Evaluation of an experiment in a driving school "Drive net profit - save energy and environment"

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SYNOPSIS

This paper discusses changes in attitudes and intentions towards driving in a fuel efficient and environmentally friendly way as a result of a specialized driver training programme "Drive net profit - save energy and environment" included in a driving school's program.

ABSTRACT

The paper discusses a framework for studying effects of a driving school project when the teaching material includes a new package on driving a car economically and in a fuel efficient way. The aim is to examine the eventual changes in attitudes and behaviour towards more efficient use of the car. The pupils were split into two groups, of which only the experimental group was offered the new teaching package. The teaching package consists of a short theoretical lesson, and concrete advice during driving practice. An identical inquiry, measuring attitudinal factors and intentions towards fuel efficient car use, was carried out before and after the driving school. A follow-up study might be carried out in late spring 1995 to investigate possible differences in fuel consumption between the experiment and control groups of driving school pupils.

MIMIC-models (i.e. models with multiple indicators and multiple causes) are used to describe relationships between unobservable attitudes towards fuel efficient car use, observable indicators of attitudes, and exogenous causal variables. The 1 - 4 point scaled responses measure the latent attitudes and intended demand for fuel efficient driving habits. The two-wave MIMIC-model makes it possible to model the relationship between attitudes before and after the driving school. The teaching of fuel efficient car use is assumed to change attitudes and encourage new drivers to drive fuel efficiently and thus reduce average fuel consumption. If this is true, it would be a good public investment to include the new training package in an appropriate part of instructions in all driving schools.

1. INTRODUCTION

1.1. Background of the project ' Drive net profit - save energy and environment'

Increasing consumer knowledge of efficient ways of using energy has been widely used as a way to influence behaviour. Private traffic is increasing steadily, and in spite of technological developments improving fuel efficiency, other means of reducing energy consumption in transport are needed (Pekkarinen 1994). Because behaviour is related to our choice of travel mode, it may be most efficient to provide knowledge and education to new drivers in driving schools. They do not probably have fixed beliefs, attitudes, or habits regarding car use.

Therefore MOTIVA, the Information Center for Energy Efficiency established by the Ministry of Trade and Industry in Finland, carried out a project where new fuel efficient and economical ways of driving a car were included as a part of the training. The project was started in August 1994 as an experiment in 15 driving schools, and in 1995 the new ideas will be widely applied in all driving schools in Finland. The evaluation of the experiment performed by the author had two objectives: (1) to examine the effectiveness of a new teaching package for changing attitudes and behaviour, and (2) to provide information for the development of the final teaching package.

1.2. Scope of the study

In this experiment, information on fuel efficient and environmentally friendly driving habits has been included in driver training. The effects of better information and concrete advice on the attitude and driving habits of future drivers were assumed to be positive. It means that the average respondent's reported scores are higher after than before the teaching. The package includes concrete examples about the effects of the following items: (1) car

maintenance, (2) cold starts, (3) idling, (4) unnecessary accelerating, and (4) general points about economical driving, particularly in congestion. Car care includes, e.g. lubrication, correct tyre pressures, and loading of the roof rack 1.

Information influences the beliefs, and possibly the attitudes we have. These in turn can change behaviour. That's why the evaluation of the experimental stage of the project was performed in order to reveal the possible effects of the information on young drivers, and later on all drivers. 2

The controlled field tests provided encouraging results by showing a great saving potential in everyday driving. For example, the use of the block heater saves fuel at the rate of approximately 0,2 - 0,3 l/100 km. The use of a block heater is a threshold issue also for the catalytic converter to function properly. Economical driving which includes several measures mentioned above can save fuel by about 1 l/100 km. Avoiding congested areas can save as much as 2,4 l/100 km. However, there can be a difference between predictions of savings potential from field tests and from the behaviour of car users. Many needs and constraints relating to car use can diminish the willingness and ability to drive fuel efficiently. In this project, the cash savings to the driver himself have been a good motive besides positive energy and environmental effects.

The influence of the project 'Drive net profit - save energy and environment' on the attitudes of young drivers, on their actual car use after the driving school and on fuel consumption were investigated. For controlling the overall effect of driver training, the courses were split into two groups, one experiment and one control group. The same questionnaires were completed by all 401 participants, both at the beginning and at the end of the first stage of the driving school. The courses began in August and September 1994.

