The Socio-Cognitive Links between Road Pricing Acceptability and Changes in Travel-Behavior

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Abstract

The objective of this study is to examine the effect of road pricing on people's tendency to adapt their current travel behavior. To this end, the relationship between changes in activity-travel behavior on the one hand and public acceptability and its most important determinants on the other are investigated by means of a stated adaptation experiment. Using a two-stage hierarchical model, it was found that behavioral changes themselves are not dependent on the perceived acceptability of road pricing itself, and that only a small amount of the variability in the behavioral changes were explained by socio-cognitive factors. The lesson for policy makers is that road pricing charges must surpass a minimum threshold in order to to entice changes in activity-travel behavior and that the benefits of road pricing should be clearly communicated, taking into account the needs and abilities of different types of travelers. Secondly, earlier findings concerning the acceptability of push measures were validated, supporting transferability of results. In line with other studies, effectiveness, fairness and personal norm all had a significant direct impact on perceived acceptability. Finally, the relevance of using latent factors rather than aggregate indicators was underlined.

Keywords: road pricing, socio-cognitive factors, acceptability, activity-travel behavior, stated adaptation experiment

1. Introduction

The previous century is characterized by an extraordinary growth in car use that has continued in the current century (Blythe, 2005). Passenger car use in the European Union grew by 18% between 1995 and 2004 and was responsible for 74% of all passenger transport in 2004 (European Environment Agency, 2008). As a result, in today's society, various car-related problems are manifested, including serious environmental, economic and societal repercussions (Schuitema et al., 2010). It is estimated that urban transport in the European Union accounts for 80% of congestion costs, 15% of all greenhouse gas emissions and annually 20,000 road fatalities (May et al., 2008). Rising concerns over these increasingly intolerable externalities have generated particular interest in how transport-planning policies might moderate the pressures resulting from growth in personal mobility and support the principles of sustainable development (Janssens et al., 2009a).

Although no standard definition of sustainable transport is available (Beatley, 1995), most delineations imply that sustainable transport balances environmental, social and economic qualities (Steg and Gifford, 2005). Generally speaking, sustainable transport could be seen as the outcome of different policy measures that aim at lowering the ecological footprint of activity-travel patterns in an economically feasible manner (Wittneben et al., 2009). These policy measures are commonly referred to as Travel Demand Management (TDM) measures. As indicated by Eriksson et al. (2006, pg. 15), Travel Demand Management measures can be defined as 'strategies aiming to change travel behavior'.

An important policy measure for governments in modifying activity-travel behavior is the introduction of road pricing (Xie and Olszewski, 2011). The term road pricing, also referred to as congestion charging and congestion pricing, can be defined as any form of charging of the use of roads during periods of peak demand (Janssens et al., 2009a). A key issue in making road pricing systems operational is building support for the policy measure.

The objective of this study is to investigate the effect of road pricing on people's tendency to adapt their current travel behavior. In order to reach this goal, we will make use of a two-stage hierarchical model (see Figure 1) concentrated around the concept of public acceptability. By means of this model, three specific research targets will be set. Firstly, we will explore the relationship between adapted travel behavior itself on the one hand and public acceptability as well as its most important first- (i.e., effectiveness and fairness) and second-order determinants (i.e., general environmental beliefs and values, problem awareness, personal norm, and willingness to act pro-environmentally) on the other. Secondly, we verify whether earlier findings concerning the acceptability of push measures replicate for road pricing. In line with previous research (Eriksson et al., 2006, 2008), we expect for instance that public acceptability in case of road pricing, besides being determined by perceived effectiveness and fairness, is rather a function of personal norm than problem awareness. In addition, we expect road pricing to be perceived as a rather unfair policy measure. Thirdly, while estimating the model, latent constructs measured by means of multiple items will not be replaced by the aggregate of their indicators.

In the next Section, a literature review will be provided discussing the concept of public acceptability and the use of two-stage models. Special emphasis will be put on the delineation of the socio-cognitive factors. Consequently, in Section 3 the methodology will be elucidated and the actual interpretation of the various socio-cognitive factors will be highlighted. Afterwards, in Sections 4 and 5, the results will be presented and discussed more in detail. Finally, Section 6 will recapitulate the most important findings and pin-point some worthwhile avenues for policy makers.

2. Literature Review

Together with Schade (2003), Eriksson et al. (2006, pg. 16) define public acceptability as 'the degree of positive or negative evaluation of a TDM-measure that may be implemented in the future.' In line with its basic definition, public acceptability is traditionally operationalized as a single-dimensional concept, captured by means of one (or more) item(s) probing for some kind of overall evaluative assessment such as the degree to which individuals consider a certain TDM-measure is likeable, acceptable, admissible, agreeable or favorable.

