



SCHOOL OF ECONOMICS
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Eco-driving?

- A discrete choice experiment on valuation of car
attributes

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Abstract

To elicit the value that car consumers place upon environmental concerns when purchasing a car, a certain type of Discrete Choice Modelling called Choice Experiment was used. The Choice Experiment includes the four car attributes safety, carbon dioxide emissions, acceleration and annual cost. The survey was sent to a random sample of 1500 people in Sweden between 25 and 50 years of age in October 2006. The data collected was incorporated in a binomial logit model from which the coefficients of the utility function for cars were estimated. Both the estimated values of Willingness to Pay and the Marginal Rates of Substitution gave indications that the private goods safety and acceleration are higher valued than a genuine public bad such as carbon dioxide emissions. The result also showed that the design of a Choice Experiment can have impact on the values obtained.

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1. Introduction

The environmental problem of global warming has placed itself on top of the agenda. Stricter environmental policies and measures are considered important in order to curb the emissions of greenhouse gases. The transport sector is becoming an increasingly more important emitter. It was responsible for 19 % of global emissions of greenhouse gases in 1971, which had risen to 23 % in 1997 (Åkerman et al, 2006). In 2001, the road transport in Sweden constituted of 29 % of the emissions in Sweden (National Road Administration, 2004).

The trend explains why there is a general agreement on stricter policies needed in the transport sector, particularly focusing on improved energy efficiency. The current voluntary agreement between the European Commission and the European Automobile Manufacturers Association (ACEA), to reduce emissions from newly produced cars to 140 grams of carbon dioxide emissions by 2008 will not be reached, thus probably resulting in a legislatively binding target by 2012. The target will limit the average new car sold in Europe to emit 120 grams of carbon dioxide per kilometre. At present the EU average is at 163 grams per kilometre (The Swedish National Road Administration, 2007).

In Sweden the situation is more troublesome. The country has the most emitting fleet of vehicles in the whole of Europe. On average, a new car sold in Sweden emits 189 grams of carbon dioxide per km, significantly higher than the EU average (The Swedish National Road Administration, 2007). Such a result could be considered to be in conflict with the general view among Swedes of themselves being a people concerned about environment.

The thesis purpose is to answer the following research questions:

1. How much is an individual willing to pay for contributing to lower carbon dioxide emissions when choosing a car?
2. How large is the Willingness to Pay (WTP) for lowered carbon dioxide emissions compared to the WTP for other attributes?
3. Do the preferences for carbon dioxide emissions differ depending on socio-demographic characteristics?

The purpose is also to present issues around survey design. There is no attempt made to discuss policy implications of the results.

1.1 Outline of the study

In the next chapter, chapter 2, includes the theoretical framework. The concept of Willingness to Pay is presented, and the different approaches used in order to elicit this value. Further, the particular method used, Choice Modelling is described and why it is appropriate to use for valuation of car qualities. The theory behind the subset of Choice Modelling used in this study, Choice Experiment, is presented. Chapter 3 handles the design of the choice experiment in question. The chapter is extensive due to the fact that there was no prior research performed on the subject and the whole choice experiment and survey had to be designed from zero. Chapter 4 presents the results. It presents the results both from the descriptive statistics in the survey and the results from the regression estimates of the Choice Experiment. In Chapter 5 the results presented in the prior chapter are analyzed more profoundly and discussed. Chapter 6 gathers conclusions from the survey and suggests areas for future research.

2. Theoretical framework

The chapter will explain basic concepts needed to use a Choice Modelling approach to elicit the value that WTP can take for certain attributes of a good, in this case, a car.

2.1 Willingness to Pay

The concept of WTP is defined as the amount an individual is willing to pay to acquire a particular good or service. A value on WTP is needed in a case where no market of the good exists and consequently the good has no explicit price. To reveal the WTP is crucial in order to maximize welfare for society as a whole. Environmental goods, which are goods without explicit market prices, have to be given economic values in order to optimize the allocation of scarce resources. This explains why economists during the last thirty years have tried to place monetary values on these (Alpizar et al, 2001).

A car is a good sold on a market with an explicit price. However, the purpose is to find the WTP for particular attributes of cars, which separately have no explicit prices. The most relevant attribute of the study is that of lower carbon dioxide emissions for people purchasing cars. The WTP value will be compared to values obtained for other car attributes.

2.2 Methods to elicit the Willingness to Pay

Two broad approaches can be applied to determine the value which people place upon non-market assets: revealed and stated preferences techniques. When relying upon revealed preferences in the valuation exercise, economists use market information and behavior related to traded goods in order to infer values of non-market goods. The connection to real life actions is the main advantage of the method and thus it should be used when WTP can be inferred from an individual's actual decisions. Revealed Preference techniques have previously been used to elicit WTP for car attributes (see Andersson 2005 - Atkinson et al, 1990 – Dreyfus et al, 1995)

However, to obtain sufficient data to indirectly infer the revealed preferences for non-market goods can be quite difficult. A car market is a good example of such a situation. It consists of many different models and brands which all have different qualities. The factors that explain why a consumer choose a particular model can be numerous and sometimes not even possible to explain. It could be a matter of personal feeling not possible to incorporate in a theoretical model. Instead, as with the situation of car preferences, hypothetical scenarios can be created in order to try to find the preferences and put a WTP on these. Such a model is called a Stated Preference Method and is becoming increasingly popular for valuation of non-market goods (Alpizar et al, 2001, Bateman et al, 2002).

The Stated Preference Techniques are separated into two groups: Choice Modeling Techniques (CM) and Contingent Valuation Methods (CVM). Contingent valuation is the most common stated preference method applied. The method is well rooted in welfare economics and has been used for more than 30 years for evaluation of environmental goods. By means of an appropriately designed questionnaire, the respondent is given information on the environmental good or bad, the institutional and policy context in which it is to be preserved or mitigated, and the means by which this will be financed (OECD, 2007). The respondent is asked either how much he/she is willing to pay for a certain level of a non-market good, or how much he/she would be willing to accept to loose the good. Criticism has been put forward to such a hypothetical setting as it runs the risk to overestimate the WTP for the good in question. First of all, many of these questions are asking for valuation of goods that for most people have no actual monetary value. Hence, it makes it difficult for the respondents to know how to value the good in questions, which could result in an overestimation. Secondly, a situation where the scenario is hypothetical, the respondent knows that he or she will not be forced to pay this money in real life and thus have no incentive to more closely consider if the stated WTP is similar to his or her "real" WTP. This is

particularly obvious in a case with dichotomous choice where the amount of money is stated in advance. Moreover, the model is not suited to deal with cases where changes are multidimensional (Hanley et al, 2001), such as a case where several car qualities are changed at the same time.

To conclude, there are certain obvious drawbacks with the CVM technique in order to elicit WTP values. The method could be used in order to extract a WTP value on reduced carbon dioxide emissions from cars, but would face all mentioned problems of how this value actually could be interpreted and related to reality. In addition, one of the purposes of the study is to analyze the size of the WTP for reduced carbon dioxide emissions in relation to the WTP for other car qualities. Such a result would be more difficult to obtain with a CVM approach. Instead, a model that allows valuation of more than one quality of cars is better suited for the purpose in question. Such models are grouped under the name Choice Modelling (CM) techniques.

2.3 Choice Modelling

Choice Modelling (CM) is the common name for a group of survey-based methodologies where goods are described in terms of attributes and levels that these take, in contrast to CVM where the good is described as the good itself and thus the WTP is stated directly (Alpizar et al, 2001 - Hanley et al, 2001). Such property explains why the model mostly has been used for marketing purposes.

In addition to having advantages of focusing on attributal changes it is considered advantageous as the trade-off can be expressed in terms of goods instead of in monetary terms, like in CVM. Such a property explains its increased use to value institutional and environmental changes. People tend to feel uncomfortable trading off money for environmental attributes. In a situation where the WTP is inferred indirectly and the respondent need to do a trade-off, it is more difficult to behave strategically which can decrease the risk of overstating WTP (Hiselius, 2005 - Ryan, 2000).

The Choice Modelling also faces downsides. First of all it runs the risk of creating a cognitive burden for the respondents. Too many attributes and levels included can result in a survey very difficult for the respondents to comprehend. Both experimental economics and psychologists have found evidence that there is a limit to how much information respondents can handle while making a decision. The random errors seem to increase simultaneously as the number of choice set increases (Bateman et al 2003). Thereby, an internal consistency test should be incorporated in the survey (Hanley et al 2001). Secondly, although the model includes a trade-off situation, it is still sensitive to survey design and that the accurate levels and descriptions are included in the choice sets (Bateman et al, 2002). Hence, the risk to over or underestimate WTP with CM should not be neglected. In order to test for these differences, the Choice Model can include several survey designs.

2.3.1 Choice Experiment

To obtain the coefficients in order to elicit the WTP for carbon dioxide emissions and compare this to the WTP of other car qualities, a certain type of CM is used, called Choice Experiment (CE). It is a subset of the CM technique and has mainly developed within the field on transport and environmental economics (Ryan et al, 2000). In a CE, the respondent is presented to a number of discrete choice situations and asked to choose the most preferred. One scenario is typically defined as the status quo (defined as no buy or, alternatively, to stick with the default scenario).

The Lancasterian microeconomic approach is the source of inspiration for the Choice Experiment technique; utility is derived from the commodity attributes rather than the commodity itself. The contribution of each attribute is the part-worth of the utility function. The choice situation makes it possible to estimate the relative weight of each attribute, i.e. the Marginal Rate of Substitution (MRS) (Hiselius, 2005). By including price/cost as one of the attributes, WTP can indirectly recovered be from the choices

made (Hanley et al, 2001). One benefit with CE is that each choice involves explanation of a number of attributes and thus much information can be elicited from each choice situation (Alpizar et al, 2001).

The Choice Experiment builds on the Random Utility Theory. It is based around an alternative theory of choice to that used to derive conventional demand curves (Bateman et al, 2002). An individual J 's utility from a certain car is stated by a utility function where the utility depends on the characteristics, Z , of the car. Some of the characteristics included in Z are not known to the researcher. To illustrate such a situation, the conventional utility function is broken down into two parts, one observable part V and one error part, ε . In addition to the car attributes that the utility function consists of, there are a number of socio-demographic characteristics, S , as well, which affect both the observed and the unobserved part. The utility function for an alternative A can be illustrated as in equation 2.1.

$$U_{Aj}(Z_{Aj}, S_{Aj}) = V_{Aj}(Z_{Aj}, S_{Aj}) + \varepsilon(Z_{Aj}, S_{Aj}) \quad (2.1)$$

When an individual J is asked to choose between two cars (A and B), differentiated by the different levels of the attributes included, the individual is assumed to compare the utility he/she would get from either choice, and select the car giving highest utility, as the individual is assumed to be a utility maximizer. The error term is included as the respondents may assess the options according to information other than shown and thus not possible to elicit from the survey. The list of available options is referred to as the choice set, which in this case includes two alternatives.

Given that an error component is incorporated in the utility function, no certain predictions can be made and the analysis becomes one of probabilistic choice. The probability that individual J prefers car A over car B can be expressed as in equation 2.2.

$$P[(V_{AJ} + \varepsilon_{AJ}) > (V_{BJ} + \varepsilon_{BJ})] = P[(V_{AJ} - V_{BJ}) > (\varepsilon_{BJ} - \varepsilon_{AJ})] \quad (2.2)$$

This implies that the respondent J will choose car A over car B if the differences in the deterministic parts exceeds the differences in the error parts. For purposes of empirical measurement, a probability distribution is assumed for the error part. It is typically assumed to be independently and identically distributed with an extreme value (Gumbel) distribution, given by equation 2.3.

$$P(\varepsilon \leq t) = F(t) = \exp(-\exp(-t)) \quad (2.3)$$

The distribution of the error term implies that the probability of A being chosen as the most preferred can be expressed in terms of the logistic distribution, known as the conditional logit model, expressed in equation 2.4.

$$P(U_{AJ} > U_{BJ}) = \exp(\mu V_{AJ}) / \sum(\exp \mu V_{BN}) \quad (2.4)$$

μ is a scale parameter, inversely proportional to the standard deviation of the error distribution. In single data sets this parameter cannot be separately identified. In a case, such as the choice between two cars A and B, a binary model is required. If the dependent variable takes on three values (for instance A, B and “neither of the alternatives”, a multinomial logit-model (MNL) is required.

The selections from the choice set should fulfil the precondition of Independence from Irrelevant Alternatives (IIA) property, which states that the relative probabilities of two options being selected are unaffected by the introduction or the removal of other alternatives. Whether the IIA is violated can be tested using a procedure by Hausman & McFadden (Hanley et al, 2001, Bateman et al, 2002). Nested Logit Models could be used to deal partially with IIA assumptions (Ryan et al, 2000).