The objectives were:

(1) to examine the attitudes and intentions towards using a car in a fuel efficient and environmentally friendly way, due to the new teaching package in the driving school,

(2) to examine the possible differences of, and changes to the attitudes and willingness to drive fuel efficiently
and
(3) to draw conclusions regarding the effectiveness of the information on fuel efficient driving habits.

The positive changes in attitudes and intentions (if they exist) should correlate with more fuel efficient driving habits and lower fuel consumption (Wachs 1991; Sheskin 1991). If this assumption is valid, information provided in conjunction with concrete examples can serve as an efficient way to save energy in transport.

2. DATA AND RESEARCH METHOD

2.1. Questionnaires - before and after the driving school

Data of the pupils' attitudes and opinions was collected using two identical questionnaires, one before and another after the driving school. The two groups were queried about their (1) general opinions and concern for environmental problems and harmful effects of traffic, (2) willingness to take steps towards reducing car emissions in their own residential area, (3) support for different measures to reduce the harmful effects of traffic (e.g., prices, taxes, legislative regulation, speed limits, driving habit changes, switching to public transport, technological improvements), (4) opinions of the easyness of changing driving habits, (5) preferred characteristics of cars (five most important ones), (6) intent to drive fuel efficiently and (7) reasons for fuel efficient driving. 3

All the questions were presented with either 1 - 3 or 1 - 5 point rating scales. The higher rating corresponds to a more favourable attitude towards environmentally friendly behaviour and fuel efficient car use (Henerson 1987). The five most preferred among fourteen different features of a car were elicited from the respondents.

The intentions of the respondents to follow the advice to drive fuel efficiently was used in the MIMIC-models as observed responses of latent willingness to drive fuel efficiently. Summary statistics of both groups before and after the survey are based on mean scores. In order to find significant changes in attitudes due to new teaching as well as differences of changes across sub samples (gender, age, education, access to a car etc.) ANOVA and non-parametric tests were used. After getting the driving licence, new drivers possessing a car were asked to keep a diary of their car use and fuel purchases for about 2 months. The diaries are used to estimate average fuel consumption of new drivers, and to examine the relationships between reported intentions, predicted attitudes and actual behaviour. The results of

the diary study are not presented in this paper because the data is not yet available. Finally, conclusions were drawn as to the total potential savings in fuel consumption by assuming that all new drivers received the same instruction during driver training (70 000 new drivers per year).

2.2. The MIMIC - model of the latent, non-measurable factor

The MIMIC - model of one period can be presented mathematically as a linear equation system. 4 The structural equation is

$$h = g' xq + z, \quad q = 1,...Q \qquad (1)$$

and the measurement model

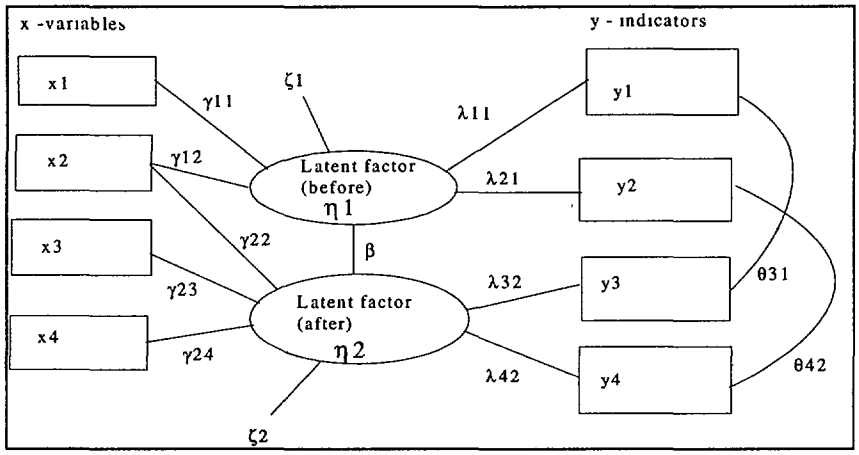
$$yp = l'h + ep, \quad p = 1,...,P \qquad (2),$$

where a vector of x -variables (q x 1) explains a latent directly unmeasurable factor, h. Because the explanatory capacity is not complete, e.g. due to omitted factors, the random error term z is included in Equation 1. A vector of y (p x 1) measures the latent variable h also with errors e (Equation 2). The unknown parameters to be estimated are vectors g (1 x q) and l (p x 1).

