Metric and Scale Effects in Consumer Preferences for Environmental Benefits

Vlada Pleshcheva (Institut für Marketing Humboldt-Universität zu Berlin)

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Ludwig-Maximilians-Universität München | Humboldt-Universität zu Berlin
Spokesperson: Prof. Dr. Klaus M. Schmidt, University of Munich, 80539 Munich, Germany
+49 (89) 2180 3405 | info@rationality-and-competition.de

Metric and Scale Effects in Consumer Preferences for Environmental Benefits *

Vlada Pleshcheva[1]

[1]*Institute for Marketing, Humboldt-University Berlin*

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Abstract

The present study investigates how the framing of information on the environmental impact of vehicles affects consumers' preferences for identical improvements in car quality. In online choice experiments, the effects of two metrics (fuel consumption vs. CO_2 emissions) and three scales of one metric (CO_2 in kg/km vs. g/km vs. g/100 km) are examined. First, from a technical perspective, fuel consumption (FC) and CO_2 emissions are linearly connected by a constant factor and are thus isomorphic in describing the environmental friendliness of a car. Second, rescaling identical information should not change consumer decisions. However, as this study demonstrates, the type of information presented to consumers significantly affects consumers' valuation of environmental benefits from a reduction in FC or CO_2. The study's contribution lies in quantifying the differences in consumers' preferences for two measures of the same information that have not been previously directly compared. Additionally, the differences in the framing effects are explored for diesel and gasoline vehicles. The estimation accounts for heterogeneity in the tastes, environmental attitudes and knowledge of the respondents. The insights of this study serve to guide policy makers and car manufacturers on how to present information on car offers.

JEL classification: D12, D90, M31, Q51.
Keywords: Choice architecture, environmental impact, framing effects, vehicle choice.

1 Introduction

Information provision in the form of energy labels for energy-consuming durable goods is an instrument of government policy to reduce environmental pollution and address issues

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related to climate change. Road transport is the second-largest source of greenhouse gas (GHG) emissions in the European Union, and passenger vehicles account for 12% of total European Union emissions of carbon dioxide (CO_2), the main GHG that contributes to climate change.[1] To reduce transport CO_2 emissions, environmental policies (e.g., Directive 1999/94/EC in the EU[2] and 49 CFR 575.401 in the US[3]) ensure that information on the fuel efficiency and CO_2 emissions of passenger cars is made available to consumers to facilitate informed choices. As a demand-side policy, car labeling is a complementary measure to the specific CO_2 emission targets imposed on car manufacturers. For policies on both the demand and supply sides to be effective at promoting low-carbon and fuel-efficient vehicles, it is crucial that consumers value improvements in the fuel consumption (hereafter, FC) and CO_2 emissions of cars. From a technical perspective, these two metrics are linearly connected by a specific (constant) factor and thus are equivalent in describing the environmental impact of vehicles.[4] However, it remains unclear whether consumers value improvements in CO_2 as much as improvements in FC. If consumers' car choices vary across metrics, such shift in choices may lead to negative financial consequences for consumers and higher environmental costs from car use.

The aim of the current study is to investigate whether and how consumers differ in their preferences and willingness-to-pay (WTP) for identical improvements in the FC versus CO_2 emissions of cars. No prior work has directly compared consumers' preferences for these two metrics. Prior research on revealed preferences has not been able to separately identify these effects because the metrics are correlated, and research on stated preferences has focused either on one of these environmentally important attributes or simultaneously considered both measures. To separately identify preferences for FC versus CO_2 emissions in this study, participants were presented with choice experiments that showed information either on FC or CO_2 emissions and were asked to choose a car to rent for an extensive holiday trip. As a result, the present study recovers the WTP for marginal changes in FC and CO_2

[1] https://ec.europa.eu/clima/policies/transport/vehicles/cars_en (accessed: March 08, 2018)
[2] http://eur-lex.europa.eu (accessed: March 08, 2018)
[3] https://www.ecfr.gov (accessed: March 08, 2018)
[4] One liter of fuel produces approximately 26.5 and 23.2 grams of CO_2 per kilometer driven by diesel and gasoline vehicles, respectively (http://www.kba.de/SharedDocs/Publikationen/DE/Statistik/Fahrzeuge/FZ/Fachartikel/emission_20110315.pdf, p. 6. Accessed: March 08, 2018).

independently and, additionally, is able to quantify relative differences in these values for each person and relate them to individual-specific characteristics.