In general, studies on public acceptability of TDM-measures concentrate around one main issue which is how to model the concept's origination. According to Eriksson et al. (2006, 2008), two basic approaches can be distinguished within the extant literature.

A first approach is to treat a TDM-measure's public acceptability exclusively in function of TDM-measure-specific aspects with the two most important ones being perceived *effectiveness* and *fairness*. A measure's perceived effectiveness stands for the extent to which a person believes it will

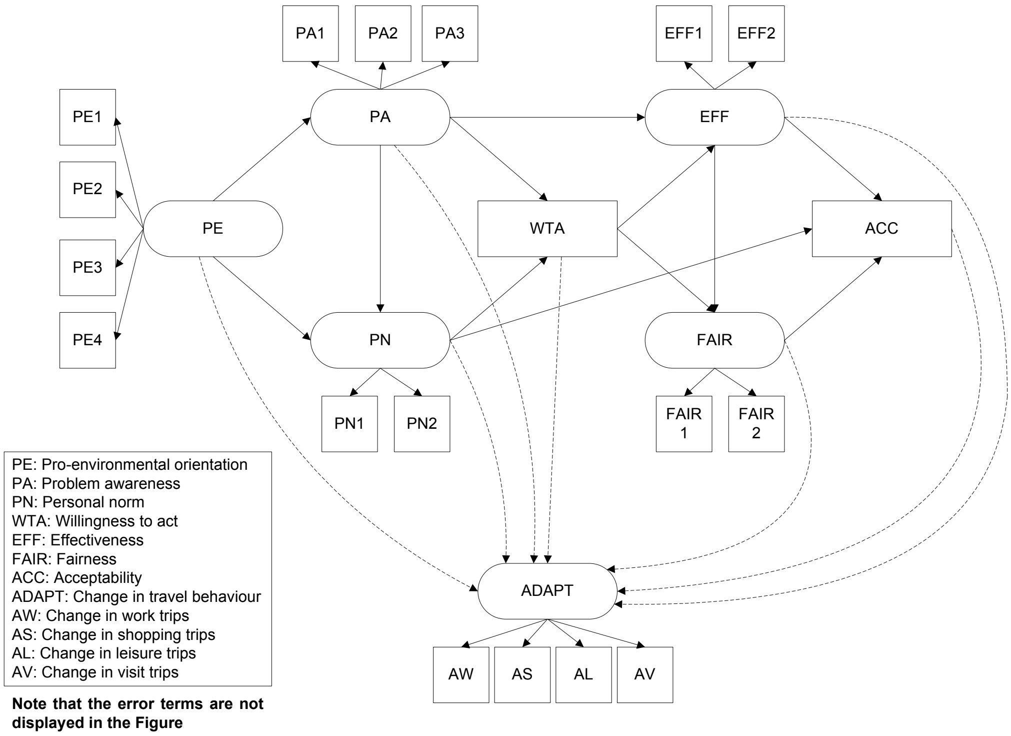

Figure 1: Conceptual model

reach the purpose for which it has been developed (in case of road pricing, the final objective is to reduce car use and thereby diminish human pressure on the ecological environment). Perceived fairness is more a matter of moral legitimacy, i.e., the degree to which a policy measure is seen as ethically just. On the one hand, fairness is seen as a function of the degree to which a measure infringes on personal freedom with the underlying reasoning being that, the more a measure threatens individual freedom, the less fair it is perceived to be (Bamberg and Rölle, 2003). On the other hand, a measure's fairness is considered as dependent upon its perceived effectiveness as well. That is, given a measure is not believed to reach its goal, its implementation is perceived as unfair (Eriksson et al., 2006). In terms of how both perceived effectiveness and fairness structurally relate to a measure's overall acceptability, it is assumed the effect of effectiveness can be direct as well as indirect, i.e., mediated through fairness.

An alternative approach is to treat public acceptability of a TDM-measure as a two-stage hierarchical model, that is, with the inclusion of deeper-lying environmental-related beliefs, norms and values. As indicated by Eriksson et al. (2006, 2008), the primary reason for doing so is drawn from the work of Schwartz (1977) on Norm Activation Theory where he explains pro-social behavior in function of altruistic norms and motives. With pro-environmental actions (such as recycling or reducing car use) seen as typical examples of pro-social behavior, the idea of explaining pro-environmental behavior in function of more deeply ingrained environment-related beliefs, norms and values is perfectly arguable. One of the most popular theoretical frameworks to this respect is the Value-Belief-Norm (VBN) Theory of Environmentalism (Stern, 2000; Stern et al., 1999). One of its basic hypotheses is that *general environmental beliefs and values* determine both the extent to which the individual is cognizant of the environmental problem (i.e., *problem awareness*) and whether s/he feels a personal obligation to contribute to the solution and thus behave in a (more) pro-environmental manner (i.e., *personal norm*). Personal norm and problem awareness in turn, are believed to affect the individual's *willingness to act pro-environmentally.*