Path diagrams are generally used to clarify the relationships between different variables and models in the LISREL - and MIMIC -models. The upper part of Figure 1 describes the relationship before driver training: explanatory variables (left hand side) and indicators (right hand side), and the lower part after training, respectively. 5

Figure 1. Path diagrams for Models of Stability and Latent Factor - panel model

Structural model Measurement model



In the panel model observations are available from the same individuals measured before and after the experiment. The latent willingness to drive fuel efficiently before teaching (h1) in Figure 1, influences the latent driving habits (h2) after teaching. The structural equations differ from the one-period model. The circumstances the respondent faces before the study could also influence post-study intentions, not directly but indirectly through latent driving intentions (b) reported before driver training. The unknown parameters g describe partial effects of causal variables on latent factors if no other factor changes. The same variable can influence the latent factor both before and after the experiment (g12,g22). The measurement errors (e) can correlate over time (q31, q42) due to memory or retest effects (same questionnaire and questions, with a few months' interval between surveys).

This relationship is shown as a structural equation for h2

$$h2 = bh1 + l'2\ xq,2 + z2, \quad p = 1,...,P. \qquad (3)$$

Measurement models are the same for both states, before and after (see Equation 2). Ly is a parameter matrix (2p x 2) that describes how well all attitude indicators measure the latent driving habits before and after the surveys. Since h is not measurable, one of the indicator parameters, l is fixed to equal 1 because of the model identification. After finding a satisfactory model, the predicted values of willingness to drive fuel efficiently can be produced and entered into the model of fuel demand or fuel use efficiency. The fuel consumption is assumed to be a function of personal characteristics, travel condition variables, car characteristics and latent intentions of driving habits. Finally, a demand equation of fuel consumption takes the form

$$Fi = f(pf, Zi, C, hi; m), i = 1,..,N \qquad (4)$$

where F is fuel efficiency (liter per 100 km) for an individual i, pf is the price of fuel used, Zi is a vector of personal characteristics. Vector C contains all attributes related to car use (distance to work place, services, car attributes), h is the predicted intent to drive fuel efficiently. Fuel efficiency is the ratio of purchased fuel and car kilometers. The fuel efficiency is assumed to be conditional on given information (m), which is described by the change of latent driving habits due to the training.

3. RESULTS

3.1. Effects of a new teaching package - changes in opinions and attitudes

A total of 401 questionnaires examining the pre-driving-school attitudes were received. In the control group there were 92 and in the experimental group 309 respondents.No systematic differences between the two groups were found before the driving school. Acceptable questionnaires after driver training were received from 160 (52 %) respondents in the experimental group and 35 (38%) in the control group by February 1995.

Background factors

Table 1 Background factors in the experiment and control group

	Experiment group	Control group
	Mean before N = 160	Mean before N = 35
- Gender (1 man, 2 woman)	1.52	1.60
- Age	18.09	19.23
- Level of education1	2.01	1.86
- Distance to nearest bus stop, km	0.520	0.350
- Distance to nearest grocery shop	1.240	1
- Distance to work or school	7.630	6.960

1 Level of education was classified on a scale of 1 - 6.

Due to non-responses after driving school, the respondents in the experiment group are a little younger, have a lower education (in relation to age), and live further away than respondents in the control group. The proportion of men is a bit higher in the experiment group than in the control group. These small differences may influence the results, so that the significance of various changes in attitude is more difficult to prove, because women have higher attitude scores than men in both situations.

Intent to drive fuel efficiently

The findings concerning indicators of willingness to drive fuel efficiently are presented in Table 2. The six different ways of consuming less fuel and saving money and the environment included in the teaching package are as follows

- to drive economically (using the accelerator, changing gear in a proper way)
- to avoid idling
- to follow the rhythm of other traffic
- to avoid congested areas, routes and times
- to avoid unnecessary accelerating
- to avoid cold starts (use of the block heater when the outdoor temperature is + 5 0C or less).

