Verhoef, 1999; Steg & Vlek, 1997). For example, in a European study, over 90% of the car users supported improved public transport and park-and-ride schemes, while less than 20% approved of reduced parking space and cordon pricing (Schlag & Schade, 2000). Furthermore, car users commonly perceive pull measures to be more effective (see e.g. Steg & Vlek, 1997), even though push measures are often estimated to influence car use to a larger extent.

Examination of factors important for the acceptability of TDM measures may further improve the understanding of various TDM measures. Previously, the acceptability of TDM measures has been studied as an indicator of a readiness to act pro-environmentally within studies of pro-environmental intention and behavior (e.g. Stern, Dietz, & Guagnano, 1995; Stern, Dietz, Abel, Guagnano, & Kalof, 1999). In addition, several studies have identified factors important for the acceptability of specific TDM measures (see e.g. Schade & Schlag, 2003; Steg, 2003). However, various beliefs predicting acceptability have generally not been integrated into a joint theoretical framework. In addition, factors influencing the acceptability of different TDM measures have not been compared. Hence, environmental beliefs and norms underlying evaluations of specific TDM measures are relatively unexplored. Based on previous research, we propose a two-part model where pro-environmental orientation, problem awareness, personal norm, and willingness to reduce car use are related to specific evaluations of TDM measures such as how the TDM measure is perceived to influence freedom to choose travel mode, own car use, others' car use, fairness, and subsequently acceptability (see Fig. 1). The model will be evaluated in relation to three TDM measures aiming to reduce private car use. One more coercive measure, a increased tax on fuel is studied, as well as two noncoercive measures, improved public transport in the municipality and a local information campaign. Since coercive and noncoercive measures may be evaluated differently (see e.g. Steg & Vlek, 1997), car users' evaluations of the three TDM measures will be compared.

[1]The term acceptability refers to degree of positive or negative evaluation of a TDM measure that may be implemented in the future (see Schade, 2003).

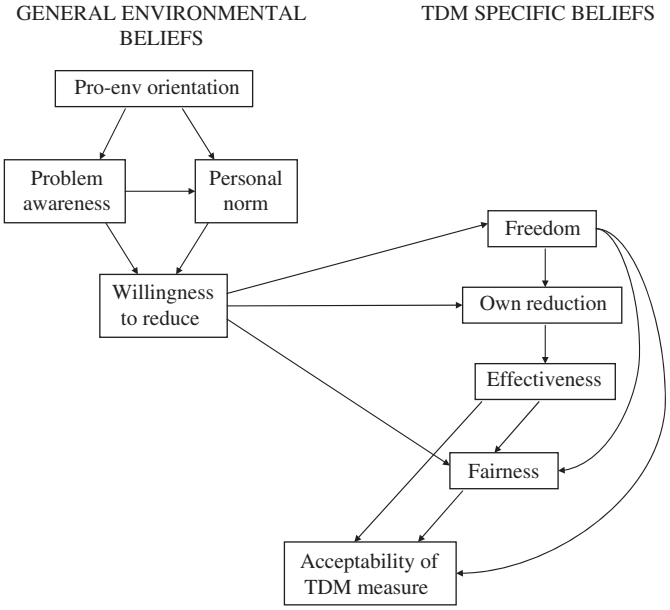


Fig. 1. Proposed model of factors predicting acceptability of TDM measures.

1.2. Values, beliefs, and norms

Within several studies, pro-environmental behavior has been conceptualized as altruistic, and Schwartz's (1977) theoretical framework of normative influences on altruism has been extended into the environmental domain (e.g. Black, Stern, & Elsworth, 1985; Hopper & Nielsen, 1991; Widegren, 1998). In the value-belief-norm (VBN) theory of environmentalism (Stern et al., 1999; see also Stern, 2000), pro-environmental behavior is explained by a hierarchical sequence of variables. According to the theory, values, general environmental beliefs such as a general problem awareness, awareness of the adverse environmental effects of human actions (awareness of consequences), and belief in that own actions could prevent those effects (ascription of responsibility), activate a personal norm. In turn, personal norm, experienced as a feeling of moral obligation to act, is stipulated to create a willingness to act pro-environmentally.

Different parts of this theoretical framework have been applied to environmentally significant intentions and behaviors. The New Environmental Paradigm (NEP) (see Dunlap & Van Liere, 1978), ecocentric beliefs, and problem awareness have been found to be positively related to pro-environmental behavior (e.g. Nordlund & Garvill, 2002; Stern et al., 1995; Thompson & Barton, 1994), and the acceptability of different TDM measures (Poortinga, Steg, & Vlek, 2004; Steg & Vlek, 1997; see also Poortinga, Steg, & Vlek, 2002). More comprehensively, Nordlund and Garvill (2003) demonstrate the importance of collective values (emphasizing the collective's interests above one's own interests), ecocentric values, and problem awareness for a personal norm, which in turn is positively related to willingness to reduce car use. In addition, the full VBN

theory has been used to explain acceptability of various energy policies influencing households (Steg, Dreijerink, & Abrahamse, 2005).

1.3. Evaluations of TDM measures

In studies of specific TDM measures, economic incentives and disincentives, as well as some regulatory and voluntary measures have been examined. In some of these studies (e.g. Van Lange, Van Vugt, Meertens, & Ruiter, 1998), travel mode choice has been conceptualized as a social dilemma where individuals' short-term interest (using the car) is in conflict with the collective's interest (not using the car), and structural TDM measures represent a possible solution to the social dilemma (e.g. Joireman et al., 2001). According to the multiattribute evaluation model (Samuelson, 1993; Samuelson & Messick, 1995), at least four dimensions are identified as important for evaluating structural changes; the efficiency of resource allocation, perceived fairness of the allocation, degree of freedom in making some decisions on one's own, and how the change would affect oneself.