3. Methodology

3.1. Two-Stage Model

This paper adopts the two-stage hierarchical model approach, explaining public acceptability by measure-specific aspects (i.e., effectiveness and fairness) as first-stage constructs and variables appearing within the VBN framework (i.e., general environmental beliefs and values, problem awareness, personal norm and willingness to act pro-environmentally) as second-stage constructs (see Figure 1). The starting point is the two-stage hierarchical model proposed by Eriksson et al. (2006, 2008), but addresses the following concerns and issues.

1. *Relationship between public acceptability and changes in travel behavior.* Although lack of public acceptability is widely acknowledged as the single greatest barrier to the implementation of road pricing (see e.g. Gaunt et al., 2007), to the best of our knowledge, no studies focusing on the psychological underpinnings of road pricing, have investigated whether or how public acceptability itself, as well as its most important determinants, relate to people's actual changes in travel behavior.

Put differently, prior research investigating the socio-cognitive underpinnings of road pricing has systematically taken public acceptability instead of behavior as the final outcome variable. This is somewhat surprising since, strictly taken, the key-question when it comes to examining the effectiveness of TDM-measures is not so much to understand what makes such measures more or less acceptable, but *whether* and (even more importantly) *how* acceptability relates to the induction of a behavioral change. Indeed, as for the 'whether' question, although it seems an agreed upon idea that acceptability is an important condition for TDM-measures to make people adapt their behavior, without this assumption being empirically verified, it remains a speculative assertion. As for the 'how' question, we do not know for instance whether it is overall acceptability itself or (one of) its underlying determinants that leads to the desired behavioral change.

2. *The use of latent factors rather than aggregate indicators.* A second issue is related to the way in which two-stage models for public acceptability of TDM-measures have been statistically analyzed. Given the fact that (1) two-stage models are structural by definition with multiple equations to be estimated simultaneously and, (2) variables appearing in such two-stage models are typical latent (i.e., not directly observable) constructs, *Structural Equation Modeling* (SEM) is the preferred approach in terms of model estimation. Interestingly, a closer look at how latent constructs are treated in the literature reveals that, in strict sense, these are not operationalized as full worthy latent constructs. Instead, a typical practice is to have the *unobservable* construct itself being replaced by the aggregation of values obtained for that construct's *observable* indicators (see e.g. Eriksson et al., 2006, 2008). Nonetheless, this practice is to be avoided. First, from theoretical point of view, SEM should be used as a confirmatory approach. As most of the socio-cognitive factors have their operationalization rooted in the theories on the explanation and prediction of behavior, the reflective structure of the latent constructs should be kept. Second, dropping an indicator from the aggregate construct might alter the meaning of the construct and measurement errors are capitalized in this one construct. Third, as the different indicators are likely to be correlated and the direction of the causality is from the construct to the indicators, only a reflective model structure will yield valid results. For a more elaborate methodological discussion concerning the need for a reflective model structure

in this type of analysis, the reader is referred to Bollen (1984) and Jarvis et al. (2003).

3.2. Stated Adaptation Experiment

The research represented in this paper was conducted in Flanders, the Dutch-speaking region of Belgium, by means of an interactive stated adaptation survey, administered on the internet, involving 300 respondents. Although it could be argued that sample bias is introduced when solely conducting an internet-based data collection, internet-based surveys allow for automatic randomization of the ordering of the questions and can be completed at the respondent's discretion. Furthermore, it is simpler to prompt additional questions within the situational context entered in the questionnaire (Janssens et al., 2009a). On the basis of these arguments, it was decided to choose for an internet-based survey rather than a traditional paper-and-pencil survey as the advantages outweighed the disadvantages.

Given that private car use is derived from needs, desires and obligations to participate in out-of-home activities, it is argued that changes in activity-travel behavior in response to road pricing are not one-dimensional and need to be conceptualized in function of the engagement of out-of-home activities (Loukopoulos et al., 2006). Therefore in this paper, changes in activity-travel behavior in response to road pricing for the four most frequent out-of-home activities (commuting (work/school), shopping, leisure and visits), most frequent according to the Flemish travel behavior survey 2007-2008 (Janssens et al., 2009b), are surveyed.

3.2.1. Behavioral Adaptations

For each activity a congestion pricing scenario was formulated of the following general form:
Assume that the fixed vehicle taxation is replaced by a variable road price which is to be paid for each kilometer traveled by car. The charge will be 7 eurocents on roads at un-congested periods, and 27 eurocents at congested periods.