The current research relates to the broad literature on how choice architecture – how choices are presented, described, and structured – affects consumers' decisions (Tversky and Kahneman, 1981; Thaler et al., 2014; Münscher et al., 2016). In contrast to previous research, the current study does not examine the effect of valence framing of information (Levin et al., 1998; Avineri and Waygood, 2013) but explores the differences in consumers' WTP for environmental benefits when they are represented in terms of two metrics that have not previously been explicitly compared. The description of the environmental impact of car options in terms of FC and CO_2 represents a specific type of choice architecture (Ungemach et al., 2017). For a rational agent, the presentation of both attributes is redundant because each metric presents a "translation" of the same underlying information (Ungemach et al., 2017). However, prior research has demonstrated that consumers might perceive various measures of the same information differently (hereafter, a metric effect). For example, when the fuel efficiency of cars is framed in terms of fuel per distance (e.g., in l/100 km), instead of distance per unit of fuel (e.g., in km/l), people tend to have a more accurate perception of potential fuel savings (Schouten et al., 2014; Allcott, 2011; Larrick and Soll, 2008) – a perceptual error referred to in the literature as the "MPG illusion" (Larrick and Soll, 2008). As a result, this cognitive error may lead to suboptimal decisions at the consumer level and reduce demand for environmentally friendly vehicles. Camilleri and Larrick (2014) also observed that people tended to select a more fuel-efficient car when fuel economy was expressed as the fuel costs rather than the amount of fuel consumed.

In addition to the metric effect, prior work has also indicated that a change in the units in which quantitative information is provided affects consumer preferences (Pelham et al., 1994; Burson et al., 2009). The same attribute differences appear larger on scales with many units or expanded scales than on contracted scales (hereafter, a scale effect; Pandelaere et al., 2011). This effect was explained by people's tendency to judge quantitative information by the number of units without considering the type of the units. For example, Camilleri and Larrick (2014) found that information on fuel costs on the most expanded scale (as in 5,000 per 100,000 miles) resulted in higher preferences for a more fuel-efficient alternative than on other more contracted scales (as in 5 per 100 miles and 750 per 15,000 miles). Cadario et al. (2016) replicated the scale effect for information on carbon emissions – consumers exposed to an expanded scale of CO_2 emissions (as in 100 g/km) more frequently selected an environmentally friendly car than those exposed to a contracted scale (as in 0.100 kg/km). The current paper extends the investigation of the scale effect in Cadario et al. (2016) by exploring the effects of three scales for CO_2 emissions (0.100 kg/km vs. 100 g/km vs. 10,000 g/100 km) that varied between subjects in the choice experiment. The use of three scales makes it possible to test for the default unit effect (Lembregts and Pandelaere, 2013) and a diminishing effect of scale expansion (Aribarg et al., 2017). The default unit effect would lead to higher WTP for an attribute expressed in familiar units (CO_2 in g/km in Germany and most European countries) compared to a more expanded scale (such as g/100 km), whereas the curvilinearity of the scale effect suggests that there is an inflection point at which the positive impact of scale expansion on attribute perception flattens and then reverses.

Compared to Cadario et al. (2016), Camilleri and Larrick (2014), and Pandelaere et al. (2011), the investigation in this paper is based on consumer choices from optimally designed choice experiments. Aribarg et al. (2017) also used optimal experiment designs, but that study focused only on the scale effect. Using a similar question as in Pandelaere et al. (2011) on perceived differences between two alternatives described by an attribute expressed on an expanded or a contracted scale, the current study found that participants were often inclined to opt for the middle response option regardless of the scale considered, potentially because they experienced difficulties in assessing the differences. Therefore, implementing an optimally designed choice experiment makes it possible to indirectly elicit consumer preferences for the investigated metrics by mimicking the actual choice situation, while additionally controlling for various determinants of choices.

Furthermore, the choice experiment in the present study is designed to be able to test for differences in the metric and scale effects by vehicle engine type (diesel versus gasoline). Because diesel and gasoline vehicles differ in both their environmental impact per unit of distance driven and fuel prices, consumers' perceptions of improvements in FC and CO_2 for these two types of vehicles may vary (Olson, 2013).

Various outcome measures are considered in the analysis: in addition to the proportion of choices in favor of a more environmentally friendly vehicle, attribute importance, and WTP for FC and CO_2 emissions, changes in individual choices between two alternatives that trade off on price per rental day, total financial costs, and total environmental costs are examined with respect to the framing of information (metric and scale effects). The distribution of the WTP for FC or CO_2 emissions is recovered by estimating a mixed (random coefficient) logit model that accounts for consumers' unobserved heterogeneity in tastes in addition to the observed heterogeneity in the respondents' socio-demographic characteristics, car use experience, and environmental attitudes and knowledge.