Similar factors have been identified as relevant for the acceptability of TDM measures. For instance, the overall evaluation of a TDM measure is influenced by expectations of how the individual would be affected, both positively and negatively, by the TDM measure (Joireman et al., 2001; Schade & Schlag, 2003). One negative consequence of coercive measures often recognized, is the infringement on car users' freedom. Indeed, studies of road pricing show that the more a measure is perceived to constrain the individual's traveling; the lower is the acceptability (Bamberg & Rölle, 2003; Jakobsson, Fujii, & Gärling, 2000). In addition, Bamberg and Rölle (2003) demonstrate a relation between perceived freedom and perceived fairness; the larger the infringement on freedom the less fair road pricing is perceived to be. Expected own reduction in car use, as a consequence of the TDM measure, is another belief reflecting effects on the individual car user. Jakobsson et al. (2000) found own reduction to be directly related to perceived fairness and infringement on freedom, and indirectly associated with the acceptability of road pricing. In addition, relations between beliefs about effectiveness and acceptability of TDM measures have been shown. More specifically, the more effective a measure is perceived to be, the more acceptable it is (e.g. Bamberg & Rölle, 2003; Nordlund & Garvill, 2006; Rienstra et al., 1999). For coercive measures, there is also evidence for evaluating more effective measures as fairer (Bamberg & Rölle, 2003; Ittner, Becker, & Kals, 2003). Several studies demonstrate the importance of perceived fairness for the acceptability of different measures; a fair TDM measure is perceived to be more acceptable (e.g. Bamberg & Rölle, 2003; Ittner et al., 2003; Jakobsson et al., 2000; Joireman et al., 2001).

In a few studies, specific factors important for the acceptability of TDM measures have been found to mediate the effects of general environmental beliefs on acceptability. For example, results by Bamberg and Rölle (2003) indicate effectiveness to be a mediator between problem awareness and the acceptability of road pricing, while Fujii, Gärling, Jakobsson, and Jou (2004) found that perceived fairness mediates between environmental concern and acceptability of road pricing.

1.4. Proposed model

As shown by the review of studies, the acceptability of TDM measures has been studied using different approaches. Some studies have focused on explaining an environmental readiness (e.g. acceptability of TDM measures) as a function of values, general environmental beliefs, and a personal norm, while others have related evaluations of specific TDM measures to acceptability. In order to understand the general environmental beliefs underlying the acceptability of TDM measures, as well as relations between general environmental beliefs and beliefs related to specific TDM measures, we propose a structural model consisting of two parts. Hierarchically ordered, general environmental beliefs (placed on the left side of Fig. 1), and beliefs related to evaluations of specific TDM measures (placed on the right side of Fig. 1), are linked to acceptability. Hence, beliefs related to the specific TDM measure mediate between more general beliefs and acceptability.

First, in accordance with the VBN theory (Stern et al., 1999), pro-environmental orientation is positively related to problem awareness and personal norm, furthermore problem awareness has a positive association with personal norm and willingness to reduce car use. In turn, a positive correlation between personal norm and willingness to reduce car use for environmental reasons is expected. In the second part of the model, willingness to reduce car use is expected to be related to evaluations of the specific TDM measure. In accordance with previous research (see e.g. Samuelson & Messick, 1995), the proposed model contains beliefs about effects of the TDM measure on freedom to choose travel mode, own car use, perceived effectiveness, and perceived fairness. This model, where general environmental beliefs are associated with beliefs about the TDM measure under evaluation, which in turn are related to acceptability, is in line with the hierarchical view found in both the VBN theory (Stern et al., 1999), and general attitude theory (see e.g. Olson & Maio, 2003). Since willingness to reduce car use implies a readiness to fulfil the aim of the examined TDM measures, that is to reduce own car use, the model depicts positive relations between willingness to reduce car use and subjective beliefs related to the specific TDM measures. Hence, a stronger willingness to reduce car use is associated with the belief that freedom to choose travel mode increases for noncoercive measures (the information campaign and improved public transport), and is a lesser infringement on freedom for more coercive measures (increased tax on fuel). In addition, a stronger willingness to reduce car use is related to a larger

reduction in own car use and perceptions of the measures as more fair.

Corresponding to earlier studies (see e.g. Bamberg & Rölle, 2003; Jakobsson et al., 2000), the model proposes that TDM measures perceived to increase freedom to choose travel mode, alternatively perceived as a lesser infringement on freedom, are evaluated as fairer and more acceptable. The reduction of own car use is supposedly influenced by car users' possibility to use different travel modes. Hence, in the model, freedom to choose is associated with the extent to which own car use is perceived to be reduced as a consequence of the TDM measure. For this association, a difference between more coercive (increased tax on fuel) and noncoercive measures (information campaign and improved public transport), is anticipated. Since travel mode use is not restricted by noncoercive measures, the more the measure is perceived to increase freedom to choose (e.g. by providing alternative travel options) the larger the reduction in car use. However, for more coercive measures, where car use is constrained, the less the TDM measure is perceived to increase on the freedom to choose, the larger the reduction in own car use. In addition, a positive relation between own reduction in car use and effectiveness, measured by expectations of others' reduction in car use, is proposed, since a common way to evaluate others' behaviors is to use oneself as a starting point, a so-called false consensus effect (see e.g. Fiske & Taylor, 1991). In turn, effectiveness is expected to be positively related to perceived fairness and the acceptability of TDM measures, as has been shown in earlier studies (Bamberg & Rölle, 2003; Nordlund & Garvill, 2006; Rienstra et al., 1999). Finally, supported by previous research (Bamberg & Rölle, 2003; Jakobsson et al., 2000; Joireman et al., 2001), the model stipulates a relation between perceived fairness and acceptability, indicating that the more fair a TDM measure is perceived to be the more acceptable it is. In order to maintain a strict model, only relations between variables directly adjacent to each other are included. However, in accordance with the VBN theory (Stern et al., 1999), the possibility of direct associations between variables further away from each other is not ruled out.