The model can then be estimated by conventional maximum likelihood procedures, which results in estimations of the coefficients of the variables included in the utility function. Marginal Rate of Substitution (MRS) is defined as the negative ratio between two attributes. When one of these is the cost attribute, the ratio is called the marginal WTP, illustrated in equation 2.5.

$$WTP_{\text{attribute}} = -\beta_{\text{attribute}}/\beta_{\text{cost}} \quad (2.5)$$

The ratio between any other attributes is showed in equation 2.6.

$$MRS_{AB} = \beta_{\text{attribute A}}/\beta_{\text{attribute B}} \quad (2.6)$$

3. Construction of the survey

One of the most challenging tasks in a choice experiment is the experimental design, where the investigation problem is specified and the survey designed. This is particularly true here, as no similar surveys have been made prior to this. The biggest difference to earlier studies is that this study does not compare environmental attributes with each other, but does instead compare environmental attributes to other car related characteristics. Such a case is interesting, as it means that the WTP for private attributes are compared to the WTP for public attributes. Furthermore, earlier studies have not been unlabelled. To perform an unlabelled study could minimize problems with errors included in the intercept variable.

As this work touches upon completely new areas of research, a great deal of the paper explains the background work of the design of the survey. The design process is based on the theoretical parts presented in Hensher et al (2005), Alpizar et al, (2001) as well as Bateman et al, (2002).

3.1 Survey design

In addition to mentioned literature used for the survey design, earlier studies on ranking of car attributes were used to find the most relevant attributes to incorporate in the model. The few earlier CM studies found were also used as reference material. (see Appendix A for a more complete description of the background material). In August 2006, a small pilot study was performed to test the model.

In the choice model, four car attributes is incorporated: safety, carbon dioxide emissions, acceleration and annual cost. The number of attributes was reduced to four after a pilot study with five attributes proved to be complex for the respondents. There is always a trade-off between the risk of leaving out attributes considered essential for the consumer, and the benefit of a low task complexity. The attribute NO_x emissions was

removed from the final design as it was not considered to outweigh the increased complexity.

In addition to include important attributes, an important precondition for the choice is the possibility of measurement, where “softer” attributes such as comfort, status and road performance often are quite difficult to measure. A compromise between possibility to measure and straight forwardness has to be made (Hensher et al, 2005).

Surveys indicate¹ that safety is considered a crucial attribute both for Swedish and European car consumer and it was therefore included in the survey. As the study is focused on carbon dioxide emissions, such an attribute is included. These are supplemented with a third attribute called acceleration. It is considered important for consumers as a way to explain speed qualities and engine size. In addition, it is to some extent in conflict with both safety and environmental considerations, which improves the need for the respondent to face a real trade-off situation. The fourth and last attribute is cost, necessary to derive the WTP.

In total, three different survey versions were created. The respondents were randomly handed one of these. Three versions were made in order to give the opportunity to perform further analysis of the Choice Experiment methodology and to study what impact the survey design can have on the final result. Such aspects are not profoundly studied here, but the data material allows for more studies of that kind to be performed.

The attributes are all given five levels in the basic design, called Version 1. The levels are linked to the real life situation in order to produce cleaner data, preferred for modeling purposes (Alpizar et al, 2001, Hensher et al, 2005). Version 2 was identical to version 1, in everything except that the cost levels were halved. The idea is to test how the cost

¹ See Annex A for more detailed information

levels used affect the obtained WTP values. It is possible that the respondents are more concerned by the relative value of the cost, especially when the levels also are illustrated in a figure, than the actual absolute value presented.

In Version 3, all attributes except cost were only presented with three levels, where the two extreme values in the basic case are excluded. The purpose is two-fold. Firstly, the motive is to see whether fewer levels improve the possibility to understand the question and to make a choice. Such a case would be seen through a greater number of complete answers compared to version 1 and 2. Secondly, only using three levels should test for the sensitivity to scale through the way values are presented. In theory, a respondent should have the same WTP for, for instance, 140 grams of carbon dioxide - independently of whether this level is illustrated as the lowest level, as in version 3, or as the second lowest level, as in version 1 and 2. However, the way the choice sets are illustrated, the respondent might take less notice of the absolute levels that describes the car and is instead more focused on how this level is described in reference to the other levels.

As it proved difficult to create a status quo scenario for cars, the final choice was to not incorporate such an alternative, despite its obvious advantages. Simply not everyone drives the same type of car with the same properties. Instead binary choice sets are used, complemented with a no-choice alternative. Unrealistically forcing decision makers to select among the two alternatives could inflate the estimates obtained (Hensher et al, 2005). Figure 1 and 2 shows examples of choice sets in Version 1 and Version 3.

Figure 1: Example of choice set in survey version 1

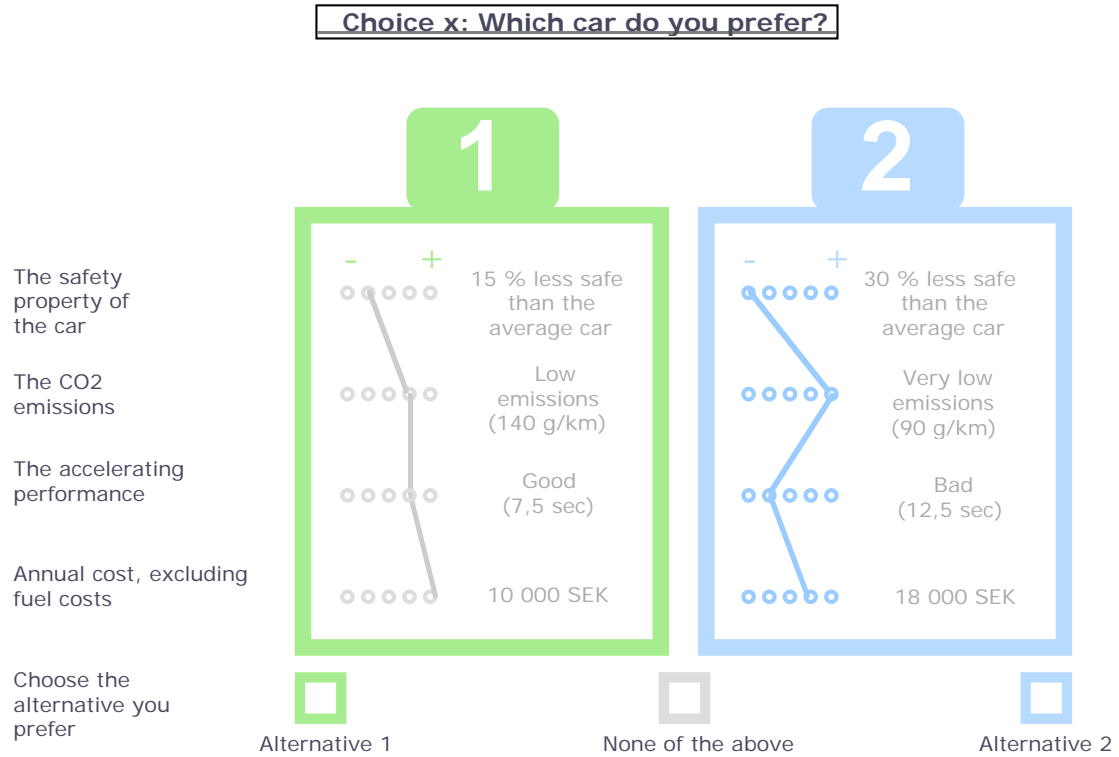
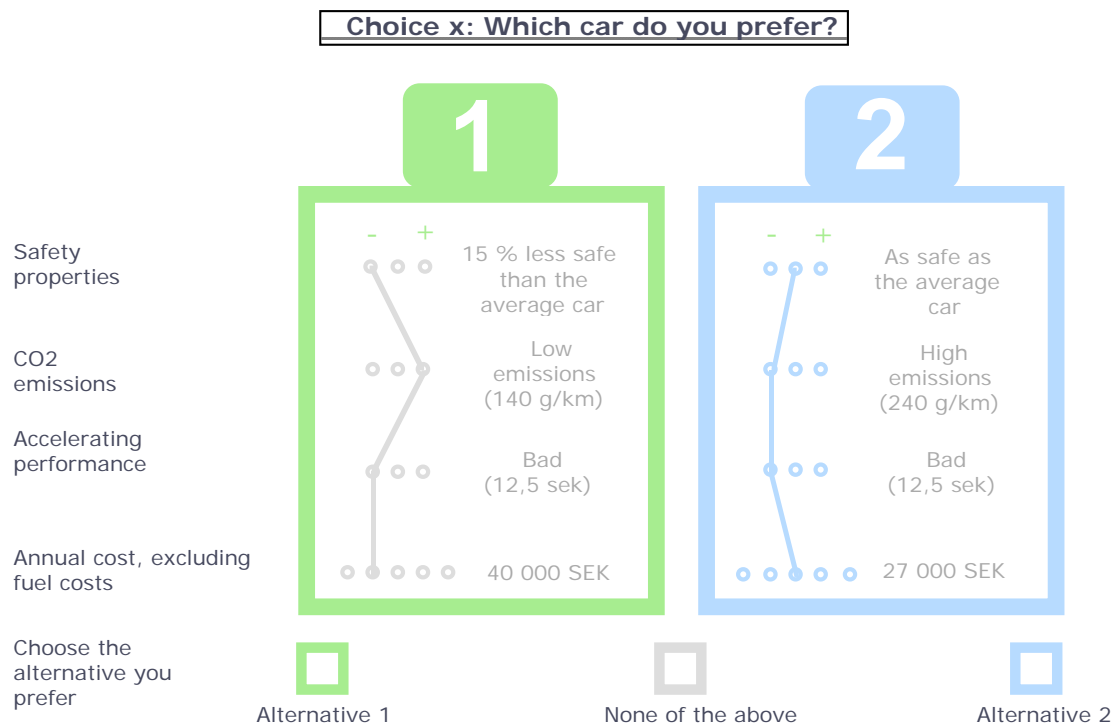


Figure 2: Example of a choice set in Version 3



The survey was sent out as a mail questionnaire, consisting of 23 questions where question 11 was the Choice Experiment with six its different choice sets. The first ten questions treated information on car preferences to obtain data on plausible purchasing plans, price class of such a vehicle and what attributes the respondent rank highest in a car. Five safety attributes were also ranked in order of importance. Lastly, the respondent stated which fuel type it thought was best in order to counter climate change. The survey ended with socio-demographic variables and some questions giving opportunity for evaluation of the survey. The whole survey is found in Appendix D.

3.1.1 Sample

The three different survey versions were in October 2006 sent to a random sample between 25 and 50 years of age, with a geographic spread over the entire country. Each survey version was randomly given to 500 people, giving a total number of 1500 individuals. To target a particular age group was motivated as a way to increase the possibility of the respondents being car owners. As the expected response rate for surveys sent out by mail is around 25-50 % (Bateman et al 2002) much effort was placed on making a survey appealing and easily understood for the respondent. In addition, a reminding letter was sent after some three weeks. Those that chose to complete the survey were rewarded with a lottery ticket.

3.2 Attributes used in the survey

This section explains the creation of the attributes used in the Choice Experiment.

3.2.1 The safety attribute

The first attribute in the Choice Experiment is safety. There are a number of aspects that have to be taken into consideration when creating a proper safety measurement. The monetary value of safety should preferably be able to translate into a reduction in mortality risk. The value of a statistical life, (VSL) defines the monetary value of a mortality risk reduction that prevents one statistical death. Monetary values for risk

reduction have been used since the 1960s by the National Road Administration in order to evaluate road-safety policies (Andersson, 2005).

A first problem to tackle is how to define safety. Safety could be a matter of personal feeling; a car could feel safe even though it is not. Moreover, there is a general misconception that a big car is safer than a smaller car. To be able to increase the validity of the measure, subjective differences need to be prevented as much as possible.

The second aspect is to whom the safety is applied. It could be driving safety, collision safety or safety for another part (pedestrians, other vehicles etc). This study is restricted to collision safety, and merely for the driver and the passengers in the car. The choice is partially based on the result of a survey conducted by MORI & EuroNCAP² in 2005, which stated that people do in fact consider safety for the driver and front seat passenger being the most influential safety aspect when choosing a car (MORI and EuroNCAP, 2005). In addition, to create a safety attribute that is a private good, it should be restricted to include safety for the people inside the car.

The third aspect is how to measure safety. One way is to look at the absolute decrease in risk, taking into account the total risk of a fatal accident or a severe injury in an accident. For example, improved safety could be a reduction in the fatal risk from 6/100 000 to 4/100 000. However, as we are facing tiny probabilities, earlier research has shown that respondents tend to be insensitive to scope. It can be difficult to comprehend such a small scale risk and state a correct WTP (Bateman et al, 2002, Rizzi et al, 2005).

Thus, it could be beneficial to use a relative measure of safety. A few well-known safety indicators already exist. In Sweden, the most commonly known are the EuroNCAP and

² MORI stands for Market & Opinion Research International and EuroNCAP for European New Car Assessment Programme.

the Folksam³ ranking. EuroNCAP is based on simulated crash tests for new cars, where the performance is graded with one to five stars. The Folksam measure is based on statistics from real life accidents, where the cars are ranked on a scale from more than 15 % less safe than the average car to 30 % more safe than the average car. The Folksam indicator was used in the survey, complemented with information of the absolute risk of a fatal accident (5/100 000 per year) stated in the attached information sheet.