After the introduction of the congestion price measure, the respondents could indicate multiple long-term and short-term adaptations. For each trip for a particular activity, the following long-term changes were considered: (i) a change of residential location of the household (e.g. moving to a location closer to the workplace), (ii) a change of work location of the individual (closer to the residential location), and (iii) no change. Concerning short-term changes the following alternatives were defined: (i) eliminating the trip by conducting the activity at home, (ii) eliminating the trip by skipping the activity, (iii) reduce the distance of the trip by conducting the activity more close to home, (iv) change the transport mode of the trip, (v) change the departure time of the trip, (vi) change the route of the trip, and (vii) no change.

For each activity, these behavioral alterations have been recoded on six point scales (1 representing the smallest impact on the activity-travel behavior, 6 the largest impact): 6 representing structural changes, 5 corresponding to changes in activity situation, 4 indicating a model shift towards environment-friendly transport modes, 3 representing time-of-day changes, 2 indicating route changes, and 1 corresponding to the no change alternative. Thus, four indicators to represent the changes in activity-travel behavior have been obtained: changes in work trips [AW], changes in shopping trips [AS], changes in leisures trips [AL] and changes in visit trips [AV].

3.2.2. Socio-Cognitive Factors

Next to indicating changes in travel behavior, the respondents were asked to answer questions concerning general environmental and policy-specific beliefs. Beliefs are defined as the subjective probability that an object has a certain outcome. The outcome of an object can be judged to be favorable, neutral or unfavorable, referring to the valance of a belief (Schuitema et al., 2010). It was decided to adopt the questionnaire implemented by Eriksson et al. (2008) to assess whether earlier findings concerning the acceptability of road pricing are transferrable across notations.

Concerning *general environmental beliefs*, first, the respondents' *pro-environmental orientation* [PE] was assessed by four items (see Table 1) included in the NEP scale (Dunlap et al., 2000). The respondents had to indicate to what extent they agreed to the statements on a five point scale (1 = strongly disagree, 2 = mildly disagree, 3 = unsure, 4 = mildly agree, 5 = strongly agree). The internal consistency of the latent construct pro-environmental orientation was reassured by a Cronbach's alpha of 0.67. Note that Moss et al. (1998) suggest that an alpha score of 0.60 is generally acceptable. Next, *problem awareness* [PA] and *personal norm* [PN] were assessed by respectively three and two statements. Similar to the pro-environmental orientation, respondents had to evaluate the statements on a five point scale. Alpha scores of 0.91 for the indicators of problem awareness, and 0.79 for the indicators of personal norm, underlined the high internal reliability of the latent constructs. Finally, *willingness to act* [WTA] was directly measured with one item, again measured on the same five point scale.

Table 1: Statements for the indicators of the socio-cognitive factors

Indicator[1]	Statements
General environmental beliefs	
PE1	When humans interfere with nature it often produces disastrous consequences.
PE2	Humans are severely abusing the environment.
PE3	If things continue on their present course, we will soon experience a major ecological catastrophe.
PE4	The balance of nature is very delicate and easily upset.
PA1	Air pollution from private car use is a threat to humans and the environment in the whole world.
PA2	Air pollution from private car use is a threat to humans and the environment in Belgium.
PA3	Air pollution from private car use is a threat to the health and well-being of me and my family.
PN1	I feel morally responsible to reduce the negative environmental effects of my car use.
PN2	I get a guilty conscience if I don't try to reduce the negative environmental effects of my car use.
WTA	I am willing to reduce the negative environmental effects of my car use.
Policy specific beliefs	
EFF1	To what extent do you perceive road pricing to be effective?
EFF2	To what extent do you perceive road pricing will lead to an improved environment?
FAIR1	To what extent do you perceive road pricing to be fair for you?
FAIR2	To what extent do you perceive road pricing to be fair for others?
ACC	To what extent are you in favor or against the implementation of this policy measure?

[1] Abbreviations are indicated in the text between square brackets.

With respect to *policy specific beliefs*, road pricing was evaluated to the extent road pricing was perceived to be effective, fair and acceptable. First, *perceived effectiveness* [EFF] was evaluated by two questions rated on a five point scale (1 = not all effective, 3 = neither effective nor ineffective, 5 = very effective). Second, respondents evaluated *perceived fairness* [FAIR] for both themselves and others using also a five point scale (1 = very unfair, 3 = neither fair nor unfair, 5 = very fair). The internal reliability of both latent constructs was reassured by alpha values of respectively 0.87 and 0.89. Finally, *perceived acceptability* [ACC] was directly measured with one item, again measured on a five point scale (1 = completely against, 3 = neither in favor nor against, 5 = completely in favor).