2. Method

2.1. Procedure and participants

The study was conducted through a mail survey in four municipalities, situated in different parts of Sweden and varying in population size (from 40,000 to 470,000 citizens). A randomly selected sample, 20–75 years of age, of 4000 respondents, received a questionnaire (see below). After two reminders the overall response rate was 31%, varying from 26% to 35% in the different municipalities. The respondents' gender, age, education, and income were compared to the population in the municipalities. Even though the sample contained more women and was slightly older compared to the population, correspondence was reasonable. The majority of the respondents, 74% (922 respondents), had a driver's license, access to car, and were car users. In this study, the group of car users is analysed. The gender distribution in this group of car users was even (52% women), and mean age was 49 years (S.D. = 14 years). Among the respondents, 36% had completed high school and 35% had a university degree. Median income in the households was 39,700 SEK per month (approximately 5160 USD), and in 40% of the households, children were living at home. On average, households' annual driving distance was 15,000 km and respondents' annual driving distance was 10,000 km. Most of the respondents had one car in the household (59%), while the remaining households had two or more cars.

2.2. Questionnaire

As part of an extensive questionnaire, background characteristics, general environmental beliefs, and beliefs related to TDM measures were assessed. In Table 1, items measuring the attitudinal variables are displayed, arranged in the same order as they appeared in the questionnaire. To begin with, the respondents' pro-environmental orientation measured by the New Ecological Paradigm (NEP) (a revised version of the New Environmental Paradigm) (Dunlap, Van Liere, Mertig, & Jones, 2000), problem awareness related to air pollution from private car use, personal norm to reduce own car use, and willingness to reduce own car use were assessed. Subsequently, three specific TDM measures aiming to reduce private car use in order to decrease the environmental impact were investigated. The TDM measures were described as scenarios with a short description of the proposed measure. First, an information campaign described as a brochure which was sent to the citizens in the municipality was evaluated. The brochure was said to contain an appeal to reduce car use for the sake of the environment and information about local alternative travel modes. Tax revenues from the municipality were stated to fund the campaign. The second measure was increased tax on fuel, decided by the government. Half of the respondents evaluated a raise with two SEK/l fuel (approximately 0.26 USD), which was a 20% raise per liter fuel and the other half evaluated a raise with five SEK/l (approximately 0.65 USD), which represented a 50% raise per liter. The third measure was an improvement of public transport in the form of increased trip frequency and less expensive fares. Since the ticket price varied in the different municipalities (between 16 SEK, approximately 2.08 USD, and 30 SEK, approximately 3.90 USD), the reduced fare was given in percentage. Half of the respondents evaluated a reduced ticket price with 25% and half the respondents a reduction with 50%. Tax revenues from the municipality were stated to fund the improved public transport. In relation to each TDM measure, the respondents were asked questions about perceived fairness, effectiveness, expected reduction

Table 1
An overview of the measures of attitudinal variables

General environmental beliefs[a]	
Pro-environmental orientation	A Swedish version of the NEP-scale (15 items).
Problem awareness	'Air pollution from private car use is a threat for …plants and animals in the world.' …people's health in the world.' …plants and animals in the municipality where I live.' …people's health in the municipality where I live.' …own health and well-being.'
Personal norm	'I feel morally responsible to reduce my car use in order to decrease the negative effects on the environment.'
Willingness to reduce car use	'I'm willing to reduce my car use in order to decrease the negative effects on the environment.'
Beliefs in relation to each TDM measure (the information campaign (INFO), raised tax on fuel (TAX), and improved public transport (PUB)).	
Perceived fairness[b]	'To what extent do you perceive INFO/TAX/PUB to be a fair measure?'
Effectiveness[c]	'How much, stated in percent of current driving distance, do you think other car drivers in your municipality would reduce their car use if the measure is implemented?'
Own reduced car use[c]	'How much, stated in percent of current driving distance, do you think you would reduce car use if the measure is implemented?'
Freedom to choose travel mode[d]	'To what extent do you perceive INFO/TAX/PUB to affect your freedom to choose travel mode yourself?'
Acceptability[e]	'To what extent are you in favor or against INFO/TAX/PUB?'

[a]Scales 1–5 (1 = strongly disagree, 2 = mildly disagree, 3 = unsure, 4 = mildly agree, 5 = strongly agree).
[b]Bipolar scales −2 to 2 (−2 = very unfair, 0 = neither unfair nor fair, 2 = very fair).
[c]Percentage of current driving distance. No reduction was indicated as 0% and 100% meant to cease using the car entirely.
[d]Bipolar scales −2 to 2 (−2 = my freedom to choose is reduced to a large degree, 0 = my freedom to choose is not affected, 2 = my freedom to choose is increased to a large degree).
[e]Bipolar scales −2 to 2 (−2 = completely against, 0 = neither in favor nor against, 2 = completely in favor).

in own car use, expected consequences for own freedom to choose travel mode, and acceptability.

2.3. Index variables

Items measuring pro-environmental orientation and problem awareness were combined into index variables. First, the seven statements expressing an anti-NEP position were reversed so that higher values on all items reflected stronger NEP-orientation. Subsequently, a mean for the 15 NEP items was calculated for each respondent, representing a measure of pro-environmental orientation (Dunlap et al., 2000). The scale had a reasonably high internal consistency ($\alpha = 0.77$). Problem awareness was calculated using the mean of the five items regarding the extent to which private car use was perceived as a global, local, and personal threat. The problem awareness variable had a high internal consistency ($\alpha = 0.95$).

3. Results

3.1. Descriptive analysis of values, beliefs, and norms

In Table 2, means and standard deviations for pro-environmental orientation, problem awareness of private car use, personal norm, and willingness to reduce car use are shown. The sample was to some extent pro-environmental, and car use was perceived as a problem. However, the respondents did not have a strong personal norm to reduce car use, nor were they seriously willing to reduce own car use.