The results of the present study suggest that participants value improvements in FC significantly more highly than the corresponding reduction in CO_2 emissions. Moreover, this discrepancy is greater when CO_2 emissions are presented on the most contracted scale. On the most contracted CO_2 scale (in kg/km), respondents are willing to pay, on average, for only 55% of the fuel savings and environmental benefits from better FC and CO_2 emissions. Individual attitudes and knowledge concerning environmental and climate issues significantly contribute to reducing the framing effects. There is a significant difference in consumers' choices based on whether they are driven by financial or pro-environmental motives. Based on this paper's findings, if consumers' car choices are guided solely by financial incentives, they may neglect the environmental damage caused by cars with lower fuel economy when information on CO_2 emissions, instead of FC, is presented.

Examining consumer valuations of and propensity to choose an environmentally friendly car is of great interest to policy makers. The insights from the current study are useful to understand how metric and scale design, as a choice architecture tool, can be used to "nudge" consumers to make better decisions (Thaler and Sunstein, 2008; Johnson et al., 2012). As the findings indicate, presenting information on the environmental impact of cars and policies that increase people's awareness of the correlation of FC and CO_2 emissions are both crucial to generate reductions in carbon emissions from vehicle use. Thus, this study also contributes to the literature on information-based policies for energy-consuming durable goods (Teisl et al., 2008; Newell and Siikamäki, 2014; Cohen and Vandenbergh, 2012; Heinzle, 2012) applied to vehicle preferences. Furthermore, the results may inform car manufacturers how to address the environmental benefits of car offers in their advertising

(Xie and Kronrod, 2012; Chang et al., 2015).

The remainder of this paper proceeds as follows. Section 2 and Section 3 present the conceptual framework and research methodology, respectively. Section 4 describes the data and presents initial (model-free) evidence for the metric and scale effects on consumers' preferences for environmental benefits. Section 5 discusses the results of the estimation. Section 6 critically examines the findings, discusses the conceptual contributions and limitations of the study, and proposes future research directions. Section 7 concludes.

2 Conceptual Framework

The present research tests three main hypotheses. The first hypothesis (H1) is designed to replicate the results of previous studies on the scale effect (Pandelaere et al., 2011; Cadario et al., 2016; Camilleri and Larrick, 2014). The current study examines the effects of three scales for presenting information on CO_2 emissions – kg/km, g/km, and g/100 km. CO_2 values in kg/km correspond to the most contracted scale relative to those in g/km and g/100 km, whereas g/100 km is the most expanded scale. For example, 0.001 kg CO_2 per kilometer is equal to 1 g CO_2/km and 100 g CO_2/100 km. According to the scale effect, consumers should perceive same attribute differences to be larger when the attribute is expressed on expanded versus contracted scales, and thus, the WTP for improvements in CO_2 emissions should increase as the scale is expanded. Following the reasoning above, the first hypothesis suggests the following result:

H1a: WTP (100 g CO_2/100 km) > WTP (1 g CO_2/km)
H1b: WTP (1 g CO_2/km) > WTP (0.001 kg CO_2/km)

The three scales considered here also make it possible to investigate the potential curvilinear relationship between scale expansion and attribute importance weight (Aribarg et al., 2017) and to examine the role of the default unit effect (Lembregts and Pandelaere, 2013). The former effect would manifest in a diminishing positive impact of scale expansion on the WTP for improvements in CO_2 emissions (differences in WTP in H1a smaller than those in H1b). The default unit effect would result in a smaller WTP for CO_2 reduction when the attribute is expressed in g/100 km (despite its expanded scale) than in g/km (reverse H1a), as the latter unit is the default presentation of CO_2 emissions in Germany and many European countries.

The other two hypotheses are novel and concern the metric effect. First, consumers' WTP for identical improvements in cars' environmental-friendliness is hypothesized to be greater when information on FC, instead of CO_2 emissions, is presented (H2a and H2b):

H2a: Diesel ΔWTP = WTP (1 l/100 km) - WTP (26.5 g/km) > 0

H2b: Gasoline ΔWTP = WTP (1 l/100 km) - WTP (23.2 g/km) > 0

This hypothesis is based on the presumption that financial costs are more important for consumers than environmental costs. According to the theory of context-dependent choices, consumers may attach disproportionately large weights to salient attributes and be inattentive to less salient or obvious information (Bordalo et al., 2013; Gsottbauer and van den Bergh, 2011). In the context of automobile choice decisions, a car's price might be more important for consumers than its ongoing fuel costs, and fuel costs might be more salient than environmental costs.