4. Results

4.1. Descriptive Analysis

Before providing an in-depth interpretation of the results of the proposed conceptual model, first the relationships between adapted travel behavior itself on the one hand and public acceptability as well as its most important first- and second-order determinants on the other, are investigated by means of Pearson correlations between the observable variables.

From Table 2 one could notice that the direct relationship between acceptability [ACC] and changes in travel behavior are not significant, except for visit trips [AV]. Moreover, most of the indicators of the first- and second-order determinants of acceptability neither have a significant relationship with the changes in travel behavior. In contrast, all these indicators, with exception of the first indicator of pro-environmental orientation, do have a statistically significant correlation with perceived acceptability. Next to the relationships between the various indicators on the one hand and acceptability on the other, most of these indicators are highly correlated among themselves.

4.2. Two-Stage Model Results

The estimated model predicting both acceptability of road pricing and behavioral adaptations in response to road pricing, is displayed in Figure 2. Recall that both general environmental and policy specific beliefs were included in the model. One could observe that the final obtained model deviates from the proposed model displayed in Figure 1 as only the significant paths (at the 5% level) were kept in the final model to ensure the parsimony of the model. The whole sample (N = 300) was used in the analysis. Note that the proposed model was tested using AMOS 4.0 (Arbuckle and Wothke, 1999).

To assess the appropriateness of the proposed model, different goodness-of-fit measures were tabulated, for the proposed model, as well as for the independence model and the saturated model. All the tabulated goodness-of-fit and model evaluation criteria (see Table 3) are indicating a good model fit, providing evidence that the proposed model can explain well the relationships between adapted travel behavior on the one hand and public acceptability and its most important determinants on the other hand.

Investigation of the causal relationships between adapted travel behavior on the one hand and public acceptability and its most important determi-

Table 2: Correlation matrix of observed variables included in the model

	AW	AS	AL	AV	ACC	PE1	PE2	PE3	PE4
AW	1								
AS	.259**	1							
AL	.251**	.439**	1						
AV	.268**	.356**	.456**	1					
ACC	.014	.024	.016	.134*	1				
PE1	-.110	-.016	-.024	.004	.092	1			
PE2	.051	.033	.005	.115*	.234**	.398**	1		
PE3	-.040	.027	-.012	.035	.193**	.293**	.433**	1	
PE4	.044	.112	-.010	.105	.144*	.180**	.347**	.353**	1
PA1	.086	.146*	.110	.016	.331**	.239**	.305**	.324**	.283**
PA2	-.002	.106	.049	.057	.306**	.249**	.291**	.361**	.286**
PA3	.013	.105	.055	.043	.299**	.265**	.286**	.388**	.297**
PN1	.111	.136*	.078	.097	.309**	.047	.286**	.256**	.222**
PN2	.060	.120*	.032	.080	.289**	.076	.323**	.274**	.188**
EFF1	.129*	.026	.066	.127*	.690**	.002	.139*	.146*	.162**
EFF2	.042	.095	.014	.095	.694**	.073	.151**	.233**	.165**
FAIR1	-.046	-.041	-.061	.022	.773**	.060	.184**	.140*	.162**
FAIR2	.029	-.019	-.061	.058	.756**	.069	.206**	.170**	.183**
WTA	.037	.033	.078	.129*	.164**	.059	.139*	.160**	.136*

	PA1	PA2	PA3	PN1	PN2	EFF1	EFF2	FAIR1	FAIR2	WTA
PA1	1									
PA2	.740**	1								
PA3	.719**	.882**	1							
PN1	.416**	.375**	.419**	1						
PN2	.370**	.405**	.450**	.651**	1					
EFF1	.366**	.344**	.312**	.254**	.218**	1				
EFF2	.318**	.308**	.284**	.232**	.266**	.774**	1			
FAIR1	.257**	.267**	.266**	.239**	.268**	.651**	.648**	1		
FAIR2	.255**	.245**	.224**	.204**	.274**	.684**	.681**	.812**	1	
WTA	.271**	.304**	.325**	.505**	.412**	.119*	.094	.132*	.072	1

** Pearson correlation is significant at the 0.01 level (2-tailed)
* Pearson correlation is significant at the 0.05 level (2-tailed)

Table 3: Goodness-of-fit-statistics

Model	χ^2/df	CFI	GFI	AFGI	NFI	TLI
Two-stage model	1.41	0.98	0.94	0.91	0.93	0.97
Independence model	16.99	0.00	0.39	0.32	0.00	0.00
Saturated model		1.00	1.00		1.00	