Table 2
Means and standard deviations for pro-environmental orientation, problem awareness of private car use, personal norm, and willingness to reduce car use

	Mean	S.D.
Pro-environmental orientation	3.67	0.48
Problem awareness of car use	3.88	0.94
Personal norm to reduce car use	2.98	1.26
Willingness to reduce car use	3.02	1.23

Scales 1–5 (1 = strongly disagree, 2 = mildly disagree, 3 = unsure, 4 = mildly agree, 5 = strongly agree).

3.2. Comparisons between the three TDM measures

The two levels of improved public transport (25% and 50% reduction in ticket price) and the two levels of increased tax on fuel (two and five SEK/l fuel) were examined with several univariate ANOVAs. No differences were found between the evaluations of the two levels of improved public transport. The evaluations of the two levels of increased tax on fuel differed significantly, however the small effect sizes indicate these differences to

Table 3
Means and standard deviations for freedom to choose travel mode, own reduced car use, effectiveness, perceived fairness, and acceptability in relation to improved public transport, information campaign, and raised tax on fuel

	Improved public transport		Information campaign		Raised tax on fuel			
	Mean	S.D.	Mean	S.D.	Mean	S.D.	*F*-value	Partial η^2
Freedom to choose travel mode[a]	0.41***	0.99	−0.16***	0.71	−0.67***	0.95	391.87[e]	0.305
Own reduced car use[b]	16.06	21.37	6.83	12.77	11.21	17.76	99.88[e]	0.104
Effectiveness [b]	22.05	24.15	8.92	11.49	15.76	15.92	153.71[e]	0.153
Perceived fairness[c]	0.90***	1.15	0.21***	1.12	−1.06***	1.18	893.44[e]	0.503
Acceptability[d]	0.98***	1.06	−0.04[ns]	1.15	−1.10***	1.14	1029.15[e]	0.536

Note: for freedom to choose travel mode, perceived fairness, and acceptability, one sample *t*-tests were performed examining if the mean differs from 0 (ns = nonsignificant, ***$p<0.001$).

[a]Scales −2 to 2 (−2 = my freedom to choose is reduced to a large degree, 0 = my freedom to choose is not affected, 2 = my freedom to choose is increased to a large degree).

[b]Percentage of current driving distance.

[c]Scales −2 to 2 (−2 = very unfair, 0 = neither unfair nor fair, 2 = very fair).

[d]Scales −2 to 2 (−2 = completely against, 0 = neither in favor nor against, 2 = completely in favor).

[e]The repeated measures ANOVAs showed significant main effects of the measures on all evaluated dimensions ($p<0.001$). In addition, post hoc tests with Bonferroni correction indicate significant differences between each of the three measures on all evaluated dimensions ($p<0.001$).

be of minor importance.[2] Consequently, for the comparisons between the three TDM measures the two levels of improved public transport and increased tax on fuel were merged.

In Table 3, means and standard deviations of beliefs related to the examined TDM measures are presented. Whether the means of the three TDM measures differed from zero on the bipolar dimensions assessing freedom to choose, fairness, and acceptability were assessed with one-sample t-tests (levels of significance are displayed in Table 3). The analyses showed that increased tax was perceived to infringe on the freedom to choose, while improved public transport was perceived to increase freedom. Rather unexpectedly, the information campaign was perceived to be a minor infringement on freedom. Improved public transport, and to some extent the information campaign, were perceived to be fair measures, while increased tax on fuel was evaluated as an unfair measure. Not surprisingly, improved public transport was rated as an acceptable measure and increased tax on fuel as an unacceptable measure. The information campaign was evaluated as neither acceptable, nor unacceptable.

Differences between the three TDM measures were assessed with repeated measures ANOVAs and post hoc test with Bonferroni correction (*F*-values, levels of significance, and effect sizes are presented in Table 3). Significant differences were found between all the examined evaluations of the three TDM measures. Increased tax on fuel was expected to infringe on freedom to choose travel mode to a larger extent compared to the information campaign. Improved public transport, on the other hand, was perceived to increase freedom to choose travel mode. Furthermore, there were differences in how effective the three TDM measures were perceived to be. With approximately a 20% reduction in others' car use, improved public transport was perceived to be the most effective measure. The respondents anticipated a slightly smaller decrease for a increased tax on fuel, around 15%, and the least effective TDM measure was the information campaign, with less than a 10% reduction in others' car use. In the same way, own car use was perceived to be reduced the most as a result of an improved public transport, slightly less in response to increased tax on fuel, and the least reduction in relation to the information campaign. In addition, respondents expected other car users to reduce their car use to a larger extent compared to the respondents' own reduction; however the effect sizes were small.[3] Finally, improved public transport was perceived to be fairer and more acceptable compared to the information campaign, and the least fair and acceptable was increased tax on fuel perceived to be.

3.3. Path analysis

For the three TDM measures, the proposed model of acceptability was estimated by the maximum likelihood

[2]The univariate ANOVAs for the two levels of increased tax on fuel, show that the increase with five SEK/liter fuel was perceived to lead to a larger infringement on freedom to choose travel mode ($F(1,905)=6.89$, $p<0.01$, partial $\eta^2=0.008$), and a larger reduction in own and others' car use compared to the increase with two SEK/l ($F(1,880)=16.96$, $p<0.001$, partial $\eta^2=0.019$ and $F(1,879)=15.64$, $p<0.001$, partial $\eta^2=0.017$ respectively). In addition, the increase with five SEK/liter was perceived as more unfair ($F(1,904)=10.06$, $p<0.01$, partial $\eta^2=0.011$) and respondents were more opposed to this TDM measure compared to the increase with two SEK/liter ($F(1,902)=4.98$, $p<0.05$, partial $\eta^2=0.005$).