Table 2. The mean willingness scores for ways of driving fuel efficiently in the experiment and control groups before and after the driving school

Scale: 1 = never, 2 = sometimes, 3 = often., 4 = always when possible (5 = cannot say is exc.)	Experiment Mean score Before	Experiment Mean score After	Control Mean score Before	Control Mean score After
Drive economically	3.28	3.57	3.45	3.57
Avoid idling	3.50	3.64	3.49	3.42
Follow the rhythm of traffic	3.54	3.65	3.65	3.64
Avoid congestion	3.52	3.65	3.62	3.54
Avoid unnecessary accelerating	3.17	3.45	3.32	3.15
Avoid cold starts	2.76	2.99	2.89	3.00

The results in Table 2 show that teaching concrete ways to save energy and environment does effect on the stated intentions. The respondents intend to drive in a fuel efficient way 'always when possible' after the driving school; whereas they intended to drive in such way only 'often' before the school. Intentions to avoid unnecessary acceleration have also increased after the surveys. All mean scores have increased in the experiment group, whereas only 'Avoid cold starts' and 'Drive economically' have increased slightly in the control group. However, only the means of changes in 'Avoid unnecessary accelerating' are significantly different ($p = 0.036$, one-way ANOVA test) between the experiment and control groups.

Reasons for following advice for driving fuel efficiently

When asked about the reasons for following advice to drive fuel efficiently, the most important reason given both before and after the driving school was economic (money) benefits. Reduction of harmful environmental effects, conservation of energy for future generations and lower energy use as a nationally beneficial action had high scores, as well. The mean score was between 'quite important' and 'very important'. All reasons were considered equally or more important after school than before.

Five most preferred features of a car

When considering the set of preferred features of a car, low fuel consumption, for example, would reveal something about the respondent's attitudes towards environmental issues or money constraints. If the importance of the low fuel consumption variable increases during driving school, it could be a result of the education and training. The proportions of the respondents who chose those factors among the five most important features of a car are shown in Table 3. Low fuel consumption, traffic safety and reliability in use were the three most popular features both before and after the driving school. Their popularity was higher in the experiment group after teaching than before. In the control group only reliability in use was higher after than before teaching.

Table 3 Proportions of the five most preferred features of a car named in the experiment and control groups before and after driving school with indication of the direction of the change

	Experiment (%)			Control (%)		
Features of a car:	Before	After	Change	Before	After	Change
Spacious inside	19	18	--	26	26	nc
Luxury feeling	4	1	--	3	6	+
Good acceleration	17	6	--	20	21	+
Low fuel consumption	90	92	+	86	85	--
Reliable in use	76	81	+	80	85	+
'Smart' outlooks	13	7	--	17	9	--
Cheap insurance	31	34	+	17	21	+
High top speed	2	1	--	6	6	nc
Safety in traffic	86	92	+	89	85	--
Good trade-off value	13	11	--	14	6	--
Low purchase price	60	50	--	40	38	--
Large space for luggage	4	3	--	3	9	+
Comfortable to drive	72	70	--	74	59	--
Block heater	24	36	+	29	41	+

The plus and minus signs in Table 3 mean that the choice proportions of that car feature were higher (+) or lower (-) after driving school than before driving school. If the proportions are same, no change (nc) were found. The changes in the proportions of choosing 'Safety in traffic' and 'Good acceleration' differ significantly between the experiment and control groups. However, because the data consists of answers from the same individuals at two different stages, it is possible to say that choices of all other characteristics except 'Block heater' have increased in the experiment group but in turn decreased in the control group. This is a weak evidence that the new information to the pupils in the experiment group has influenced their preferences of a car positively.

Concern about environment and harmful effects of traffic

The respondents were asked to react to five claims measuring general concerns about the environment and harmful effects of traffic. Those were: (1) Air pollution is a serious problem in Finland; (2) Air pollution is a serious problem in my residential area; (3) Energy must be saved for future generations; (4) Car traffic causes most of the air pollution; (5) It is worthwhile for an individual to act environmentally friendly although others do not. Surprisingly, the respondents disagreed with the statement that air pollution is a serious problem in their own residential area. Both the experiment and the control group agreed on the claims equally or a bit stronger after the driving school than before.

Support for concrete measures to reduce the harmful effects of traffic

The support for different ways to reduce fuel consumption and pollution by influencing car traffic was also asked. A four point scale was used, excluding the 'undecided' from the analysis. The higher the number the greater is the support. The measures can be grouped into economic tools, legislative regulation and development tools. The changes in support were small but some interesting findings were made. The experiment group supported on average the changing of driving habits more strongly after the school, whereas the control group did not. Changes in the support for car taxation differentiation according to fuel consumption differ across groups. Again, the respondents receiving new training supported it more and the pupils in the control group less after the school.