Figure 3: Safety levels in survey version 1 & 2:



The safety levels presented in Figure 3 are based on the levels used by Folksam (2005), based on real accidents registered. The levels were modified somewhat as the real life indicator includes both risk for severe injuries and fatal accidents. In the survey it is explained to the respondent that the levels demonstrate the risk for fatal accidents. Attached to the description of attribute levels, the annual absolute risk for a fatal accident was included to make sure the respondent gets a good perception of the risk measure.

3.2.2 The environmental attribute

The main purpose of the study is to find a WTP value for lower emissions of carbon dioxide. At the beginning of this work, the idea was to compare lower emissions of carbon dioxide to other environmental concerns, such as the emissions of NO_x and particles. However, the pilot study that included a NO_x emissions attribute, turned out to be too complicated for the respondents. Thereof, the final study only includes carbon dioxide emissions, as this environmental problem is the most evident related to cars

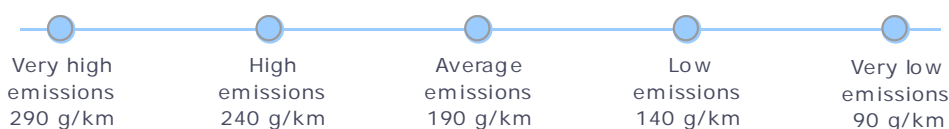
³ Folksam is a Swedish insurance company known for its extensive research on car safety.

nowadays. In addition, newer cars do often have engine techniques which remove particles and other emissions.

In the survey, the environmental attribute consists of grams of carbon dioxide emitted per kilometer. This to make the attribute technology neutral, i.e. it does not relate environmental classification of the fuel type used. It could be a conventional diesel or gasoline car, a hybrid, or even a car driven by alternative fuels, although their carbon dioxide emissions are harder to quantify. By using the simple measure grams carbon dioxide per kilometer, there is no need to take into consideration what type of fuel or car technology that is actually best for the environment, in a climate change perspective.

The indicator carbon dioxide emissions per kilometer is frequently used. For instance, in the present agreement with ACEA the target is to reduce the emissions of carbon dioxide to 140 g/km by 2008. In addition to these advantages, the attribute is expected to be easily understood by the respondent, where the levels are stated clearly in a cardinal scale.

Figure 4: Levels of carbon dioxide emissions in survey version 1 & 2



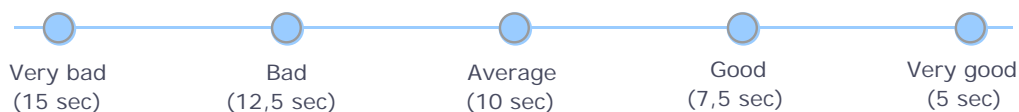
As seen in Figure 4, five absolute levels of carbon dioxide emissions were used, that ranges from 290 g/km down to 90 g/km. All these levels are feasible at present. The average value corresponds to the average of a new car sold in Sweden. Only a few newly produced cars can reach the lowest emissions, 90 g/km, whereas there are cars with emissions up to 450 g/km or more (The Swedish Consumer Agency, 2006).

In this leveling, plausible lower net-emissions from cars using alternative fuels like ethanol and gas are not considered as the net emission estimations are unclear, depending on the share of bio fuel used for driving. A hybrid like Toyota Prius, falls into the level interval with 104 g/km (ibid). As seen here, the levels used are based on national values. That 190 g/km is the average value in a Swedish context, whereas it would be a high value in a European context, does entail that the results have to be considered in a national perspective.

3.2.3 The performance attribute

The surveys in the relevant literature revealed high impact of road performance/road holding and running reliability. To represent such an attribute, acceleration is chosen. It is easily leveled and can be stated in numbers. In addition, the acceleration indicator is commonly used in car commercials to explain its engine power. The acceleration attribute is not covering all criteria on performance, but was found most appropriate for this purpose. It indicates the time it takes for the car to accelerate from 0 to 100 km/h - the shorter time, the better acceleration. The levels showed in Figure 5 are based on real life data on acceleration of new cars provided by the Swedish Consumer Agency in April 2006.

Figure 5: Levels of acceleration in survey version 1 & 2



3.2.4. The cost attribute

A cost attribute is included to be able to state WTP in monetary terms. According to Bateman et al, 2002, the price tag needs to be credible and realistic, and should ideally minimize incentives for strategic behavior. It should be commensurate with the levels of

the attributes; prices that are too low will always be accepted and result in a small price coefficient. Vice versa, prices that are too high will always be rejected.

The car cost consists of many different parts: Vehicle purchasing cost, fuel cost per kilometer, insurance cost, reparation cost and maintenance cost, to mention a few. In this study, the annual cost of the car is used, which here includes depreciation rate, insurance, and tires, but excludes fuel consumption costs. The inclusion of fuel costs could interfere with the environmental attribute as it induces considerations on distance driven and consumption per kilometer. Annual cost is preferable over a cost such as purchasing cost, as it is limited to a certain time period and thus does not have to take discount values into consideration. Moreover, both the costs and the gains (safety, environment and acceleration) need to be included in comparable periods of time, in order to know the trade-off situation.

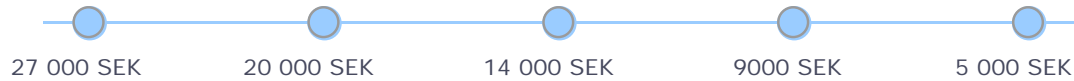
Another benefit in using annual cost is that it removes difficulties with large price differences between newer and older cars. If purchasing cost would be used, it would run the risk of being either too expensive for the persons only interested in buying second hand cars and vice versa, as it would not take into consideration people wanting to buy the most expensive cars if these were not included. With annual costs, the cost interval becomes smaller than with an initial purchasing cost.

Figure 6: Levels of annual cost in survey version 1 & 3



The attribute levels in Figure 6 are based on a web tool on the Swedish Consumer Agency website, where it is possible to calculate the annual cost on certain car models (Bilkalkylen, April 2006). Almost the entire cost span which was found is included in the interval used here. Version 1 & 3 include identical cost levels, whereas the version 2 has halved cost levels, showed in Figure 7.

Figure 7: Cost levels in survey version 2



3.3 Reduction of experiment size

After deciding how many attributes, levels, alternatives in the choice set, number of choice sets and the number of survey versions, it is necessary to design a statistically efficient subset of possible alternative combinations (Bateman et al, 2003). The full factorial design in version 1 and 2 generates $5*5*5*5= 625$ number of combinations and Version 3 generates $3*3*3*5= 135$ combinations of the attributes. The standard approach has been to identify four criteria for the efficient design (Alpizar et al, 2001):

1. Orthogonality. The combinations chosen should be those where the variations of the levels of the attributes are uncorrelated in all choice sets.
2. Level balance. The level of each attribute should occur with equal frequency in the questionnaire.
3. Minimal overlap. The attribute level should not repeat itself in the choice sets.
4. Utility balance. The utility in each of the two alternatives in the choice set should be set equal. This to be able to extract the best available information from each choice set. The disadvantage is the increased difficulty that this implies for the respondent (Alpizar et al, 2001).

In order to create an orthogonal design, the statistical package SPSS was used. 25 combinations of the attributes and attribute levels for the set to be orthogonal were created. Although orthogonality is a desirable property in a choice task design, there are practical reasons to depart from it (Bateman et al, 2003), which was the case in this survey. The levels presented have to be realistic and plausible. Based on that, several combinations were removed from the design. After removing unrealistic combinations,

each of the survey versions 1, 2 and 3 included 20 combinations of the attributes. Each choice set included two sets of combinations, creating a total of 10 choice sets for each survey version. However, as 10 choice sets were considered too many for each respondent to handle, the combinations in each survey version were divided into two separate surveys. Thus, the set of 500 respondents provided with each survey version was divided in to two parts, giving 250 individuals receiving exactly the same choice sets.

When creating the choice sets from the attribute combinations, focus was placed on the utility balance (criteria 4), in order to prevent any of the alternatives to become dominant. This property was seen as most important, as the larger the difference in utility between the alternatives, the less information is extracted from the specific choice set (Alpizar et al, 2001). But as some of the combinations had been removed it was a problem to maintain the minimal overlap and the level balance.

Table 1: Level balance after reduction of experiment size and the choice set creation

Version 1 and 2	"Worst" level			"Best" level	
Safety	4	5	3	3	4
CO2	4	3	4	4	4
Acceleration	3	4	4	4	4
Cost	3	3	4	5	4
Version 3					
Safety		8	7	5	
CO2		8	9	3	
Acceleration		8	7	5	
Cost	2	5	3	5	6

Table 1 shows the number of times each attribute level is presented in each survey version, 1,2 and 3. As seen, the level balance is not exact in neither of the versions, i.e. each level is not presented an equal number of times, which could create collinearity (Mc Intosh et al, 2002). The five-levelled version 1 & 2 is however better balanced than

version 3. In Version 3, the “worst” level is presented more times than the “best”. This bias should be studied further, but is out of scope of this study.

3.4 Test of consistency

As mentioned in section 3.1, each participant was given six choice set, to not make it too demanding. Five of these were combinations created in the orthogonality design. The sixth choice set was an internal test of consistency.

An individual is rational when its preference ordering is complete, reflexive, transitive and continuous. If these are fulfilled, the individual’s preferences can be represented by a utility function. (Mc Intosh et al, 2002) This survey merely included a test for transitivity. The sixth choice set was duplication of the first, but with changes in the attribute levels in one of the alternatives. The attributes in alternative A was changed to include more utility, whereas the utility in alternative B was kept identical as in choice set one. If the respondent in choice set one chose alternative A, it should choose A in the sixth, as it is better. Hence, the criteria of transitivity would be fulfilled. If the respondent had chosen A in the first set and then chose B in the sixth, the answer is inconsistent. A drawback with such a test is that only those that had chosen A in choice set 1 could be tested. If the respondent had chosen B in the first choice set and B in choice set 6 nothing could be said. Although A in the sixth choice set was given higher utility than in the first it does not necessarily mean that the respondent will change from B to A. However, if the individual chose the alternative “none of the above” in choice set 1 and then chose B in choice set 6, which had less utility than A, the individual had violated the assumption of transitivity. All responses from respondents who violated the transitivity criteria were removed from the final data set.

4. Results

4.1 Descriptive statistics

This section presents the results from the questions not connected to the Choice Experiment.

4.1.1 Background data

In this section, the sample is described. Table 2 compares the background data of the sample with the same characteristics of the Swedish population as a whole.

Table 2: Comparison of the sample data and the population as a whole

Variable	Sample	Population ⁴
Number of usable responses	734	
Response rate	49 %	Population⁴
Share men	52 %	49.6 %
Share women	48 %	50.4 %
Mean age	37.8 years	40.9 years
Median age	38 years	40 years
Resides in city/densely populated area	73 %	77 %
Education level upper secondary school or higher	93 %	84 %
University studies	45 %	35 %
Household income average/month	SEK 37 000	SEK 22 000

There is a slight bias towards a higher share of men in the sample, 52 %, compared to 49.6 % in the population. The small difference could be explained by the fact that men to a larger extent own cars than women do and car owners are more likely to respond a

⁴ Statistics from Statistics Sweden and Swedish National Rural Development Agency

survey treating car preferences. In the end of 2006, 66 % of all privately owned cars were owned by a man (SIKA Fordonsstatistik⁵). Due to this it is not surprising that the share of men among the respondents exceed the share of men in the population.

The mean and median age of the respondents are somewhat lower than in the population as a whole. However, the sample consisted of people aged 25 to 50 years, which means that the mean value of about 38 years is very close to the expected mean of that particular age group.

In the sample 73 % of the respondents live in densely populated areas. The corresponding share of the population amounts to 77 %, not a great difference.

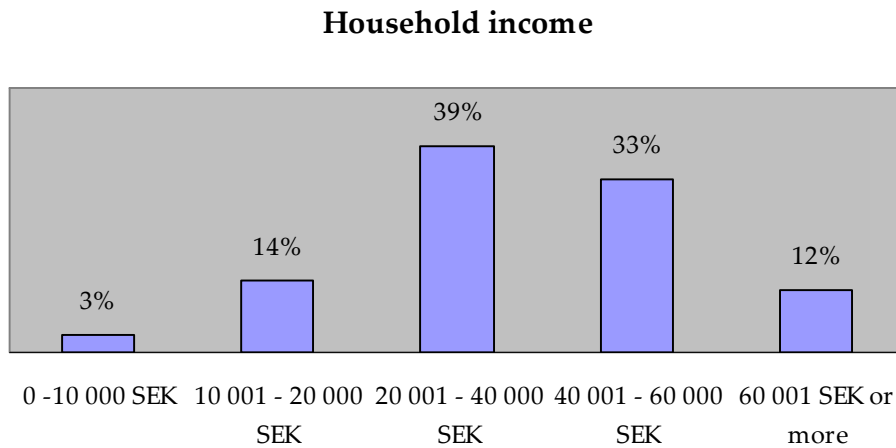
The respondents tend to possess a higher education level than the national average of the age group. In the sample, 45 % of the respondents have attended some form of post high-school studies, compared to the national average of 35 %, and the group with nine years of compulsory school is smaller in the sample than in the population, 7 % compared to the national average of 16 %. A possible explanation to the divergence is the fact the people with a higher level of education generally have a higher income and are therefore more likely to have a car. In addition, it could be that more educated people are more interested in responding to such a survey.