[3]Results from three repeated measures ANOVAs show significant differences between own and others' reduction in car use for the information campaign ($F(1,867)=28.461$, $p<0.001$, partial $\eta^2=0.032$), for increased tax on fuel ($F(1,867)=63.635$, $p<0.001$, partial $\eta^2=0.068$), and for improved public transport ($F(1,866)=53.918$, $p<0.001$, partial $\eta^2=0.059$).

method with AMOS 5.0 (Arbuckle & Wothke, 1999). The variables included in all three models were pro-environmental orientation, problem awareness, personal norm, and willingness to reduce car use. Specific for each model were beliefs related to the TDM measure under examination. These variables were perceived influence on freedom to choose travel mode, own reduction in car use, effectiveness, perceived fairness, and acceptability. In order to obtain suggestions of modifications in the tested models, so-called modification indices, no missing values are accepted by AMOS. Therefore, missing values were replaced by using the Expectation Maximization algorithm. The percent of missing values varied between 0.4 and 4.8 for the variables included in the model. No substantial discrepancies were detected in means, standard deviations, or covariances as a result of the replacement. A multiple group analysis was performed in order to examine if the path coefficients differed between the two levels of increased tax on fuel (two SEK versus five SEK/l). One unconstrained model and one model with equality constraints on path coefficients for the two levels were tested. The analysis indicates no differences in path coefficients for the two levels of increased tax on fuel. In the same way, the path coefficients for the two levels of reduced ticket price (25% versus 50%) were examined. The analysis shows a significant difference ($p<0.01$) in path coefficients between the two levels. After removing the constraint on the path coefficient between freedom to choose and own reduction, the two levels of reduced ticket price no longer differed significantly. The path coefficients between freedom to choose and own reduction were 0.274 for low decrease and 0.433 for high decrease. On the whole, the analyses show only a slight divergence between the different levels, hence the two levels of increased tax on fuel and improved public transport were merged for the evaluation of the proposed model.

The model evaluation was made in two steps. First, rather than performing a confirmatory analysis, the models were evaluated in an exploratory manner in order to uncover relations not identified in advance (see e.g. Jöreskog & Sörbom, 1993). The models were thus tested, and modified, on a randomly selected sub-sample, including approximately half of the respondents ($N = 462$) (sub-sample 1). Second, in order to validate the models, the modified models were tested on the rest of the sample ($N = 460$) (sub-sample 2). Correlations between the incorporated variables are displayed in Table 4. Except for a few nonsignificant correlations, mainly positive associations were found between variables. As expected, the correlation between freedom to choose travel mode and own reduction in car use, as a consequence of a increased tax on fuel, was negative.

3.3.1. Improved public transport

When the model of improved public transport was tested on sub-sample 1, the path coefficient between effectiveness and acceptability was nonsignificant. This relation was therefore excluded and the model was re-estimated. There are several goodness-of-fit indexes available to evaluate the fit of the model, for example root mean squared error of approximation (RMSEA) and Bentler's Comparative Fit Index (CFI). RMSEA takes population error into consideration and is a measure of discrepancy per degree of freedom, while CFI indicates to what extent the fit of the model is better compared to the independence model (Jöreskog & Sörbom, 1993; see also MacCallum & Austin, 2000). According to Browne and Cudeck (1993), a RMSEA value of 0.05 is indicative of a good fit, and a value of 0.08 a reasonable fit. Divergence from a RMSEA value of 0.05 may be tested, and a nonsignificant p value of close fit (PCLOSE) indicates that the RMSEA value does not significantly differ from 0.05. Hu and Bentler (1999) suggest a CFI value of 0.95 to be a fairly good fit. For the model of improved public transport, goodness-of-fit indexes indicated a reasonable fit (RMSEA = 0.078 (PCLOSE = 0.004), CFI = 0.948). However, including a path between problem awareness and acceptability was suggested by the modification indices. Since improved public transport was perceived to increase freedom to choose travel mode, a personal norm and a willingness to reduce car use, may not be necessary for acceptability. Instead an awareness of the problem may be important in order to accept the measure. After re-estimating the model with this relation included, all path coefficients were significant and goodness-of-fit indicated an improved model (RMSEA = 0.063 (PCLOSE = 0.116), CFI = 0.968). The modified model was then tested on sub-sample 2, and results showed that all proposed relations were significant and goodness-of-fit was adequate (RMSEA = 0.070 (PCLOSE = 0.035), CFI = 0.967). Explained variance in acceptability was 51% in the first sub-sample and 49% in the second sub-sample (see Fig. 2).

3.3.2. Information campaign

When the model of the information campaign was analysed using sub-sample 1, the path coefficients between freedom to choose and own reduction in car use, as well as between effectiveness and acceptability, were nonsignificant ($p>0.05$), these paths were therefore excluded and the model was re-estimated. Goodness-of-fit indexes indicated a reasonable fit (RMSEA = 0.074 (PCLOSE = 0.013), CFI = 0.949), however modification indices suggested a direct relation between personal norm and acceptability. In contrast to improved public transport, the information campaign was perceived to be a slight infringement on freedom. Hence, a norm proscribing a change in behavior may be particularly important for the acceptability of the information campaign. The direct relation between personal norm and acceptability was therefore included in the model. After re-estimating the model, all path coefficients were significant and goodness-of-fit was improved (RMSEA = 0.064 (PCLOSE = 0.098), CFI = 0.963). This modified model was then tested on sub-sample 2, all proposed path coefficients were significant and goodness-of-fit

Table 4
Correlation matrix of variables in the models of improved public transport (PUB), information campaign (INFO), and raised tax on fuel (TAX). The left column (S1) are correlation coefficients in sub-sample 1 ($N = 462$), and the right column (S2) are correlation coefficients in sub-sample 2 ($N = 460$)