Model	RMSEA	PCLOSE	AIC	BIC	ECVI
Two-stage model	0.037	0.97	297	616	0.99
Independence model	0.231	0.00	2944	3070	9.85
Saturated model	380	1643	1.27		

nants on the other (Table 4), reveals that the behavioral changes themselves are not dependent on the perceived acceptability of road pricing. Moreover, only a relative small amount of the variability in the behavioral changes (10.7%) is explained by the socio-cognitive factors. Nonetheless, personal norm and in particular, perceived effectiveness, have an inducing effect on changes in activity-travel behavior. In contrast, perceived fairness has a

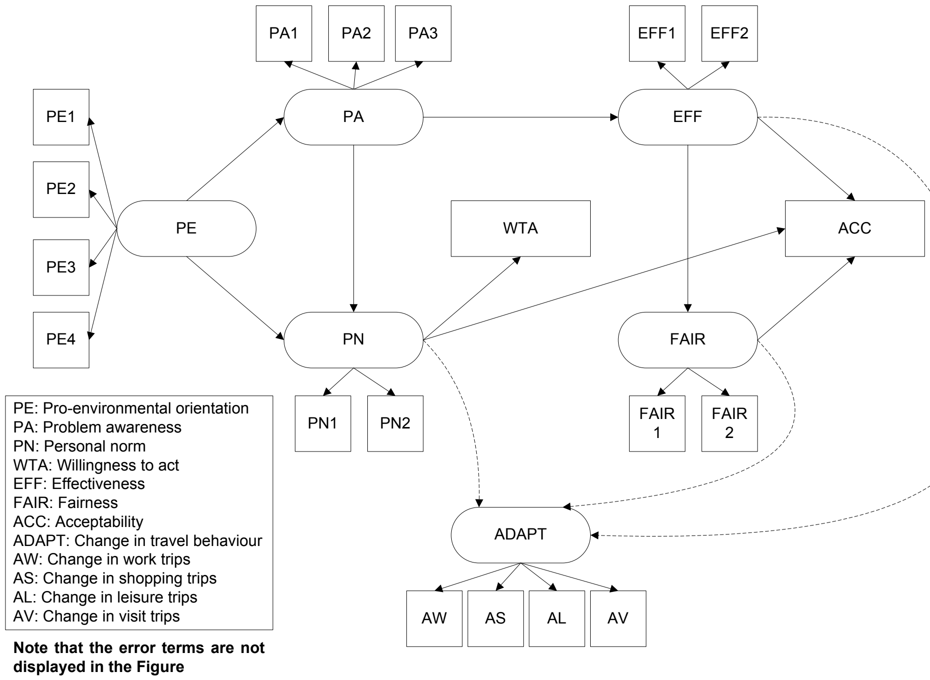

Figure 2: Estimated model

negative effect on the behavioral changes.

An assessment of the total standardized effects (i.e. the sum of direct and indirect effects) displayed in Table 5, yields the insight that next to personal norm, perceived effectiveness, and perceived fairness, also pro-environmental orientation and problem awareness have an impact on behavioral changes, albeit it a small impact.

Evaluation of the regression weights (Table 4) illustrates that acceptability of road pricing is directly influenced by effectiveness, fairness and personal norm: all three socio-cognitive factors have an increasing effect on acceptability.

5. Discussion

Earlier findings concerning the acceptability of push measures could be validated. The fact that effectiveness, fairness and personal norm have an

Table 4: Regression weights, standard errors and standardized regression weights

Path	Est.	S.E.	S. Est	Path	Est.	S.E.	S. Est
EFF → ACC	0.324	0.107	0.246	ADAPT → AW	1.000		0.402
EFF → ADAPT	0.404	0.156	0.477	EFF → EFF1	1.093	0.057	0.885
EFF → FAIR	0.959	0.062	0.838	EFF → EFF2	1.000		0.875
FAIR → ACC	0.711	0.093	0.618	FAIR → FAIR1	1.000		0.901
FAIR → ADAPT	-0.349	0.134	-0.470	FAIR → FAIR2	0.917	0.041	0.903
PA → EFF	0.432	0.067	0.390	PA → PA1 0.899	0.048	0.784	
PA → PN	0.440	0.080	0.425	PA → PA2 1.001	0.037	0.941	
PE → PA	1.044	0.181	0.552	PA → PA3 1.000		0.934	
PE → PN	0.436	0.177	0.223	PE → PE1 1.000		0.473	
PN → ACC	0.141	0.052	0.100	PE → PE2 1.389	0.217	0.680	
PN → ADAPT	0.153	0.073	0.168	PE → PE3 1.391	0.218	0.662	
PN → WTA	0.525	0.056	0.577	PE → PE4 1.042	0.183	0.514	
ADAPT → AL	1.624	0.298	0.706	PN → PN1 1.000		0.846	
ADAPT → AS	1.459	0.274	0.611	PN → PN2 0.969	0.082	0.768	
ADAPT → AV	1.283	0.240	0.625				