The largest difference between the sample and the population is found in average household income. In the sample, average household income amounts to SEK 38 000 per month, compared to an estimated average income of SEK 22 000 of a Swedish household⁶.

⁵ Statistics from the Swedish Institute for Transport and Communications Analysis

⁶ In the SCB statistics there are only numbers for disposable income.

Figure 8: Distribution of household income in sample



As seen in Figure 8, the majority of households in the sample have an income level above SEK 20 000 per month. It is obvious that the sample respondents consist of a higher share of high income households than the population average. The underlying reasons are several. At first, the age group included in the sample is 25-50 years, whereas the national estimation also includes senior and younger citizens – age groups that often have lower incomes. Secondly, there is the earlier mentioned divergence towards a sample with a higher proportion of car owners and highly educated people, in turn leading to a higher average income.

To summarize, the sample is in several aspects very similar to the population. In despite of a response rate of below 50 %, the only two variables with a significant deviation is average income and education level - discrepancies that have obvious explanations.

4.1.2 Car-related characteristics

Table 3: Comparison of the sample data and the population as a whole

Variable	Sample	Population ⁷
Share with driver's license	91.5 %	90 %
Average number of cars per household	1.5	0.97
Cars per person	0.53	0.46
Average yearly driving distance per car	1190 km/year	1439 km/year
Average yearly driving distance per car among company car owners	2120 km/year	1799 km/year
Plans to buy a car within next year	Yes 22 % No 56 % Don't know 23 %	
If yes, would you buy a new or a second hand car	New 25 % Second hand 75 %	

An expected bias in the survey was that only persons with a driver's license would complete it. A person with a driver's license is more likely to actually own a car, which in turn makes him/her more likely to complete the survey. Table 3 shows that in the age group 25-66 years around 90 % of the Swedes have driver's license. The corresponding share in the sample is 91.5 %, which implies that the sample in this context is, if anything, very modestly biased towards respondents with a driver's license. However, in order to get good results, it may have been more desirable to have a sample only containing persons that can drive a car, as these people probably are more aware of what attributes they prefer in a car.

⁷ Statistics from Statistics Sweden, BIL Sweden and SIKA

To further investigate whether the sample is biased towards car-owners, information on average number of cars per household was provided. In the sample the average number of cars among the respondents' households is 1.5, compared to the national average of about 1. At first sight it seems as a rather great distortion towards more car-owners among the respondents completing the survey, but could be explained as a person in the age group 25-50 can be expected to be part of a larger household and therefore in need of more cars. Moreover, the particular age group could be expected to have a higher income. Such things could explain the higher number of cars per person in the sample.

The average yearly driving distance per car in the sample amounts to 1190 km/year, which is below the national average of 1439 km/year. A shorter driving distance is partly expected since the households in the sample have access to a higher number of cars. An interesting feature is the occurrence of households solely driving a company car. In transport statistics it is a well-known phenomenon that these types of cars on average have a higher yearly driving distance, a fact that is true also for the sample⁸.

The survey included some questions about the respondent's possible plans to purchase a car in the future. About one fourth of the respondents stated that they plan to buy a car within a year. Out of these respondents, 75 % planned to buy second-hand. In addition, the survey contained a question of which price group a newly purchased car would lie within. The answers were distributed as illustrated in Figure 9.

⁸ Note that the sample only contains 25 households solely depending on company car(s).

Figure 9: Distribution of aimed price groups for car buyers

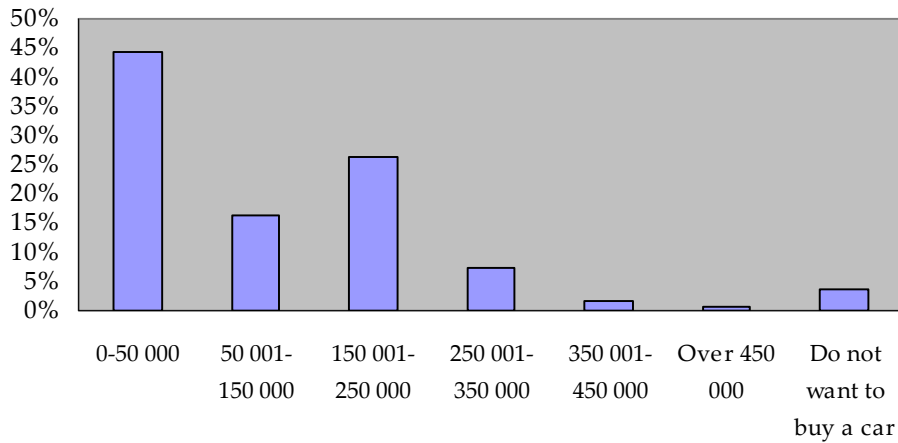
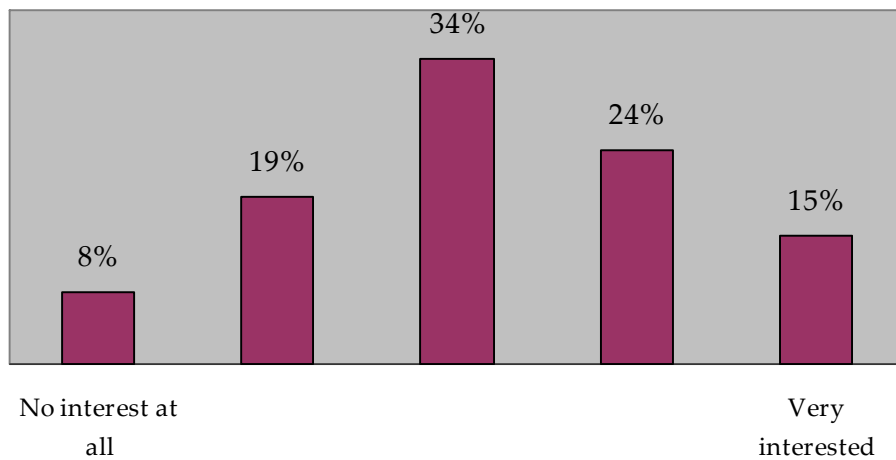


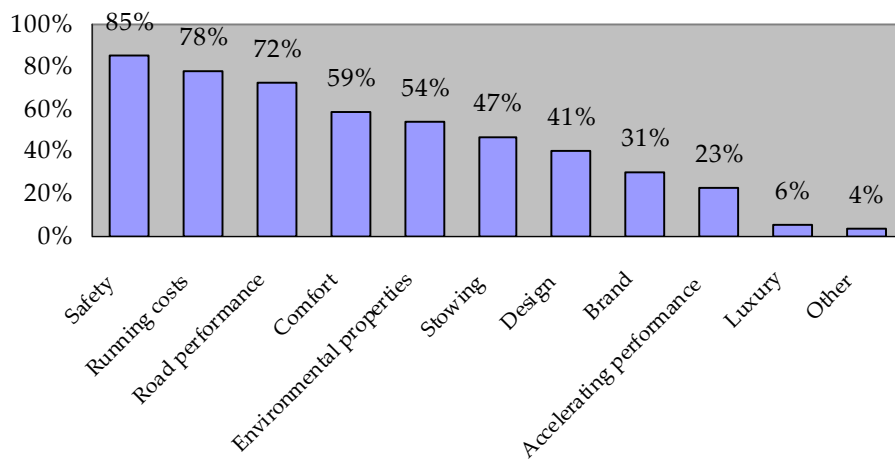
Figure 9 illustrates that the majority would purchase a car in the lowest price group. This is an obvious consequence to the statement that a vast majority would buy a second hand car. As a large share of the respondents stated that they would purchase a car in the cheaper price groups, it could be expected that that would have a lowering effect on the final WTP values obtained in the regression analysis part of the study. A question about the respondents' interest in cars was asked in order to further study the possibility of a bias towards the more car interested part of the population. The answers were distributed as seen in Figure 10.

Figure 10: Distribution of car interest among respondents



The sample seems to be a rather evenly distributed when it comes to interest in cars as illustrated in Figure 10. Obviously there are difficulties comparing this distribution, as there is no information available of the corresponding distribution among the population.

Figure 11: Share of attributes that were chosen as one of the five most important



Question 8 in the survey asked the respondent to choose five out of ten presented attributes and rank these in order of importance. If the respondent thought an important was missing he/she had the possibility to include it. Figure 11 presents part of the results. Safety was considered most important, being included among the five most important in 85 % of the responses. In addition, out of those who had included it in the five, 42 % had selected safety as the most important attribute.

4.1.3 Survey evaluation

At the end of the survey, two questions of evaluation were included. These revealed that more than 50 % thought it was easy or very easy to complete the survey, whereas only 8 % thought it was difficult or very difficult, while the remaining 42 % chose the average alternative. Moreover, 82 % said that the background information attached was

sufficient to answer the questions. The respondents also had the opportunity to add comments to the responses, which merely a small portion of the respondents did.

4.2 Regression analysis

A binomial logit model was used to estimate the coefficients of the utility function for cars, using the Limdep software. As the model actually included three alternatives including the “none of the above” alternative, the experiment could have been estimated using a MNL model. However, the alternatives where the “none of the above” was chosen provided no data for the estimation and was thereof treated identically as the alternatives where no choice was made at all. Thus, all rows with no response at all or where the alternative “none of the above” was chosen were removed and not included in the estimation. This goes against the rules on how to maintain orthogonality in the experimental design, where all the individuals’ choice sets should be removed from the final results if the opt-out alternative was chosen in one or more of the choice sets. However, this created too few complete responses in order to maintain statistical significance in the result. Moreover, as showed in section 3.3, there was already in the complete design a slight distortion in level balance.

All attributes in the choice set were continuous. The alternatives were generic and not labeled, which gave no extra value of including an alternative specific constant in the model. An unlabelled experiment where the choice is between A & B, where the only difference is the levels of the attributes, A & B does not convey meaning to the respondent on what the alternatives mean in reality. If the choice also had included something like the brand of the car, there could be expected that factor others than shown could be influencing (Hensher et al, 2005).

Intransitive responses were tested for in the sixth choice set. All the respondents that had acted intransitive were removed from the choice experiment; as such answers are inconsistent with basic consumer theory assumptions. Out of the responses, 21 were

intransitive responses, which is less than 3 % of the total number of responses. The highest rate of inconsistent answers is found in survey 2 and 4 out of the six in total (29 % respectively 43 % of all inconsistent answers). The finding is interesting as these versions are identical in everything except the halved cost levels, but this will not be analyzed further in the study.

It was not possible to create a Nested Logit Model, where only those that plan to purchase a car within a year is included. Only 22 % of the respondents said they planned to buy a car within a year, which was too few in order to create such a model where the statistical significance was maintained. The advantage of only including those planning to buy a car is that such a group solely consist of people that are to perform a similar choice in real life, which can improve the reliability of the result by making sure the IIA criteria, explained in the theory part, is fulfilled.

4.2.1 Results from basic model estimates

Table 4: Estimates from the binomial logit model

Version 1		
Number of observations: 1342		
	Coefficient	Standard error
Safety	0.0107***	0.00274
Carbon dioxide emissions	-0.00133**	0.000576
Acceleration	0.0560***	0.0111
Annual cost	-0.0000123***	0.00000314
Version 2		
Number of observations: 1362		
	Coefficient	Standard error
Safety	0.0168***	0.00278
Carbon dioxide emissions	-0.00304***	0.000546
Acceleration	0.0847***	0.011
Annual cost	-0.0000218***	0.00000641
Version 3		
Number of observations: 1498		
	Coefficient	Standard error
Safety	0.0115***	0.00442
Carbon dioxide emissions	-0.00166	0.00104
Acceleration	0.0647***	0.0198
Annual cost	-0.0000139***	0.00000362

* = p-value < 0,1

** = p-value < 0,05

*** = p-value < 0,01

The results from the regressions are seen in Table 4. For a more comprehensive description of estimation results, please go to Appendix B. All coefficients are significant at the 99 % level, except carbon dioxide emissions, with a 95 % level significance in Version 1 and 89 % in Version 3. The sign of the coefficients are equal in all three estimations; whereas the number of observations is somewhat higher in version 3 compared to the other two.

Table 5: Calculations of marginal WTP

Values on marginal WTP	Version 1	Version 2	Version 3
Safety	868,9	767,2	826,5
Carbon dioxide emissions	-107,8	-139,0	-119,9
Acceleration	4553,7	3878,5	4666,2

In Table 5 the marginal WTP has been estimated as the negative ratio between the attribute concerned and the cost attribute. The marginal WTP can be interpreted as the value a person would pay to receive one more or one less unit of the quality in question. The marginal WTP should be seen as an average value, meaning that a linear utility function is assumed. Once again the results are quite similar in the different versions. The individuals are willing to pay between SEK 767 and 827 for a car with one percent increased safety and between SEK 3878 and 4557 for one with one second's faster acceleration. The values of WTP for carbon dioxide show that the respondents want to pay between SEK 107 and 139 to lower the emissions of carbon dioxide with one gram.