	PRO-ENV		PROBLEM		PN		W									
	S1	S2	S1	S2	S1	S2	S1	S2								
PROBLEM	0.422	0.430														
PN	0.278	0.356	0.450	0.510												
W	0.298	0.319	0.402	0.492	0.641	0.618										
									PUB FREE		PUB OWN		PUB EFFECT		PUB FAIR	
PUB									S1	S2	S1	S2	S1	S2	S1	S2
FREE	0.128	0.174	0.180	0.145	0.051^{ns}	0.117	0.105	0.140								
OWN	0.116	0.170	0.162	0.227	0.109	0.249	0.200	0.310	0.387	0.377						
EFFECT	0.110	0.155	0.099	0.237	0.105	0.217	0.070^{ns}	0.255	0.182	0.300	0.416	0.684				
FAIR	0.231	0.237	0.284	0.356	0.185	0.275	0.238	0.270	0.529	0.411	0.386	0.394	0.289	0.395		
ACC	0.282	0.254	0.353	0.351	0.154	0.266	0.225	0.301	0.549	0.520	0.354	0.408	0.250	0.407	0.674	0.645
									INFO FREE		INFO OWN		INFO EFFECT		INFO FAIR	
INFO									S1	S2	S1	S2	S1	S2	S1	S2
FREE	0.049^{ns}	0.086^{ns}	0.125	0.145	0.135	0.165	0.135	0.191								
OWN	0.020^{ns}	0.092	0.139	0.181	0.247	0.327	0.275	0.391	0.110	0.143						
EFFECT	−0.037^{ns}	0.002^{ns}	0.119	0.117	0.231	0.208	0.240	0.288	0.099	0.099	0.544	0.627				
FAIR	0.117	0.110	0.230	0.267	0.355	0.313	0.349	0.401	0.197	0.280	0.237	0.362	0.331	0.313		
ACC	0.202	0.135	0.266	0.281	0.379	0.352	0.375	0.375	0.321	0.312	0.278	0.377	0.290	0.331	0.675	0.699
									TAX FREE		TAX OWN		TAX EFFECT		TAX FAIR	
TAX									S1	S2	S1	S2	S1	S2	S1	S2
FREE	0.051^{ns}	−0.014^{ns}	0.163	0.026^{ns}	0.115	0.040^{ns}	0.120	0.121								
OWN	0.082^{ns}	0.116	0.158	0.180	0.200	0.285	0.240	0.290	−0.098	−0.113						
EFFECT	0.095	0.073^{ns}	0.124	0.159	0.167	0.194	0.186	0.237	−0.049^{ns}	−0.017^{ns}	0.613	0.565				
FAIR	0.079^{ns}	0.114	0.179	0.239	0.298	0.293	0.305	0.335	0.379	0.334	0.109	0.204	0.122	0.247		
ACC	0.170	0.142	0.260	0.309	0.364	0.354	0.341	0.412	0.328	0.306	0.153	0.216	0.150	0.240	0.721	0.752

Variables included in the models are: pro-environmental orientation (PRO-ENV), problem awareness (PROBLEM), personal norm (PN), willingness to reduce car use (W), freedom to choose travel mode (FREE), own reduction in car use (OWN), effectiveness (EFFECT), perceived fairness (FAIR), and acceptability (ACC).
Note: all correlations are significant ($p < 0.05$) except those marked with ns (nonsignificant).

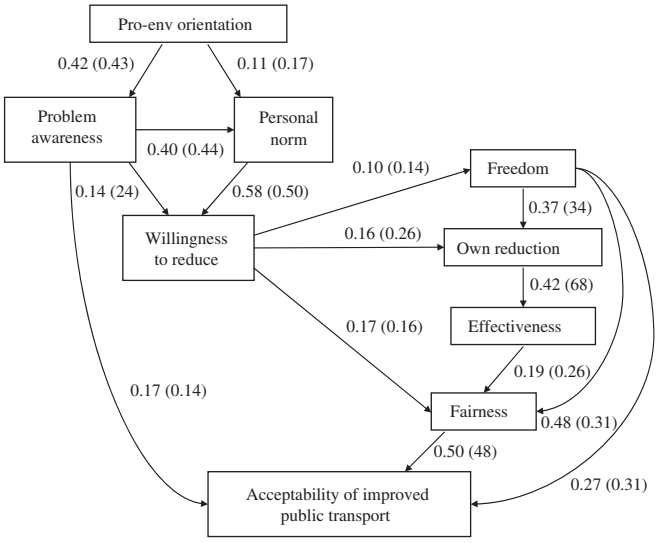
was good (RMSEA = 0.051 (PCLOSE = 0.446), CFI = 0.980). In the first sub-sample, 49% of the variance in acceptability was explained, and in the second sub-sample explained variance was 51% (see Fig. 3).

3.3.3. Increased tax on fuel

For the model of increased tax on fuel, all proposed relations were significant and goodness-of-fit indicated a reasonable fit (RMSEA = 0.064 (PCLOSE = 0.106), CFI = 0.967). Modification indices however, proposed a relation between personal norm and acceptability which would improve the model. As for the information campaign, increased tax on fuel was perceived to infringe on freedom, making a normative pressure more important for acceptability, hence this direct relation was added to the model. After the model was re-estimated, the path coefficient between effectiveness and acceptability was no longer significant. Excluding this relation caused the path coefficient between freedom to choose and acceptability to be nonsignificant. Subsequent to these modifications, goodness-of-fit was improved over the initial model (RMSEA = 0.047 (PCLOSE = 0.574), CFI = 0.981). Testing this model on sub-sample 2, all proposed relations were significant and goodness-of-fit was good (RMSEA = 0.055 (PCLOSE = 0.302), CFI = 0.976). Explained variance in acceptability was 53% and 57%, respectively (see Fig. 4).