Note: Est. = Estimate, S.E. = Standard Error, S. Est = Standardized Estimate
Explained variance: ADAPT 10.7%, ACCEPT 74.1%, FAIR 70.2%, EFF 15.2%, WTA 33.3%, PN 33.5%, PA 30.5%

Table 5: Total standardized effects for road pricing

	PE	PA	EFF	FAIR	PN
ADAPT	0.095	0.104	0.083	-0.470	0.168
ACC	0.211	0.341	0.764	0.618	0.100

increasing effect on acceptability is in line with the model predicting the acceptability of raised tax on fossil fuel (which could be seen as an operationalization of road pricing) presented by Eriksson et al. (2008). The transferability of the results across nations is even further supported by the mutual relationships between the most important first- (i.e. effectiveness and fairness) and second-order determinants (i.e. pro-environmental orientation, problem awareness and personal norm).

Despite the large amount of similarities, the relationships concerning the willingness to act differ between the two studies. Whereas willingness to act was significantly influenced by both problem awareness and personal norm, and had on its own a positive effect on effectiveness and fairness in the study reported by Eriksson et al. (2008), in the study reported in this paper willingness to act was only directly influenced by personal norm, and had on its own no significant impact on effectiveness and fairness. This could be an indication that the concept of willingness to act might be better grasped by a latent factor using multiple indicators.

An important difference between the present study and the study reported by Eriksson et al. (2008) is that the latent constructs measured by means of multiple items in this study are not replaced by the aggregate of their indicators. The appropriateness of using latent constructs is supported by the proportion of the variance that is explained by the model presented in this paper, when compared to the percentage of the variance that is explained by the TAX-model presented by Eriksson et al. (2008). When focussing on the final outcome variable of their model (i.e. perceived acceptability) in the present study, 74% of the variance is explained, while the TAX-model reported by Eriksson et al. (2008) accounts for 58%. Also for all underlying determinants a larger portion of the variance is explained by the model that uses the latent constructs. The largest difference in variance explained could be noticed for perceived fairness: 70% of the variance was explained by the latent construct model, while only 22% of the variance was accounted for by the model using aggregate indicators. Especially for this socio-cognitive factor the reflective structure of the construct contributed significantly.

A controversial finding in this paper is the negative effect caused by perceived fairness on changes in activity-travel behavior. This finding can be partially accounted for by the fact that the monetary value of the road pricing charges must surpass a minimum threshold before people will actually change their activity-travel behavior. This is especially true for the structural changes, such as residential relocations and changes of job location. This is in line with the findings reported by Tillema et al. (2010) who reported that travel costs (i.e. toll and fuel) are a crucial factor in the actual residential location choice in the case of road pricing. Notwithstanding, this finding does not imply that the level of congestion charging has no boundaries. After all, when congestion charges are too high, and no reasonable alternatives are available, people might oppose to the congestion charges and accessibility (see e.g. Condeço-Melhorado et al. (2011)) and equity problems (see e.g. Eliasson and Mattsson (2006)) can arise.

6. Conclusions

In this paper, changes in activity-travel behavior in response to road pricing are treated as a complex psychological phenomenon. The most important finding is that acceptability of road pricing as a single dimensional overall evaluative construct itself does not directly entice changes in activity-travel behavior. As Goodwin and Lyons (2010) reported, there are strong arguments that socio-cognitive factors and actual choices may be ill-matched. The lack of a direct impact of acceptability on behavioral changes supports this hypothesis of mismatching. From policy point of view however, it was argued that road pricing charges must surpass a minimum threshold in order to change a person's mind set in such way that he/she alters his/her activity-travel behavior. This however, does not mean that acceptability can be neglected. A very delicate issue of importance in every (mobility) policymaking program lays in the challenge to shift people away from the self-interest that commonly drives them. Therefore, creating a sound basis of policy support first is essential, especially when push measures such as road pricing are to be introduced (Cools et al., 2009).

How much effort is required to convincing someone to move over to the societal side of the spectrum and thus to create policy support for the policy initiatives is heavily dependent on the individual's values, i.e. the individuals' orientation with respect to how inclusive the measures' impact on their environment is perceived to be (Stern et al., 1999). Homocentric and ecocentric personalities can fairly easily be convinced by focusing the attention on the pressure daily congestion lays on society and the ecosystem. To convince the most radical egocentric members of society to adapt to the new initiative, the before-mentioned negative impact of perceived fairness on changes in activity-travel behavior is of interest here: because of their self-centered mind-set, they will continue to strive for the optimization of their own benefits. Driving more in off-peak hours will therefore become more interesting, since the egocentric human being will experience it as more beneficial when compared to driving during rush hour. As Bonsall et al. (2007) suggest, opportunities for getting these people on board may lay in presenting the road pricing tariff as an off-peak discount rather than as a peak surcharge.