The WTP value only shows the trade-off between cost and the attribute in question. In order to see the trade-off between the other attributes, Marginal Rate of Substitution (MRS) is used. The values shown in Table 6 implies that

- individuals are willing to give up a little more than 5 % of safety to improve the acceleration with one second;
- individuals are willing to emit between 28 and 42 grams more of carbon dioxide to improve acceleration with one second;
- individuals are willing to emit between 5 and 8 grams more of carbon dioxide to improve safety with 1 %.

Table 6: Values of MRS

	MRS (-X/Y)	Safety	Carbon dioxide emissions	Acceleration
Version 1	Safety	1,00	8,06	-0,19
	Carbon dioxide emissions	0,12	1,00	0,02
	Acceleration	-5,24	42,23	1,00
Version 2	Safety	1,00	5,52	-0,20
	Carbon dioxide emissions	0,18	1,00	0,04
	Acceleration	-5,06	27,90	1,00
Version 3	Safety	1,00	6,89	-0,18
	Carbon dioxide emissions	0,15	1,00	0,03
	Acceleration	-5,65	38,93	1,00

4.2.2 Results from specific estimations

To answer the last of the questions stated in the beginning of the paper, more specific estimations are made to test the effects of socio-demographic characteristics. Table 7 lists the estimations. The details in the estimations are not presented here, but can be obtained from the author.

Table 7: List of estimations compared to the basic model

Model	Version 1	Version 2	Version 3
High income group	<ul style="list-style-type: none"> • 606 observations • Higher WTP values • Safety and CO2 more important 	<ul style="list-style-type: none"> • 526 observations • Lower WTP values • Safety and acceleration more important 	<ul style="list-style-type: none"> • 680 observations • Higher WTP values. • Safety more important
Low income group	<ul style="list-style-type: none"> • 650 observations • Not significant coefficients 	<ul style="list-style-type: none"> • 810 observations • Higher WTP values • Acceleration and CO2 more important 	<ul style="list-style-type: none"> • 800 observations • Not significant coefficients
Female respondents	<ul style="list-style-type: none"> • 564 observations • Higher WTP values • CO2 more important 	<ul style="list-style-type: none"> • 490 observations • Higher WTP values • Safety and CO2 more important 	<ul style="list-style-type: none"> • 762 observations • Higher WTP values • CO2 more important
Male respondents	<ul style="list-style-type: none"> • 706 observations • Not significant coefficients 	<ul style="list-style-type: none"> • 872 observations • Lower WTP values • Acceleration and CO2 more important 	<ul style="list-style-type: none"> • 728 observations • Not significant coefficients
Families without children	<ul style="list-style-type: none"> • 612 observations • Not significant coefficients 	<ul style="list-style-type: none"> • 552 observations • Higher WTP values. • CO2 and acceleration more important 	<ul style="list-style-type: none"> • 614 observations • Not significant coefficients
Families with children	<ul style="list-style-type: none"> • 730 observations, • Higher WTP values • Safety and CO2 more important 	<ul style="list-style-type: none"> • 810 observations, • Lower WTP values. • Acceleration and safety more important 	<ul style="list-style-type: none"> • 884 observations, • Higher WTP values. • Safety and CO2 more important

5. Discussion

5.1 Basic model

5.1.1 Coefficients

The attribute coefficients estimated in the basic model have equal signs for the same attributes in all three versions. Safety and acceleration are both positive in the coefficients, whereas carbon dioxide emissions and annual cost have negative signs. Hence, the results are as expected; acceleration and safety are attributes that generate utility for the respondents, whereas the negative signs on cost and carbon dioxide emissions indicate that these attributes are considered to be negative for the respondents' utility. The negative value of the carbon dioxide emissions coefficient implies that all values of carbon dioxide emissions have negative effect on utility, but that a lower value has a less negative effect on total utility than a higher value has. The results confirm the fact that the respondents take environmental aspects into consideration in the choice. However, that the significance is somewhat lower for the carbon dioxide emission coefficients in Version 1 and 3 compared to those of the other attributes suggests that carbon dioxide emissions are considered a less important attribute than the others when making the choice.

5.1.2 WTP and MRS

The results on WTP and MRS presented in Table 5 and 6 suggest that acceleration is considered the most important attribute; to improve acceleration, a greater amount of both carbon dioxide emissions and safety has to be given up. However, such an interpretation does not take into consideration the presentation of the attributes in the survey.

In the survey, acceleration is expressed with a total of ten units (from 5 to 15 seconds). Safety on the other hand, is presented with 60 units (- 30 % to 30 %) and carbon dioxide

is explained by 200 units (90 to 290 grams). Each second of acceleration could be said to be “worth more” than each percent of safety, although these are both presented with five levels in the choice sets. Thus, it could be interesting to adjust the MRS values taking into account the difference in the number of units. Table 8 illustrates the adjusted MRS, calculated through a multiplication of the MRS with the adjustment factor, which is the relation between the number of units in each attribute.

Table 8: MRS with adjustment⁹

Adjusted MRS	Adjustment factor	min	max
Acceleration/safety	10/60	0,84	0,94
Safety/Carbon dioxide emissions	60/200	1,66	2,42
Acceleration/Carbon dioxide emissions	10/200	1,39	2,11

Table 8 shows safety as the most important attribute for the respondents, while acceleration still is more important than carbon dioxide emissions. The interpretation of the coefficients thus has impact when trying to find out which attribute that is considered most important. The MRS and the adjusted MRS should be seen as two alternative methods to present the results of the estimations.

5.2 Specific models

The results from the specific estimations generated many interesting features that could be analyzed further. Some general conclusions are drawn:

1. Female respondents in general have higher marginal WTP than the population as a whole. They are also considering lower carbon dioxide emissions as more important.
2. The alternative estimations in version 2 generate lower WTP values for the high income group, male respondents and families with children. The cost coefficients for the high income groups are also lower than for the low income group. These results could suggest that high income groups have a lower marginal valuation of cost, that is, a diminishing marginal utility of income.

⁹ The author’s own calculations

3. There are no insignificant estimations in version 2, whereas both version 1 and 3 had several insignificant estimations, all in the same specific models (male respondents, low income group, and families without children). This can not be explained by the fact that the version 2 estimations included more observations, as the specific model on families without children only proved to be significant in version 2, despite the fact it was estimated with fewer observations.
4. All estimations of families with children show that safety is important, which is expected. Respondents made comments on children safety being the reason for purchasing a car with high safety rating. The high income group also tends to value safety higher.

5.3 Comparison of model results with other survey questions

The result from the Choice Experiment is compared to the results from the question in the survey where respondents were asked to rank car preferences. Safety was the most frequently chosen attribute in the car preference question and was also ranked the highest in most number of cases. Such a result is in line with the result from the Choice Experiment, which after the adjustment of MRS suggests that safety in fact was considered most important. The same does however not apply to acceleration. It was rated much lower in the preference question compared to the result in the Choice Experiment. In the Choice Experiment it was considered more important than carbon dioxide emissions, whereas good environmental properties were considered more important than acceleration in the ranking. The explanation could be that the environmental attribute was more generally formulated in the ranking question, suggesting that the respondent might include more environmental considerations in the meaning of good environmental properties. When carbon dioxide emissions are presented just as a number it does not entail the same meaning for the respondents. Such a conclusion is important for further work within the field, where the attributes maybe should be explained more profoundly than only in numbers.

A general conclusion from the question is that there are a number of attributes valuable for respondents, but all these were not used in the Choice Experiment. This shows the catch 22 with this kind of model. Fewer attributes increase the risk of not including attributes that generate utility for the respondents, resulting in an increase of the unknown error-part of the utility function. More attributes on the other hand, runs the risk of creating a choice situation too complicated for the respondents, which could lower the response rate and consistency - thus deteriorate the significance of the result.

5.4 Issues on survey design

In addition to merely study the results from the questions in the survey, there was also ambitions to examine issues on survey design. As the evaluation results reveals, the survey seems to have been easy to understand and respond to. There was however several of the choice sets where the respondents had chosen not to answer the question at all or where they chose the opt-out alternative.

The halved cost levels in version 2 generated some interesting observations. The coefficients in version 2 were all greater in absolute terms compared to those in version 1 as Table 9 illustrates.

Table 9: Difference in coefficient size between version 2 and version 1

Safety	57 %
Carbon dioxide emissions	129 %
Acceleration	51 %
Cost	77 %

The fact that all coefficients became greater in version 2 explains why the WTP values in version 2 did not deviate significantly from those obtained in version 1, illustrated in Table 10. This shows that although the coefficient size differed greatly, the final WTP values did not differ largely between the two versions, although the cost levels used were half the size. However, it points out that the final estimations depend on the

survey design and what cost levels that are used. To increase the validity of future surveys it is suggested to include different cost levels as a sensitivity case and/or to put effort on trying to use cost levels corresponding to the real world situation as much as possible.

Table 10: Difference in WTP in version 2 and 1

Safety	13 %
Carbon dioxide emissions	22 %
Acceleration	17 %

In version 3, only three levels were included. This had two effects on the result. Firstly, the number of observations where the respondents had chosen neither A or B are more frequent in version 1 and 2 than in version 3. It confirms that task complexity actually could have had an effect on the number of completed choice sets. The respondents seem to have found it easier to answer when the three attributes safety, carbon dioxide emissions and acceleration only had three levels as in version 3. Such a result points out the downsides that a choice situation, with either many attributes or many levels, could have on the result. Although the model only included four attributes, even more simple methods are favored in order to improve the response rate and to stimulate efforts made by the respondents to complete the survey. In addition to having impact on task complexity, attributes with only three levels could have effect on the estimated coefficients and WTP.

Secondly, it could be expected that people are more sensitive to the presentation of the values than their actual levels. When only three levels are presented, the marginal values could be expected to be higher as the sensitivity for levels is lower. The result in Table 11 shows that all coefficients are greater in version 3 compared to version 1, as expected. Also the final absolute values of marginal WTP become higher in version 3, indicating that the way attributes are presented could have some impact on the final result.

Table 11: Difference in coefficient size between version 3 and 1

Safety	7 %
Carbon dioxide emissions	26 %
Acceleration	16 %
Cost	13 %

There are many more aspects of experimental design and its impact on the result that could be studied here. Due to the fact that this particular study is aiming at only presenting the first results, these issues will not be further studied here.

6. Conclusions

The estimations made from the Choice Experiment showed that the attribute carbon dioxide emissions was the lowest ranked among those presented. Such a result can be seen as an indication that Swedish car consumers are more interested in other car qualities when purchasing a car, which in turn could be a partial explanation to the fact that the car fleet is the most emitting in Europe. However, there are at the same time a few problems in drawing such conclusions. The first issue is that of survey design. As the hypothetical setting in the survey is based on Swedish reference values on carbon dioxide emissions, it is hard to make comparisons with European emissions levels. A majority of the respondents probably has no perception of whether 190 grams of carbon dioxide emissions is plenty or not. Instead, the respondent will compare this average national level to the other levels presented in the survey. This means that the results perhaps would have been different if the levels were presented in a European setting, where 190 grams is considered to be very high emissions. This shows that the hypothetical setting can have implications on the final result.

Another issue is to make a distinction of WTP values for private and public goods. Acceleration, cost and safety are private goods, while carbon dioxide is a public bad. That the WTP for private goods are higher than that of public goods is in coherence with economic theory, particularly as carbon dioxide emissions is a pure public bad; both non-excludable and non-rivalrous.

Of all attributes, safety proved to be most important; both the highest ranked in question 8 about ranking of car attributes and in the Choice Experiment. As expected, families with children were those most keen on high safety.

One last conclusion to present is that great effort has to be made to the creation of such a survey, particularly the part with the Choice Experiment. The survey has to catch

interest in order to generate a high response rate and thus significant estimations. It cannot be too demanding at the same time as it needs to generate significant and interesting results. Hence, the time of preparation should not be underestimated. Most important, the attributes need to be relevant, possible to measure as well as presented with accurate levels. The results here, with high significance for all attribute coefficients, suggest that all attributes included were considered important for the respondents. The Choice Experiment proved to be a model well suited to reveal preferences for car attributes. However, there are great possibilities for future development of the methodology in order to provide even more interesting results. Issues on survey design, such as testing the effect of changing cost levels and constructing versions with fewer or more levels and attributes, can give great insight to possible downsides of the model, which has to be taken into consideration. In addition, more complex modelling structures could provide even more interesting results, seeing this attempt as a starting point.

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Appendix A: Background material

Studies on attribute rankings

To decide upon what attributes to include, it is relevant to get information on which attributes people see as most influencing. Three studies were found.

Table A.1: Ranking of attributes in survey conducted by MORI and NCap

Attribute	Ranking
Safety	1
Reliability	2
Running costs including insurance and depreciation	3
Performance/road holding	4
Prestige/quality	5
Styling	6
Air conditioning	7
Audio system	8
Satellite navigation	9

The results from a survey conducted by MORI on behalf of EuroNCAP are presented in Table A.1. It was conducted on adult population in Great Britain, France, Germany, Italy, the Czech Republic, Poland and Portugal. Safety and reliability were found to be the most important attributes when buying a car, followed by running costs and performance/road holding. However, only nine attributes were included where of none directly brought up environmental considerations.