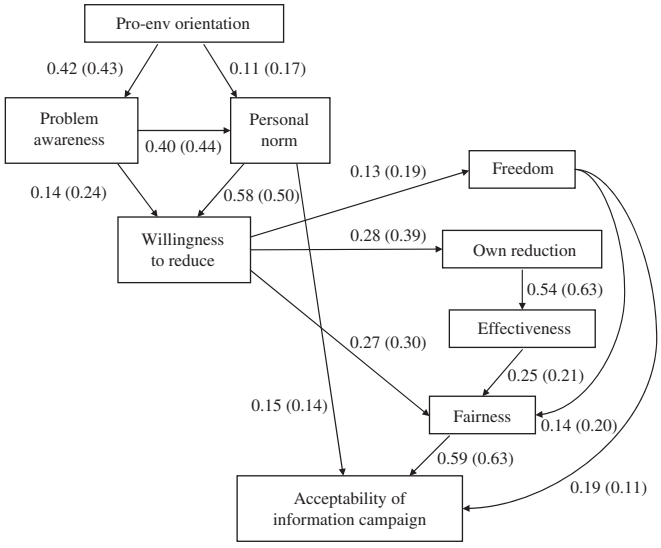
3.3.4. Summary of model evaluation

In accordance with the proposed model, a pro-environmental orientation and problem awareness were important for personal norm, which in turn was related to willingness to reduce car use for the sake of the environment. In addition, evaluations of the specific TDM measures mediated between willingness to reduce car use and acceptability. However, a few modifications improved the models. For all three TDM measures, perceived effectiveness was not significantly related to acceptability. In addition, no significant relations were found between



Explained variance: problem awareness 18% (18%), personal norm 21% (28%), willingness to reduce 43% (42%), freedom 1% (2%), own reduction 18% (21%), effectiveness 17% (47%), fairness 35% (27%), acceptability 51% (49%).

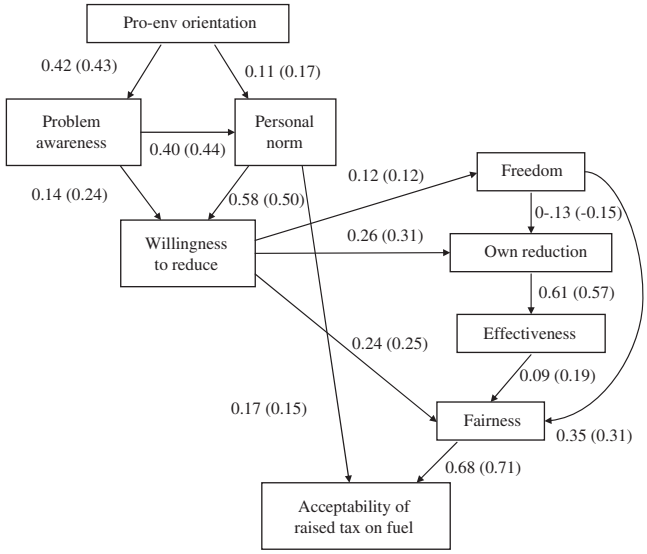
Fig. 2. Path model predicting acceptability of improved public transport. Path coefficients for the final model tested on sub-sample 1 and path coefficients for the final model tested on sub-sample 2 in brackets.



Explained variance: problem awareness 18% (18%), personal norm 21% (28%), willingness to reduce 43% (42%), freedom 2% (4%), own reduction 8% (15%), effectiveness 30% (39%), fairness 19% (24%), acceptability 49% (51%).

Fig. 3. Path model predicting acceptability of the information campaign. Path coefficients for the final model tested on sub-sample 1 and path coefficients for the final model tested on sub-sample 2 in brackets.

freedom to choose travel mode and own reduction in car use for the information campaign, and between freedom to choose travel mode and acceptability for increased tax on fuel. Notably, for the information campaign and increased tax on fuel, personal norm was significantly related to acceptability, and in the model of improved public transport a significant relation between problem awareness and acceptability was found. An examination of standardized total effects on acceptability further illustrates these



Explained variance: problem awareness 18% (18%), personal norm 21% (28%), willingness to reduce 43% (42%), freedom 1% (1%), own reduction 7% (11%), effectiveness 38% (32%), fairness 22% (22%), acceptability 53% (57%).

Fig. 4. Path model predicting acceptability of increased tax on fuel. Path coefficients for the final model tested on sub-sample 1 and path coefficients for the final model tested on sub-sample 2 in brackets.

differences between, on the one hand acceptability of the information campaign and increased tax, and on the other hand the model of improved public transport (see Table 5). The most important factor explaining acceptability in the models of the information campaign and increased tax was perceived fairness. However, for acceptability of improved public transport, freedom to choose travel mode and perceived fairness were equally important. In addition, personal norm was to some extent important for acceptability of the information campaign and increased tax on fuel. Instead, problem awareness was important for acceptability of improved public transport.

4. Discussion

In this study, differences in the way TDM measures were evaluated by car users were demonstrated. While improved public transport was perceived to increase freedom to choose travel mode, and was evaluated as a fair and an acceptable measure, the increased tax on fuel was perceived to infringe on freedom, considered to be unfair, and unacceptable. The information campaign was conceived to be a minor infringement on freedom, although to some degree a fair measure, and it was perceived as neither acceptable nor unacceptable. In addition, improved public transport was considered the most effective TDM measure, increased tax on fuel as slightly less effective, and the information campaign as the least effective measure. Even though this study had a rather low response rate, and there is always a risk of framing effects when policy measures are evaluated (see e.g. Nelson & Oxley, 1999), the evaluations

Table 5
Standardized total effects on the acceptability of improved public transport (PUB), information campaign (INFO), and raised tax on fuel (TAX)

	PRO-ENV	PROBLEM	PN	W	FREE	OWN	EFFECT	FAIR
Sub-sample 1								
PUB	0.105	0.227	0.085	0.148	0.519	0.040	0.095	0.499
INFO	0.090	0.143	0.276	0.220	0.270	0.082	0.151	0.593
TAX	0.091	0.144	0.284	0.205	0.236	0.039	0.064	0.680
Sub-sample 2								
PUB	0.108	0.219	0.083	0.168	0.491	0.086	0.125	0.478
INFO	0.125	0.184	0.273	0.269	0.242	0.081	0.130	0.627
TAX	0.117	0.170	0.262	0.230	0.209	0.078	0.139	0.714

Pro-environmental orientation (PRO-ENV), problem awareness (PROBLEM), personal norm (PN), willingness to reduce car use (W), freedom to choose travel mode (FREE), own reduction in car use (OWN), effectiveness (EFFECT), and perceived fairness (FAIR).

of the TDM measures are in general corresponding with earlier findings (see e.g. Hölzer, 2003; Steg & Vlek, 1997).