Thus, a main focus point in the strategy of creating broad policy support for road pricing lays in clearly communicating and even providing education on the benefits thereof. It is a matter of convincing rather than seducing the public. In addition, these benefits should be clearly visible for the road users (Schuitema et al., 2010). The rationale "*may need to be communicated in a variety of ways, in both summary and detailed formats, in order to meet the needs and abilities of different types of driver. Significant effort would be required, prior to launch, to explain the reasons for the scheme and the logic of the charging structure, and the system should be trialed with no actual charging to help people become familiar with the charge structure. The development of information services [...] could play an enormous role in helping people to understand, predict and react to variable charges. Government has a role in facilitating this development while staying alert to the equity.*" (Bonsall et al., 2007, pg. 680). Additional issues that have to be taken into account when introducing a road pricing policy on order to enhance the measure's acceptance are matters of technical simplicity and minimized hindrance (Blythe, 2005) and uniformity, clarity and stability in the diversity of tariffs (Bonsall et al., 2007).

Note that an increase in generalized transport costs (e.g. induced by road pricing), may cause accessibility disparities at a regional level (Condeço-Melhorado et al., 2011) and within the population. Certain areas may become economically unattractive and people may be cut off from opportunities because of the increased transport costs. The introduction of congestion charging policies will remain a controversial issue, making it politically risky. Urban planners, policy makers and politicians are forced to consider how they can legitimately introduce a policy that the public may not want. Especially for the latter group of actors, this is an unnatural given. Politicians have a difficult task: to continuously find a good balance between acceptability and efficiency (Eriksson et al., 2008; Isaksson and Richardson, 2009; Rotaris et al., 2010). For a combination of the before mentioned arguments, it is suggested that the responsibility of introducing a road pricing policy is assigned to a higher (national or regional) level of policymaking. In general, a decent preparation and a strong leadership with a clear and well-underpinned vision in mind are essential when bringing a road pricing initiative into practice (Isaksson and Richardson, 2009).

In the attempt of achieving a more sustainable transport, road pricing alone will not counterbalance the growth in car use. As discussed by Jakobsson et al. (2002), even substantial economic disincentives are unlikely to lead to any large reduction in private car use. Therefore, it is important to implement a wider range of policy packages at a higher intensity in application (Hickman et al., 2010). Combined improvements to public transport services and fares, road pricing and integration of land use and transport planning can be instrumental in achieving a more sustainable transport (May et al., 2008). A single policy response is unlikely to encourage changed behavior in all users. The travel market is thus probably best simplified and understood by segmentation into coherent groups that share similar characteristics (Hickman et al., 2010). The key challenge will be to induce the most car-dependent travelers to shift towards more sustainable activity-travel behavior. Even focusing on small changes in behavior might yield significantly larger benefits on the long term, as people who are already inclined to show ecological activity-travel behavior are more likely to express similar behavior.

Once a first step toward an increased environmental awareness is achieved, more significant changes can be obtained more easily (Janssens et al., 2009a).

Appendix A. Model Evaluation

As was indicated before, the appropriateness of the proposed model has been assessed by tabulating different goodness-of-fit and model evaluation criteria. The first criterion that is displayed in Table 3 is the chi-square value divided by the degrees of freedom of the model. Values lower than 2 are generally considered to represent a minimally plausible model (Byrne, 1991). Second, the comparative fit index (CFI) is displayed, which should be greater than 0.95 to represent a good fit (Hu and Bentler, 1999). Next, the goodness-of-fit index (GFI), adjusted GFI (AFGI), normed fit index (NFI) and Tucker-Lewis index are computed. A good fit is indicated by values greater than 0.90 (Hu and Bentler, 1999; Sanders et al., 2005). In addition, the root mean square error of approximation (RMSEA) and PCLOSE are presented. RMSEA values lower than 0.05 indicate a good fit (Browne and Cudeck, 1993). PCLOSE tests the null hypothesis that RMSEA is not greater than 0.05. If PCLOSE is greater than 0.05, the null hypothesis is not rejected, indicating a good fit. Finally, the Akaike information criterion (AIC), Bayesian information criterion (BIC) and expected cross-validation index (ECVI) are displayed. The model with the lowest value is considered to be the best model according to these criteria.

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