Table A.2: Results from a ranking study conducted by Garvell et al, 2004

Attribute	Ranking
Reliability	1
Safety	2
Driver comfort	3
Performance/road holding	4
Low insurance, reparation costs	5
Low fuel consumption	6
Driving performance	7
Passenger comfort	8
Good stowage possibilities	9
<i>Low carbon dioxide emissions</i>	12
<i>Environmental classification 1</i>	16
<i>Possibility to drive on E85 (ethanol)</i>	23

Table A.2 shows the results from a study conducted by Garvell et al (2004), from the Transport Research Unit at Umeå University in Sweden. The total number of attributes was 28, from which three were directly related to environment; low emissions of carbon dioxide, environmental classification 1 and possibility to drive on ethanol (E85). These are all rated quite low. Carbon dioxide emissions were however ranked almost as high as engine size, accelerating performance, low price, extra equipment and good stowage possibilities. This study ranked safety second after running reliability (driftsäkerhet).

Table A3: Ranking study conducted by The Swedish Consumer Agency, 1999

Car attribute	Ranking private	Ranking company cars
Safety	1	1
Reliability	2	2
Fuel consumption	3	12

Price	4	8
Car economy	5	6
Road holding	6	5
Space	7	3
Performance	8	9
Design	9	7
<i>Environmental attributes</i>	10	10
Comfort	11	4
Brand	12	11

The survey from the Swedish Consumer Agency, presented in Table A.3, makes a distinction between privately owned cars and company cars. In both categories safety and reliability are ranked at the top. The generally described attribute “environmental attributes” is rated fairly low (Inregia, 1999).

Applied discrete choice models

The literature shows that few discrete choice models have been performed on car choice. Vehicle demand studies performed are foremost focused on preferences for clean-fuel vehicles. It could be assumed that car manufacturers themselves have performed similar studies in order to better fit the products to what consumers demand. Unfortunately, no such survey has been found.

Ewing et al, 2000

The authors assess preferences for clean-fuel vehicles (CFVs) versus the conventional vehicle using a discrete choice experiment. The authors surveyed a random sample of 1500 commuters who drive to work regularly. The attributes included was purchase price, repair and maintenance cost, cruising range (i.e., the maximum distance traveled on a full tank or charge), refueling time (i.e., the time it takes to fill a fuel tank or charge batteries), acceleration and polluting emissions. In addition, two commuting attributes,

commuting time and cost, were included. The results showed that although consumers had a positive disposition toward CFVs and perceive environmental impact as important, they were unwilling to trade off the standard vehicle performance levels of range, acceleration, and refueling time.

Golob et al, 1997

A conjoint analysis was performed on fleet decision makers in California. They were asked to simulate a fleet-replacement decision by allocating purchases over a set of three hypothetical future vehicles. The vehicles were described in terms of vehicle fuel type (gasoline, electric, compressed natural gas, and methanol), vehicle capital cost, operating costs, range between refueling, refueling times, fuel availability, cargo capacity, and emission levels. Gasoline was defined to be the base fuel. The results showed major differences in preferences for fuel types among fleet market segments. For example, schools were less negative toward electric vehicles and compressed Natural Gas Vehicles, but more negative toward methanol vehicles, relative to the other sectors. There were also substantial differences among fleet market segments in terms of preference tradeoffs for other vehicle attributes. The availability of alternative fuel stations off-site was important to fleet managers, indicating that fleets are willing to trade off improved fuel infrastructure for changes in other vehicle attributes.

Lundquist Noblet et al, 2006

A two-stage choice experiment was performed on a statewide sample of registered vehicle owners in Maine, USA. The purpose was to examine factors that affect their assessments of eco-labelled conventionally fuelled passenger vehicles. In the first stage participants choose a vehicle class (car, van, SUV or truck), where each of the four classes was presented with information on average prices, miles per gallon and scores for criteria pollutants and carbon dioxide emissions. In the second stage the respondents had to select one of three vehicles within their chosen class, also here complemented with information on average prices, miles per gallon and scores for criteria pollutants

and carbon dioxide emissions. The result showed that environmental attributes of an eco-labeled passenger vehicle are significant in the purchase decision. The eco-information is considered in the vehicle purchase decision, but is generally not considered at the class-level decision.

Appendix B: Model estimations

Version 1

```
logit ;lhs=cset
      ;rhs=safety,co2,acc,cost $
Normal exit from iterations. Exit status=0.
```

```

+-----+
| Multinomial Logit Model
| Maximum Likelihood Estimates
| Model estimated: May 02, 2007 at 04:56:46PM.
| Dependent variable          CSET
| Weighting variable          None
| Number of observations      1342
| Iterations completed        4
| Log likelihood function     -908.0943
| Restricted log likelihood    -930.2035
| Chi squared                 44.21839
| Degrees of freedom          3
| Prob[ChiSqd > value] =     .0000000
| Hosmer-Lemeshow chi-squared = 172.19716
| P-value= .00000 with deg.fr. = 8
+-----+
+-----+-----+-----+-----+-----+-----+
| Variable | Coefficient | Standard Error | b/St.Er. | P[|Z|>z] | Mean of X |
+-----+-----+-----+-----+-----+-----+
+
+-----+-----+-----+-----+-----+-----+
| Characteristics in numerator of Prob[Y = 1]
| SAFETY   .01068381   .00273537   3.906   .0001   2.29284650
| CO2      -.00132568   .00057620  -2.301   .0214   183.936662
| ACC      .05598812   .01109869   5.045   .0000   9.78055142
| COST     -.122952D-04 .313718D-05 -3.919   .0001   25731.7437
+-----+-----+-----+-----+-----+-----+
+-----+-----+-----+-----+-----+-----+
| Information Statistics for Discrete Choice Model.
| M=Model MC=Constants Only M0=No Model
| Criterion F (log L)      -908.09432   -930.20352   -930.20352
| LR Statistic vs. MC     44.21839     .00000       .00000
| Degrees of Freedom       3.00000     .00000       .00000
| Prob. Value for LR       .00000       .00000       .00000
| Entropy for probs.      908.09432     930.20352     930.20352
| Normalized Entropy       .97623       1.00000       1.00000
| Entropy Ratio Stat.     44.21839     .00000       .00000
| Bayes Info Criterion    1837.79439     1882.01278     1882.01278
| BIC - BIC(no model)     44.21839     .00000       .00000
| Pseudo R-squared        .02377       .00000       .00000
| Pct. Correct Prec.      54.17288     .00000       50.00000
| Means:                   y=0   y=1   y=2   y=3   yu=4   y=5,   y=6   y>=7
| Outcome                   .5000 .5000 .0000 .0000 .0000 .0000 .0000 .0000
+-----+-----+-----+-----+-----+-----+

```

```

Pred.Pr      .4973  .5027  .0000  .0000  .0000  .0000  .0000  .0000
Notes: Entropy computed as Sum(i)Sum(j)Pfit(i,j)*logPfit(i,j).
      Normalized entropy is computed against M0.
      Entropy ratio statistic is computed against M0.
      BIC = 2*criterion - log(N)*degrees of freedom.
      If the model has only constants or if it has no constants,
      the statistics reported here are not useable.

```

```

-----+-----
Fit Measures for Binomial Choice Model
Logit      model for variable CSET
-----+-----

```

```

Proportions P0= .500000  P1= .500000
N =      1342  N0=      671  N1=      671
LogL =   -908.09432  LogL0 =  -930.2035
Estrella = 1-(L/L0)^(-2L0/n) = .03280

```

Efron	McFadden	Ben./Lerman
.03231	.02377	.51622
Cramer	Veall/Zim.	Rsqr ML
.03244	.05491	.03241

```

-----+-----
Information Akaike I.C. Schwarz I.C.
Criteria      1.35931      1844.99631
-----+-----

```

```

Frequencies of actual & predicted outcomes
Predicted outcome has maximum probability.
Threshold value for predicting Y=1 = .5000
Predicted

```

Actual	Predicted		Total
	0	1	
0	336	335	671
1	280	391	671
Total	616	726	1342

```

=====
Analysis of Binary Choice Model Predictions Based on Threshold = .5000
-----

```

```

Prediction Success
-----

```

```

Sensitivity = actual 1s correctly predicted      58.271%
Specificity = actual 0s correctly predicted      50.075%
Positive predictive value = predicted 1s that were actual 1s  53.857%
Negative predictive value = predicted 0s that were actual 0s  54.545%
Correct prediction = actual 1s and 0s correctly predicted    54.173%

```

```

Prediction Failure
-----

```

```

False pos. for true neg. = actual 0s predicted as 1s      49.925%
False neg. for true pos. = actual 1s predicted as 0s      41.729%
False pos. for predicted pos. = predicted 1s actual 0s    46.143%
False neg. for predicted neg. = predicted 0s actual 1s    45.455%
False predictions = actual 1s and 0s incorrectly predicted  45.827%
=====

```

Version 2

```

logit ;lhs=cset
      ;rhs=safety,co2,acc,cost $
Normal exit from iterations. Exit status=0.

```



```

+-----+
| Multinomial Logit Model
| Maximum Likelihood Estimates
| Model estimated: May 03, 2007 at 01:05:35PM.
| Dependent variable           CSET
| Weighting variable           None
| Number of observations       1362
| Iterations completed         4
| Log likelihood function      -894.4979
| Restricted log likelihood    -944.0665
| Chi squared                  99.13720
| Degrees of freedom           3
| Prob[ChiSqd > value] =      .0000000
| Hosmer-Lemeshow chi-squared = 105.08751
| P-value= .00000 with deg.fr. = 8
+-----+

```

```

+-----+-----+-----+-----+-----+-----+
| Variable | Coefficient | Standard Error | b/St.Er. | P[|Z|>z] | Mean of X |
+-----+-----+-----+-----+-----+-----+
|
| Characteristics in numerator of Prob[Y = 1]
| SAFETY   .01676141   .00277984      6.030   .0000   2.25770925
| CO2      -.00303703   .00054554     -5.567   .0000   191.395007
| ACC      .08473234   .01097303      7.722   .0000   9.72650514
| COST     -.218464D-04 .640936D-05    -3.409   .0007   12872.9809
+-----+-----+-----+-----+-----+-----+

```

```

+-----+-----+-----+-----+-----+-----+
| Information Statistics for Discrete Choice Model.
| M=Model MC=Constants Only M0=No Model
| Criterion F (log L)      -894.49786      -944.06646      -944.06646
| LR Statistic vs. MC     99.13720        .00000          .00000
| Degrees of Freedom       3.00000         .00000          .00000
| Prob. Value for LR      .00000          .00000          .00000
| Entropy for probs.      894.49786       944.06646       944.06646
| Normalized Entropy      .94749          1.00000         1.00000
| Entropy Ratio Stat.     99.13719        .00000          .00000
| Bayes Info Criterion    1810.64585      1909.78305      1909.78305
| BIC - BIC(no model)     99.13720        .00000          .00000
| Pseudo R-squared        .05251          .00000          .00000
| Pct. Correct Prec.      60.42584        .00000          50.00000
| Means:                   y=0   y=1   y=2   y=3   yu=4   y=5,   y=6   y>=7
| Outcome                  .5000 .5000 .0000 .0000 .0000 .0000 .0000 .0000
| Pred.Pr                  .5005 .4995 .0000 .0000 .0000 .0000 .0000 .0000
| Notes: Entropy computed as Sum(i)Sum(j)Pfit(i,j)*logPfit(i,j).
| Normalized entropy is computed against M0.
| Entropy ratio statistic is computed against M0.
| BIC = 2*criterion - log(N)*degrees of freedom.
| If the model has only constants or if it has no constants,
| the statistics reported here are not useable.
+-----+-----+-----+-----+-----+-----+

```

```

+-----+-----+-----+-----+-----+-----+
| Fit Measures for Binomial Choice Model
| Logit model for variable CSET
+-----+-----+-----+-----+-----+-----+
| Proportions P0= .500000 P1= .500000
| N = 1362 N0= 681 N1= 681
| LogL = -894.49786 LogL0 = -944.0665
| Estrella = 1-(L/L0)^(-2L0/n) = .07204
+-----+-----+-----+-----+-----+-----+
| Efron | McFadden | Ben./Lerman
| .07039 | .05251 | .53532
| Cramer | Veall/Zim. | Rsqrd_ML
+-----+-----+-----+-----+-----+-----+

```

	.07064	.11679	.07020
Information Criteria	Akaike	I.C. Schwarz	I.C.
	1.31938	1817.86256	

Frequencies of actual & predicted outcomes
Predicted outcome has maximum probability.
Threshold value for predicting Y=1 = .5000

	Predicted		
Actual	0	1	Total
0	428	253	681
1	286	395	681
Total	714	648	1362

=====
Analysis of Binary Choice Model Predictions Based on Threshold = .5000
=====