3. 2. Differences of changes in attitudes across gender

The respondent's age, gender, level of education and residential area represent the different circumstances in which they live, and possibly the differences of, and changes in attitudes they have. The accessibility of public transport,

groceries and work or school, were also investigated. Long distances to work or school would encourage a young licence holder to use a car because of inadequate public transport services. On the other hand higher travel costs due to longer distances would encourage fuel efficient car use.

Men and women had significantly different opinions and attitudes in their willingness to follow the advice to drive fuel efficiently, both before and after the driving school. However, the changes in answers did not differ significantly across gender. This means that women had a higher level of attitudes towards environment, reducing car traffic, and changing own behaviour than men. There were some questions where the gender difference was less significant after the driving school, than it had been before. For instance, 'Avoid idling' and 'Avoid cold starts' were not significantly different between genders after, although they had been before the driving school. Of the most preferred features, the choice of a block heater increased more among women than among men.

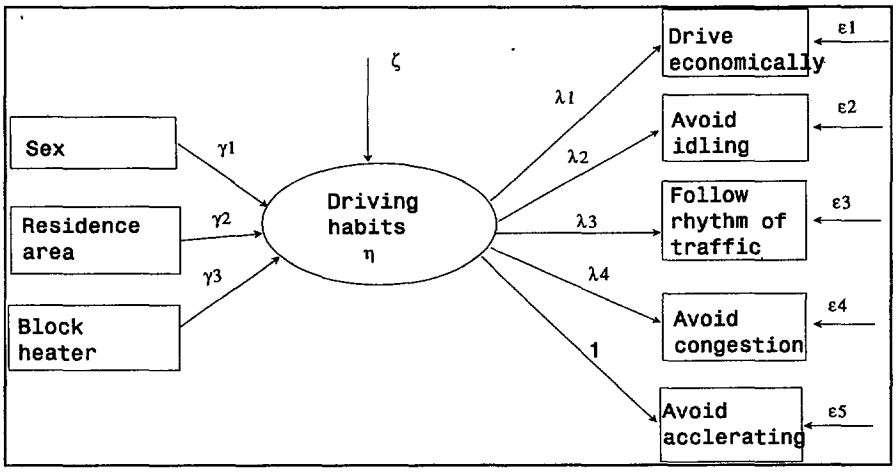
3.3. Model specifications and estimation results

Because the interest of the work is in the change of latent attitudes, we prefer to use a one-wave MIMIC-model (Model A) including one structural equation (relationships of h and x -variables) and five measurement equations (y -variables and h); a panel measurement model (Model B) with twelve measurement equations, and a panel MIMIC-model with two structural and ten measurement equations (Model C). The polychoric correlation matrices that were used as the model inputs are not presented here. The models were calculated using the maximum- likelihood method.

MIMIC-model of latent driving habits before driving school (Model A)

The theoretical, schematic introduction of MIMIC-models is given in Section 2.2. The latent attitude of driving habits (h) towards fuel efficient car use is assumed to be influenced by the respondent's gender (0 man, 1 woman), type of residential area (2 metropolis area of Helsinki, 1 other cities, and 0 other areas) and their preferred car features (block heater; 0 no, 1 yes). Because the latent variable is unobservable and unmeasurable, the observed indicators (rating scaled intents) are used to measure the latent driving habits (see, Figure 2 right hand side). The pre-assumption was that the best measure for h is 'Avoid unnecessary accelerating (y5), and so it is fixed to equal 1. The path diagram of latent willingness to drive fuel efficiently in the case of Model A is given in the figure below.

Figure 2 MIMIC-model for driving habits before the teaching (Model A)



The presumptions made were that women have stronger positive attitudes towards driving fuel efficiently and environmentally friendly than men. The lower the class of the residential area, the stronger the respondents' willingness to drive fuel efficiently is assumed to be (longer distances, higher car need, higher fuel prices, lower income). The choice of block heater as an important feature of a car is assumed to indicate the willingness to drive fuel efficiently.

The results of three specified models are given in Table 5. The goodness-of-fit in Table 4 measure adjusted by sample size (AGFI) is (0.933), and the root mean square of residual is 0.04. Both measures show that Model A is

quite good. The measurement model is also satisfactory as its total determination is 84 %. Model A can explain the willingness to drive fuel efficiently by 35 % which is not good. This means that the model needs more variables in the structural equation. Women have more positive attitudes towards driving fuel efficiently than men before driving school as expected. The coefficients of residential area and the block heater have expected signs, but both are insignificant.