In a proposed model, the acceptability of TDM measures is explained by general environmental beliefs and beliefs related to specific TDM measures. In line with the VBN theory (Stern et al., 1999; see also Nordlund & Garvill, 2003; Steg et al., 2005), a pro-environmental orientation and an awareness of the problem with private car use were associated with a personal norm, which in turn was positively related to willingness to reduce car use. In addition, a stronger willingness to reduce car use was related to a more favorable evaluation of the specific TDM measures aiming to reduce private car use. As expected, evaluations of the specific TDM measures mediate, for the most part, between a general readiness to reduce car use and acceptability. Previously, the VBN theory has explained around one-third of the variance in acceptability of various policies (e.g. Steg et al., 2005). In this study, where general environmental beliefs were combined with beliefs related to the specific TDM measure, approximately half of the variance in acceptability was explained. To further validate the results, the tested models were verified on an independent sample. Hence, the study gives valuable insights about the way in which the acceptability of TDM measures may be conceptualized in line with a general environmental theory. However, there are ways to improve the models. For instance, several items representing different concepts would improve the reliability of the variables. In addition, the low level of explained variance in freedom to choose travel mode, may indicate that this variable is more appropriately considered an exogenous variable. Rather than a readiness to reduce car use, contextual factors (e.g. the supply of alternative travel modes) and individual factors (e.g. income level) may be more important for perceived freedom. Furthermore, the importance of other variables for the acceptability of TDM measures ought to be considered. In general, there may be a need to include other variables directly and/or indirectly related to the acceptability of TDM measures (e.g. additional beliefs related to specific TDM measures, behavioral control, and social norms).

More specifically, this study confirms the importance of perceived fairness for the acceptability of TDM measures identified in earlier studies (e.g. Jakobsson et al., 2000; Joireman et al., 2001). In addition to perceived fairness, Bamberg and Rölle (2003) showed effectiveness to be important for the acceptability of road pricing. However, in this study effectiveness, measured as expectation of others' reduction in car use, was not directly associated with acceptability. A possible explanation is that expectations of others' reduction in car use may not be an appropriate measure of effectiveness, or effectiveness may primarily be an indirect predictor of acceptability, through fairness. Contrary to our expectations, and previous studies of road pricing (e.g. Bamberg & Rölle, 2003; Jakobsson et al., 2000), freedom to choose travel mode was not significantly related to the acceptability of increased tax on fuel. Since freedom to choose was related to perceived fairness, and perceived fairness was linked to acceptability, the association between freedom to choose and acceptability appears to be mediated by perceived fairness. Hence, perception of freedom was of importance for the acceptability of increased tax, even though the direct relation is nonsignificant.

In this study, the models explaining the acceptability of different TDM measures share a common frame. However, there are notable differences between factors explaining the acceptability of increased tax on fuel and factors important for the acceptability of improved public transport. Increased tax on fuel was perceived to be constraining and the significance of perceived fairness for acceptability, in addition to a direct association between personal norm and acceptability, was particularly evident for this TDM measure. Hence, in order to accept increased tax on fuel the car user needs to feel morally responsible to act. In contrast, for improved public transport freedom to choose was important for acceptability. Furthermore, problem awareness, rather than personal norm, was significantly related to acceptability. Improved public transport was not perceived to be constraining, and in order to accept such a measure no sacrifice is required by the car user, consequently moral and fairness considerations are less important. Instead, an awareness of car use as a problem and

perceiving the measure to increase travel options, are more important for acceptability. Increased tax on fuel may be categorized as a push measure while improved public transport is a pull measure (see Steg & Vlek, 1997). This classification fits the division present in this study between, on the one hand a stronger moral foundation of acceptability, and on the other an emphasis on freedom issues. Even though information is often classified as a pull measure, factors important for the information campaign studied here is comparable both to increased tax on fuel and improved public transport. The importance of personal norm for the acceptability of the information campaign is similar to the model of increased tax on fuel, while the significant relation between freedom to choose and acceptability is more similar to the model of improved public transport. In addition, there is no significant relation between freedom to choose travel mode and own reduction in car use in the model of the information campaign. Since the information campaign examined here, including both an appeal to reduce car use and information about alternative travel modes, incorporates constraining as well as facilitating components, these results are reasonable. Presumably, other information campaigns may be evaluated somewhat differently.

Behavioral consequences of various TDM measures are obviously important for policy makers. In addition, the acceptability of TDM measures is important if the measure's aim is to be achieved (see e.g. Schade, 2003). Results from this study may assist policy makers during formulation and implementation of TDM measures in order to increase acceptability among car users. For instance, when TDM measures are planned, it is essential to consider how to increase a measure's perceived fairness (a fair decision process may enhance perceived fairness, and as a consequence increase acceptability). The results also indicate that different strategies ought to be used when attempting to increase the acceptability of different TDM measures. For constraining measures, acceptability may be facilitated by highlighting moral aspects during implementation (e.g., through an appeal to car users' conscience). Instead, acceptability of measures aiming to improve travel options may require raised problem awareness, and accentuating positive consequences of the TDM measure for the individual car user. Since data is correlational one cannot be sure of the causal order between variables, hence there is a need to be cautious when interpreting the order of relations.

Since TDM measures rarely are both effective in an objective sense, and accepted by car users, a combination is often suggested (e.g. Steg, 2003). In a few studies, evaluations of packages of TDM measures have been investigated (see e.g., Thorpe, Hills, & Jaensirisak, 2000). However, as this study indicates, the acceptability of various TDM measures may be determined by slightly different factors, hence it is not obvious how different combinations of TDM measures will be evaluated. In future studies, it is important to improve the understanding of how various packages of TDM measures are evaluated, and what their behavioral consequences would be, in order to design TDM measures that are both effective and accepted by car users.

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