Prediction Success

Sensitivity = actual 1s correctly predicted 58.003%
Specificity = actual 0s correctly predicted 62.849%
Positive predictive value = predicted 1s that were actual 1s 60.957%
Negative predictive value = predicted 0s that were actual 0s 59.944%
Correct prediction = actual 1s and 0s correctly predicted 60.426%

Prediction Failure

False pos. for true neg. = actual 0s predicted as 1s 37.151%
False neg. for true pos. = actual 1s predicted as 0s 41.997%
False pos. for predicted pos. = predicted 1s actual 0s 39.043%
False neg. for predicted neg. = predicted 0s actual 1s 40.056%
False predictions = actual 1s and 0s incorrectly predicted 39.574%
=====

Version 3

```
logit ;lhs=cset
      ;rhs=safety,co2,acc,cost $
Normal exit from iterations. Exit status=0.
```

```
+-----+
| Multinomial Logit Model
| Maximum Likelihood Estimates
| Model estimated: May 03, 2007 at 03:10:55PM.
| Dependent variable          CSET
| Weighting variable          None
| Number of observations      1498
| Iterations completed        4
| Log likelihood function     -1023.990
| Restricted log likelihood    -1038.334
| Chi squared                 28.68909
| Degrees of freedom          3
| Prob[ChiSqd > value] =      .2602173E-05
| Hosmer-Lemeshow chi-squared = 44.55138
| P-value= .00000 with deg.fr. = 8
+-----+
```

```
+-----+-----+-----+-----+-----+
| Variable|Coefficient | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+-----+-----+-----+-----+-----+
+
```

Characteristics in numerator of Prob[Y = 1]					
SAFETY	.01145395	.00442404	2.589	.0096	.78971963
CO2	-.00166129	.00103720	-1.602	.1092	200.555407
ACC	.06467038	.01980173	3.266	.0011	10.2132844
COST	-.138592D-04	.361980D-05	-3.829	.0001	23242.3264

Information Statistics for Discrete Choice Model.								
	M=Model	MC=Constants Only	M0=No Model					
Criterion F (log L)	-1023.98993	-1038.33448	-1038.33448					
LR Statistic vs. MC	28.68909	.00000	.00000					
Degrees of Freedom	3.00000	.00000	.00000					
Prob. Value for LR	.00000	.00000	.00000					
Entropy for probs.	1023.98993	1038.33448	1038.33448					
Normalized Entropy	.98619	1.00000	1.00000					
Entropy Ratio Stat.	28.68909	.00000	.00000					
Bayes Info Criterion	2069.91552	2098.60461	2098.60461					
BIC - BIC(no model)	28.68909	.00000	.00000					
Pseudo R-squared	.01381	.00000	.00000					
Pct. Correct Prec.	57.00935	.00000	50.00000					
Means:	y=0	y=1	y=2	y=3	yu=4	y=5,	y=6	y>=7
Outcome	.5000	.5000	.0000	.0000	.0000	.0000	.0000	.0000
Pred.Pr	.5008	.4992	.0000	.0000	.0000	.0000	.0000	.0000

Notes: Entropy computed as $\sum(i)\sum(j)Pfit(i,j)*\log Pfit(i,j)$.
Normalized entropy is computed against M0.
Entropy ratio statistic is computed against M0.
BIC = 2*criterion - log(N)*degrees of freedom.
If the model has only constants or if it has no constants, the statistics reported here are not useable.

Fit Measures for Binomial Choice Model		
Logit model for variable CSET		
Proportions P0=	.500000	P1= .500000
N =	1498	N0= 749 N1= 749
LogL =	-1023.98993	LogL0 = -1038.3345
Estrella =	$1 - (L/L0)^{-2L0/n} = .01910$	
Efron	McFadden	Ben./Lerman
.01928	.01381	.50957
Cramer	Veall/Zim.	Rsqr ML
.01915	.03235	.01897
Information Criteria	Akaike I.C.	Schwarz I.C.
	1.37248	2077.22741

Frequencies of actual & predicted outcomes
Predicted outcome has maximum probability.
Threshold value for predicting Y=1 = .5000

	Predicted		
Actual	0	1	Total
0	435	314	749
1	330	419	749
Total	765	733	1498

=====
Analysis of Binary Choice Model Predictions Based on Threshold = .5000

Prediction Success

Sensitivity = actual 1s correctly predicted	55.941%
Specificity = actual 0s correctly predicted	58.077%
Positive predictive value = predicted 1s that were actual 1s	57.162%
Negative predictive value = predicted 0s that were actual 0s	56.863%
Correct prediction = actual 1s and 0s correctly predicted	57.009%

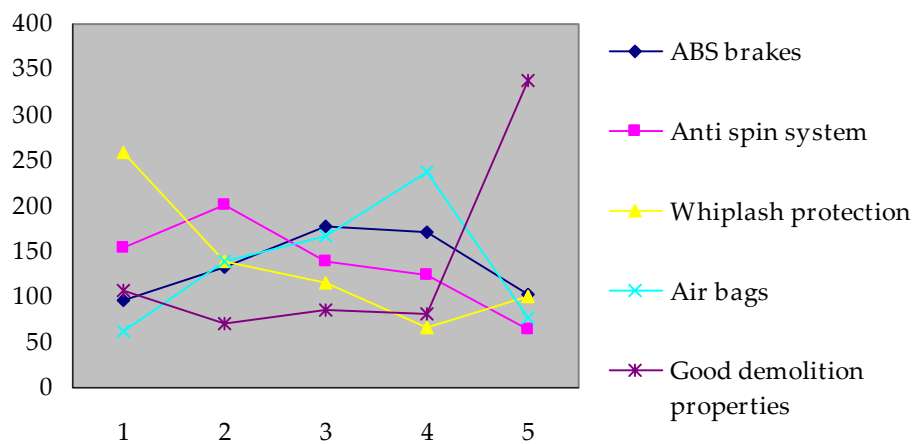
Prediction Failure	

False pos. for true neg. = actual 0s predicted as 1s	41.923%
False neg. for true pos. = actual 1s predicted as 0s	44.059%
False pos. for predicted pos. = predicted 1s actual 0s	42.838%
False neg. for predicted neg. = predicted 0s actual 1s	43.137%
False predictions = actual 1s and 0s incorrectly predicted	42.991%
=====	

Appendix C: Additional questions in the survey

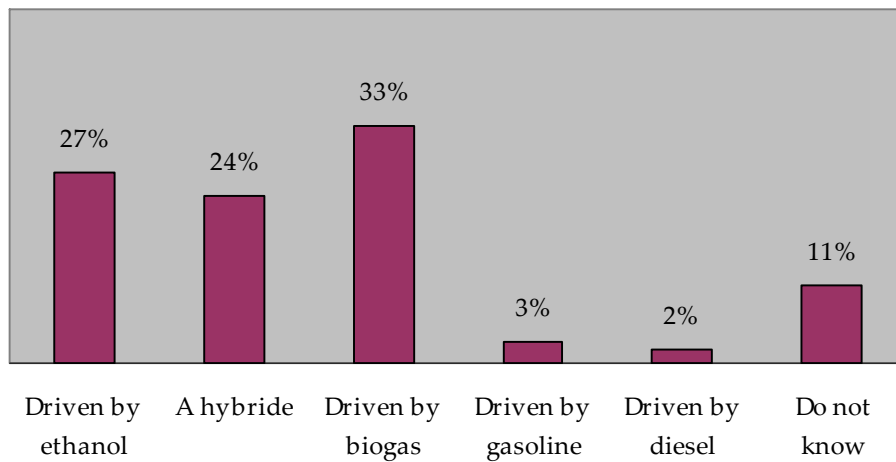
Two of the questions asked in the survey were not further analyzed in the study. Here are the results from question 9 and 10.

Figure C.1: Which safety aspect do you think is most important in a car? Rank these 1 to 5, 5 being the most important.



Evident is that good demolition properties of a car are seen as most important for almost 50 % of the respondents. The high number could be due to how the question was stated. It may have been inappropriate to compare a wider attribute such as “demolitions properties” with more specific safety details such as anti spin system. ABS brakes and airbags also proved to be important. 82 % of those that chose good demolition properties ranked either ABS breaks or air bags as the second most important safety property. As many as 80 % chose air bags as number 2 to 4.

Figure C.2: Which type of car do you think is best for low emissions of carbon dioxide?



The result shows that there was no clear “winner”. At present there is an ongoing debate over what is the best alternative to reduce the impact on climate change from the transport sector. Perhaps surprisingly, not many people chose diesel, although a diesel car emits less carbon dioxide than a corresponding gasoline car. The reason is probably a general thought of diesel being a fuel with high emissions of NO_x or particles. That both diesel and gasoline are rated low could also be due to how the question was stated. Perhaps it would have been more accurate to put forward the alternatives small/efficient gasoline and diesel cars.

Appendix D: The survey

Attached is one of the six survey versions that were sent out. All questions except the Choice Experiment in question 11 are identical across the six different versions. This shows the second part of survey version 1.

Vilka egenskaper hos en bil vill Du betala för?



EKONOMI
HÖGSKOLAN
Lunds universitet

Hej!

Du har tillsammans med 1499 andra personer i Sverige slumpmässigt valts ut för att delta i denna studie. I samarbete med Väg- & Transportforskningsinstitutet (VTI) gör Lunds Universitet en undersökning om hur konsumenter i Sverige värderar olika egenskaper hos en bil. Betoningen ligger på bilens miljö- och säkerhetsegenskaper.

Efter några inledande frågor om bilar kommer Du att ställas inför sex valsituationer, där en bil beskrivs på olika sätt till olika kostnader. Det gäller att välja det alternativ som Du anser passa Dig bäst. Till Din hjälp finns en bilaga där Du kan läsa lite kort om vad de olika egenskaperna innebär. Läs igenom den noga.

Det är helt frivilligt att delta i undersökningen, men vi vill betona att Ditt bidrag är oerhört viktigt och inte kan ersättas med någon annans. Alla svar kommer naturligtvis att behandlas helt anonymt. Som ett tack för att Du deltar kommer en trisslott att skickas hem till Dig per post.

När Du har besvarat enkäten, lägg den i det bifogade svarskuvertet och posta det. Inget frimärke behövs - VTI betalar portot. Svara gärna så snart som möjligt!

Tack på förhand för Din hjälp. Har Du några frågor är Du välkommen att ringa eller att skicka e-post.

Med vänliga hälsningar

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Bakgrundsinformation

- 1 Är Du intresserad av bilar?
Inte alls Mycket
- 2 Har Du körkort?
Ja Nej
- 3 Hur många bilar har Du tillgång till?
 Ägd eller leasad av hushålletbil/bilar
 Ägd eller leasad av arbetsgivarebil/bilar
 Är med i organiserad bilpool
 Ägd/leasad på annat sätt
 Har ej tillgång till bil
- 4 Du som har tillgång till bil, gör en uppskattning om årlig körsträcka mil
- 5 Planerar Du att köpa bil inom ett år?
Ja Nej Vet ej
- 6 Om "Ja" - ny eller begagnad?
Ny Begagnad
- 7 Om Du skulle köpa en bil, vilken prisklass skulle Du då välja?
(Oavsett om Du svarat "Ja" på fråga 6 eller inte)
 0 - 50 000 kronor
 50 001 - 150 000 kronor
 150 001 - 250 000 kronor
 250 001 - 350 000 kronor
 350 001 - 450 000 kronor
 Över 450 001 kronor
 Vill ej köpa bil

Bilens egenskaper

- 8 Om Du skulle välja ut FEM av följande egenskaper som Du helst vill att en bil ska ha, vilka väljer Du? Rangordna med siffrorna 1 till 5, där 5 är den viktigaste egenskapen.

- Den är av önskat bilmärke
- Den har stort lastutrymme
- Den har goda säkerhetsegenskaper
- Den har hög komfort
- Den har goda vägegenskaper
- Den inger lyxkänsla
- Den har goda miljöegenskaper
- Den har god accelerationsförmåga
- Den har en tilltalande design
- Den har låga driftskostnader
- Annan egenskap:

- 9 Koldioxid är den gas som sägs bidra mest till den så kallade växthuseffekten. I Sverige står vägtrafiken för cirka 30 % av dessa utsläpp vilka dessutom ökar år för år. Det finns olika sätt att få ner koldioxidutsläppen från bilar. Vilken av dessa biltyper tror Du leder till lägst koldioxidutsläpp och därmed gör en bil mest miljövänlig? Markera endast ETT alternativ.

- Den drivs med etanol (E85)
- Det är en sk. hybridbil, dvs drivs med både el och bensin/diesel
- Den drivs med biogas
- Den drivs med diesel
- Den drivs med bensin
- Vet ej

10

När Du tänker på en säker bil, vilken säkerhetsegenskap är då viktigast att bilen innehar?

Rangordna alternativen 1 till 5, där 5 är den viktigaste egenskapen.

- Den har ABS-bromsar
- Den har antisladd-system
- Den har whiplash-skydd
- Den har air-bags
- Den har goda krockegenskaper

11

Vilken bil väljer Du?