Panel measurement model of latent driving habits (Model B)

The objective is to find a stable and good measurement model for the latent willingness to drive fuel efficiently including two time periods, before the new teaching and after it. The possible impact of the new teaching is caught by a dummy variable, which has the value of 1 if an individual is in the control group, otherwise the value of the dummy variable is zero. In this model, six measures were chosen, five mentioned in Figure 2 plus 'Avoid cold starts'. The results of Model C are presented in Table 5. The goodness-of-fit measures (Table 4) are slightly worse than in Model A, but the measurement model can determine the latent driving habits by nearly a hundred per cent. This means that the chosen indicators are effective.

The indicator coefficients are all higher after the driving school except the measure 'Follow the rhythm of traffic'. The ability to measure the latent factor is thus better after the driving school than before. The size of b -coefficient is 0.95 (very significant) which means that the measurement model is stable. The construction of measurement with the chosen indicators has not changed between the two points in time. There is some positive autocorrelation over time related to indicators 'Drive economically', 'Follow the rhythm of traffic' and 'Avoid cold starts'. The error terms of 'Follow the rhythm' and 'Avoid unnecessary accelerating' are correlated with the indicator of 'Avoid congestion', all positively.

Two-wave MIMIC model of latent driving habits (Model C)

The two-wave MIMIC -models are models where the latent willingness of the respondent to drive fuel efficiently before the driving school can influence the willingness of the respondent after the driving school. If the hypothesis of zero impact can be rejected, it means that the respondents in the control and experimental groups have a different willingness to drive fuel efficiently. The results of the two-wave MIMIC -model are shown in the last column of Table 5.

The total coefficient for the determination of y in Model B (0.958) shows that the chosen indicators can measure as a group the latent driving habits (drive fuel efficiently) very well. According to the squared multiple correlations for the y-variables, chosen indicators measure better after driving school than before (not shown here). Correlations are almost twice as high after than before.

The total coefficient of determination for the structural equations (0.51) in the two-wave model (Model C) shows that gender, car features and a dummy for the control group can explain the latent willingness to drive fuel efficiently better than in Model A (0.346). Now the coefficient b (0.86) presents also indirect effects of x-variables before driving school on the latent willingness after driving school (replacing h1 in Equation 3 with Equation 1). The author performed trials to include some of the more general attitudes in the models. The modelling is under process and more information is available by request from the author.

Table 4. The goodness-of-fit statistics of Models A, B and C

	Model A	Model B	Model C
Chi-square, c2	18.09	78.85	408.29
df.	13	45	69
AGFI	0.933	0.863	0.702
RMS	0.04	0.056	0.079
Total coeff. for y	0.841	0.99	0.958
Total coeff. for x	0.346	-	0.510

Table 5 Estimation results of three models of the latent willingness to drive fuel efficiently (h1, h2)

Parameter coefficient	Name of variable	Model A Before MIMIC-model	Model B Panel model	Model C Panel MIMIC-model
Indicator coefficients:				
l1	Drive	0.97(6.72)	0.81(5.66)	0.76(7.20)
l2	economically	0.73(5.46)	0.80(5.60)	0.70(6.65)
l3	Avoid idling	0.63(4.96)	0.73(5.28)	0.70(6.59)
l4	Follow rhythm	0.37(3.17)	0.63(5.04)	0.74(6.96)
l5	Avoid congestion	1.00	1.00	1.00
l6	Avoid acceler.	--	0.29(2.22)	--
l7	Avoid cold starts		0.88(11.9)	0.92(13.68)
l8	Drive econ		0.85(8.93)	0.79(11.00)
l9	Avoid idling		0.59(6.99)	0.56(7.07)
l10	Follow rhythm		0.76(10.1)	0.85(12.10)
l11	Avoid congestion		1.00	1.00
l12	Avoid acceler.		0.36(4.16)	--
b	Avoid cold starts		0.95(6.52)	0.86(8.45)
Causal coefficients:	From h1 to h2			
l1		0.43(6.96)	--	0.38(6.14)
l2	Sex(h1)	- .03(-	--	--
l3	Residence	.05)	--	0.09(1.56)
l21	area(h1)	0.07(1.30)	--	--
l23	Block heater1(h1)	--	--	-.15(- 2.27)
l25	Sex(2)	--	--	0.31(4.51)
l26	Block heater1(h2)	--	--	-.26(- 5.19)
	Block heater2(h2)	--		
	Group dummy h2)			

t-values in parentheses

4. DISCUSSION

Attitude campaigns for increasing knowledge of fuel efficient and environmentally friendly driving habits are often used to encourage drivers to think about the consequences of their behaviour. However, there is a lot of evidence that general information does not necessarily change to actual behaviour. Providing the target groups with selective information can be more influential in changing people's action in everyday life. If we could increase the influence of information by making it more concrete and offering special means of affecting fuel consumption through the driver's own action, and if this targeting behaviour resulted in money savings, there could be more savings potential in attitude campaigns as well.

This work evaluates the possible changes of attitudes and intentions of pupils at driving schools when they (experiment group) have received special advice and concrete examples of how to drive with low fuel consumption, and in that way save money and reduce environmental damage.

The pupils of the experiment group have more positive attitudes towards the features of cars relating to fuel efficiency after the driving school. A total of 92 % of the respondents did choose 'Low fuel consumption' as one of the five most important features of their future car, whereas in the control group 85 % made a similar choice. In the experiment group one tenth of the respondents no longer chose 'High acceleration' as a preferred feature after the driving school, whereas the proportion of the choices rose little in the control group. Higher intentions of following concrete means to reduce the fuel consumption of the car were responded after the driving school. Mean scores regarding the driver's intent to avoid unnecessary accelerating and idling increased after the driving school in the experimental group, but decreased in the control group, respectively. Willingness to drive fuel efficiently differs between men and women for all six means before the project. After the project only the willingness to drive economically and avoid unnecessary accelerating differ across gender. It seems that the new teaching has been influential, especially on young men. The project 'Drive net profit - save energy and environment' has shown that a large fuel-saving potential can be found in the drivers' own behaviour. If every new driver follows the given advice concerning fuel efficient driving, a maximum of 14 million litres of fuel could be saved per year (70 000 new drivers, 20 000 kms per year, fuel saving 1 l/100 kms) which means an economic saving of about 12 MECU per year.

The results from the MIMIC -models (Table 4 and 5) show some interesting relationships between the causal variables (gender, residential area, block heater feature) and the latent willingness to drive fuel efficiently, and on the other hand relationships between latent driving habits and indicators that measure those habits. It seems that the concept 'Avoid unnecessary accelerating' is a successful measure, and that the other indicators (Drive economically, Avoid idling, Follow the rhythm of traffic, Avoid congestion and Avoid cold starts) measure the willingness less strongly. The weakest measure is 'Avoid cold starts' and therefore it was excluded from the MIMIC -models A and C (Table 5). The beta coefficient is almost one (0.95) in Model B and (0.86) in Model C, which means that the measurement model is stable over two stages. It also produces the means of including the impacts of exogenous factors on willingness to drive fuel efficiently after the driving school through the latent factor before driving school.

This work is one stage in the evaluation of the effectiveness of the project "Drive net profit - save energy and environment ". When an information campaign provides very concrete advice relating to everyday driving, it might be effective in improving the car users' knowledge of their own ability to reduce fuel consumption. Good results, however, demand that different interest groups, in this case driving schools, governmental institutions and organisations, work together to maximise the motivation at different stages of the project. Future work will also concentrate on positive impacts on fuel consumption.

5. ACKNOWLEDGEMENTS

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6. ENDNOTES

1. Special boxes for carrying skiis are widely used in Finland in wintertime and it were estimated that avoiding unnecessary use of the box, including unnecessary loads in the luggage space, can save one liter of fuel per 100 kilometers. Drivers can thus save about 125 ECU (720 FIM) per year.

2. The role of attitudes and intentions in modelling consumer preferences, see Mitchell and Carson (1989); Sheskin (1991), Kahneman and Snell 1992; Castleberry, et al (1994).

3. Previous research about surveys concerning environmental and energy attitudes, see, e.g. Uusitalo (1986); GŠrling and Sandberg (1990); Nurmela (1990).

4. Structural equation modeling for latent variables (Full LISREL model, MIMIC model) and estimation procedures, see, e.g. Jšreskog, Sšrbom 1989; Diamantopoulos 1994).

5. The causal variables can also be directly unmeasurable and unobservable variables (x) which extends the model to the full LISREL model. According to the Fishbein -Ajzen model (Mitchell and Carson 1989, 179), for instance, a general concern for the environment and energy resources can explain attitudes towards driving fuel efficiently or the intent to drive in that way more properly.

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