På de följande tre sidorna kommer Du att ställas inför sex olika val-situationer där en bil beskrivs genom vissa av dess egenskaper. En fullständig beskrivning av en bils egenskaper kan göras hur omfattande som helst och alla människor värderar bilens egenskaper olika. Här begränsar vi oss till att beskriva bilen genom en miljöegenskap, en säkerhetsegenskap, en fartegenskap samt genom dess årliga kostnad.

Alla andra bilegenskaper antas vara lika bilarna emellan!

Utifrån den information som ges kring bilen i vardera valsituation ska Du välja den bil som passar Dig bäst. Du kan välja 1, 2 eller "ingen av de två".

För att underlätta, illustreras de olika egenskaperna även med en prickad skala. Dessutom bör Du läsa den medföljande bilagan innan Du börjar. Där beskrivs innebörden av de fyra bilegenskaperna mer utförligt.

Tänk igenom svaren noga.

Val A: Vilken bil föredrar Du?

1

2

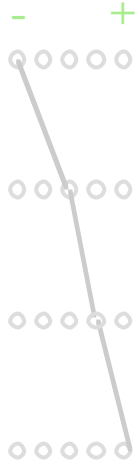
Bilens säkerhets-egenskaper

Bilens utsläpp av koldioxid

Bilens accelerationsförmåga

Års-kostnad (exkl bränsle)

Kryssa för det alternativ Du föredrar



30 % mindre säker än medelbilen

Medelstora utsläpp (190 g/km)

God (7,5 sek)

10 000 kr



30 % mindre säker än medelbilen

Mycket låga utsläpp (90 g/km)

Dålig (12,5 sek)

18 000 kr

Alternativ 1

Ingen av de två

Alternativ 2

Val B: Vilken bil föredrar Du?

1

2

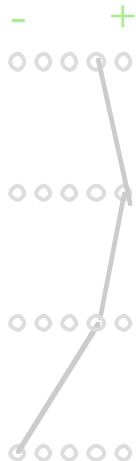
Bilens säkerhets-egenskaper

Bilens utsläpp av koldioxid

Bilens accelerationsförmåga

Års-kostnad (exkl bränsle)

Kryssa för det alternativ Du föredrar



15 % mer säker än medelbilen

Mycket låga utsläpp (90 g/km)

God (7,5 sek)

55 000 kr



30 % mer säker än medelbilen

Medelstora utsläpp (190 g/km)

Mycket god (5 sek)

55 000 kr

Alternativ 1

Ingen av de två

Alternativ 2

Val C: Vilken bil föredrar Du?

1

2

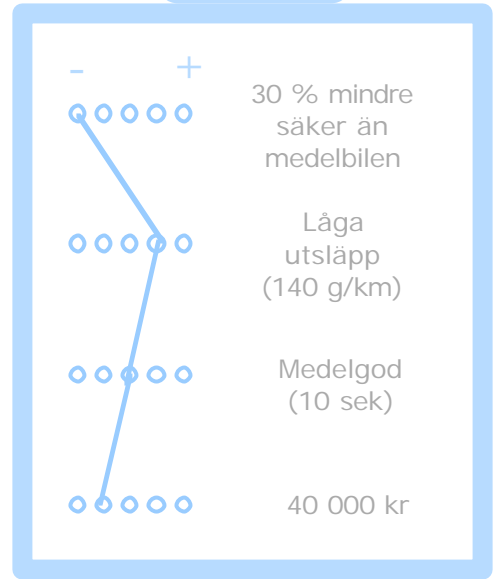
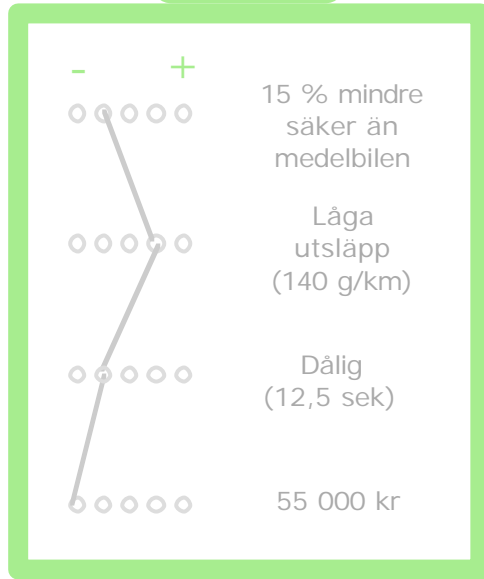
Bilens säkerhets-egenskaper

Bilens utsläpp av koldioxid

Bilens accelerationsförmåga

Års-kostnad (exkl bränsle)

Kryssa för det alternativ Du föredrar



Alternativ 1



Ingen av de två



Alternativ 2

Val D: Vilken bil föredrar Du?

1

2

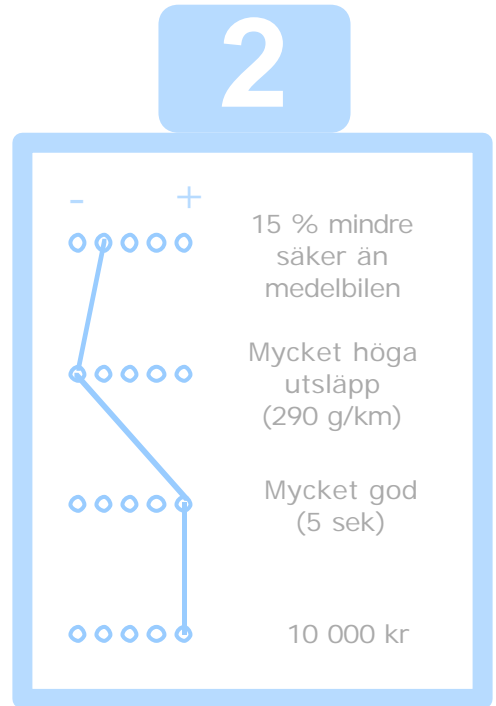
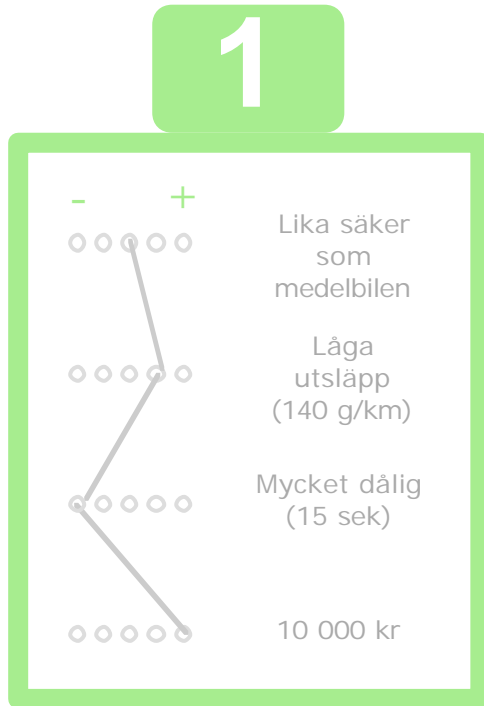
Bilens säkerhets-egenskaper

Bilens utsläpp av koldioxid

Bilens accelerationsförmåga

Års-kostnad (exkl bränsle)

Kryssa för det alternativ Du föredrar



Alternativ 1



Ingen av de två



Alternativ 2

Val E: Vilken bil föredrar Du?

1

2

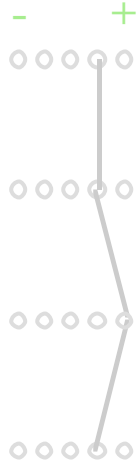
Bilens säkerhets-egenskaper

Bilens utsläpp av koldioxid

Bilens accelerationsförmåga

Års-kostnad (exkl bränsle)

Kryssa för det alternativ Du föredrar

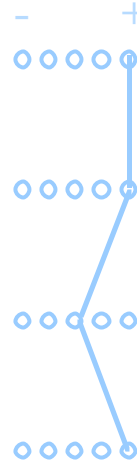


15 % mer säker än medelbilen

Låga utsläpp (140 g/km)

Mycket god (7,5 sek)

18 000 kr



30 % mer säker än medelbilen

Mycket låga utsläpp (90 g/km)

Medelgod (10 sek)

10 000 kr



Alternativ 1



Ingen av de två



Alternativ 2

Val F: Vilken bil föredrar Du?

1

2

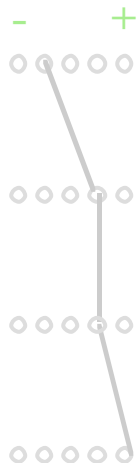
Bilens säkerhets-egenskaper

Bilens utsläpp av koldioxid

Bilens accelerationsförmåga

Års-kostnad (exkl bränsle)

Kryssa för det alternativ Du föredrar

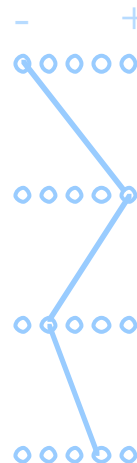


15 % mindre säker än medelbilen

Låga utsläpp (140 g/km)

God (7,5 sek)

10 000 kr



30 % mindre säker än medelbilen

Mycket låga utsläpp (90 g/km)

Dålig (12,5 sek)

18 000 kr



Alternativ 1



Ingen av de två



Alternativ 2

Avslutande frågor

12 Ålder

.....

13 Kön

Man

Kvinna

14 Vilken är Din högsta skolutbildning?

Grundskola, folkskola, ej avslutad grundskola eller liknande

Realskola, folkhögskola, gymnasium eller liknande

Högskola/universitet (minst en termins fullbordade studier)

15 Fördela personerna i Ditt hushåll i följande åldersklasser. Räkna även med Dig själv.

.....

0- 18 år

.....

Över 18 år

16 Vad är hushållets sammanlagda inkomst per månad (dvs. inkomst av anställning, sjukpenning, pension och/eller rörelse) före skatt?

0 - 10 000 kronor

10 001 - 20 000 kronor

20 001 - 40 000 kronor

40 001 - 60 000 kronor

60 001 kronor eller mer

17 Boendesituation

Stad/tätort

Glesbygd

18 Hur lätt/svårt tyckte Du det var att besvara enkäten?

Mycket lätt

Mycket svårt

19

Anser Du att bakgrunds-
informationen given i enkäten
var tillräckligt omfattande för att
kunna besvara frågorna?

Ja

Nej

Varken eller

Motivera gärna Ditt svar:

20

Tycker Du att valsituationerna
innefattade viktiga egenskaper
för att beskriva en bil?

Ja

Nej

Varken eller

Motivera gärna Ditt svar:

21

Övriga synpunkter om enkäten:

**Vi är tacksamma om Du skickar tillbaka det ifyllda frågeformuläret i
det bifogade svarskuvertet så snart som möjligt. Som tack för Din medverkan
skickas en trisslott per post så fort vi fått tillbaka den ifyllda enkäten.**

Bilaga: De fyra bilegenskaperna

Som informationsstöd när Du gör Dina val i enkäten följer här en mer utförlig beskrivning av de fyra egenskaper som i enkäten beskriver bilen.

1. Bilens säkerhetsegenskaper

Definition	Säkerhetsbegreppet visar risken för dödlig skada som är direkt relaterad till bilens konstruktion. Risknivån uttrycks i förhållande till en medelsäker bil i Sverige. Risken att dö i en trafikolycka är i genomsnitt 5 på 100 000 personer i Sverige per år.
Skala	<p>30 % mindre säker än medelbilen 15% mindre säker än medelbilen Lika säker som medelbilen 15 % mer säker än medelbilen 30 % mer säker än medelbilen</p>

2. Bilens koldioxidutsläpp

Definition	Koldioxid är den gas som bidrar i särklass mest till den så kallade växthuseffekten. Vägtrafiken står för cirka 30 % av Sveriges koldioxidutsläpp. Därmed är bilar med låga koldioxidutsläpp viktiga för att kunna motverka en kommande klimatförändring. Den genomsnittliga bilen i Sverige släpper ut ca 190g koldioxid per kilometer, men variationen är stor.
Skala	<p>Mycket höga utsläpp 290 g/km (53 % högre) Höga utsläpp 240 g/km (26 % högre) Medelstora utsläpp 190 g/km Låga utsläpp 140 g/km (26 % lägre) Mycket låga utsläpp 90 g/km (53 % lägre)</p>

3. Bilens accelerationsförmåga

Definition	Accelerationsförmågan beskriver bilens fartegenskaper. Skalan visar bilens accelerationsförmåga genom tiden det tar för bilen att accelerera från 0 till 100 kilometer i timmen, där en medelsnabb bil har en accelerationstid på ca 10 sekunder.
Skala	<p>Mycket dålig (15 sek) Dålig (12,5 sek) Medelgod (10 sek) God (7,5 sek) Mycket god (5 sek)</p>

4. Bilens årskostnad exklusive bränsle

Definition	Bilens årskostnad består av kostnaden som värdeminskningen innebär, reparationskostnader, skatter, försäkringskostnader samt däckkostnad. En ny bil kostar mest i förlorat värde. <i>Inga</i> bränslekostnader är inkluderade.
Skala	<p>55 000 kr 40 000 kr 27 000 kr 18 000 kr 10 000 kr</p>