Finally, the differences in consumers' perceptions of and WTP for the two metrics are explored across diesel and gasoline vehicles (H3). Because diesel fuel is less expensive, individuals may prefer diesel vehicles due solely to a financial motive, to save on operating costs. Accordingly, these consumers could more frequently pay attention to FC but not to CO_2 emissions than do drivers of gasoline vehicles. For example, in one of the conjoint studies that included the effects of pro-green attitudes on car choices, Olson (2013) found that, relative to gasoline buyers, diesel buyers have less interest in environmental issues and are more likely to seek the cheapest alternative regardless of its impact on the environment.

H3: Diesel ΔWTP > Gasoline ΔWTP

All hypotheses are formulated in terms of average effects. Additionally, individual differences may weaken or amplify the proposed relationships. For example, education and pro-environmental attitudes are expected to be associated with more accurate perceptions of the environmental impact of vehicles (Meyer, 2015; Poortinga et al., 2004; Hines et al., 1987) and thus result in smaller discrepancies in the WTP between the metrics and scales. Various consumer characteristics are included in the estimated models to study these differences.

3 Research Methodology

3.1 Questionnaire design

As a framework to investigate the effects of the framing of vehicles' environmental impact, this study considers a car rental for a holiday trip. In contrast to automobile purchases, the choice of which car to rent is less complicated but a longer trip with a rented car still has non-negligible environmental and financial consequences.

The questionnaire to study personal preferences for selected features of a car rental service in Europe contained an introduction to the survey, which described its purpose, time required for completion, and an incentive to participate; questions regarding respondents' car rental experience; two choice experiments that were separated by questions on respondents' perceptions of differences between pairs of attribute levels in terms of their environmental benefits; questions on respondents' knowledge and attitudes towards environmental issues and car use; and finally, questions on respondents' socio-economic characteristics.

The environmental attitudes and knowledge of the respondents were measured with various scales. First, the scale used by the German Federal Environment Agency was used – the "General Environmental Consciousness" scale (UBA, 2016; Best, 2011). This scale combines cognitive, affective, and conative environmental orientations into a single score. The confirmatory factor analysis delivers a high internal consistency estimate of reliability of this scale in the present study – the Cronbach's α is 0.83 with a bootstrap confidence interval of 0.80-0.86.[5] The path diagram and model fit statistics are presented in Figure B1.

[5] The bootstrap confidence interval was computed based on 1,000 bootstrap samples of size 400 from the initial 586 observations.

Second, statements related to the perception of car use, financial motives, and knowledge were taken from previous studies or formulated specifically for the present study. The order of the items varied among the respondents. Responses were measured on a four-point Likert scale from "strongly disagree" to "strongly agree" and also included a "do not know" option. Additionally, the participants reported how well informed they are on issues related to climate change and how significant the problem of climate change is to them personally. These questions were presented to participants after the choice experiments to mitigate a priming of their decisions as being environmentally related.

3.2 Choice experiments

Within the choice experiments, participants were asked to assume that they planned to rent a car for a ten-day holiday trip and to drive 2000 kilometers in total. Additionally, fuel prices for diesel and gasoline were provided. Respondents were asked to consider the presented car offers to be identical and acceptable to them in all attributes not mentioned and were informed that comprehensive insurance coverage and all rental fees were included in the price per day. Participants responded to two choice experiments – with information either on FC (hereafter, the FC design) or CO_2 emissions on various scales (hereafter, the CO_2 design) as one of the attributes of the presented car options. In total, four designs (FC + $CO_2 \times 3$ scales) of the choice experiment were constructed. Each design had three attributes: engine type, with two levels; price per day, with four levels; and metric (FC or CO_2), with four levels (see Table 1).

The attribute levels were selected to correspond to current market offers. Moreover, the levels of the rental price were chosen to ensure that there are alternatives within choice tasks that trade off on the price per day (€), total financial costs (€ for the whole trip), and environmental costs (kg of CO_2 for the whole trip). The total financial costs (TC) were computed as $\text{P} \times \text{Days} + \text{FC}/100 \times \text{FP} \times \text{KM}$, and the environmental costs (EnvC) were given by $CO_2 \times \text{KM}$, where P is the rental price in € per day, FC is fuel consumption in liters per 100 kilometers, FP is fuel price for diesel or gasoline in €/liter, CO_2 is the amount of CO_2 emissions in g/km, and KM stands for kilometers driven over 10 days. For example, if an alternative with the highest price per day in a choice task should have the lowest total financial costs, then the condition (1) should hold.

$$(P1 - P2) < (FP2 \times FC2 - FP1 \times FC1) \times \frac{KM}{Days \times 100} \tag{1}$$

Table 1: Attributes in the choice experiment design

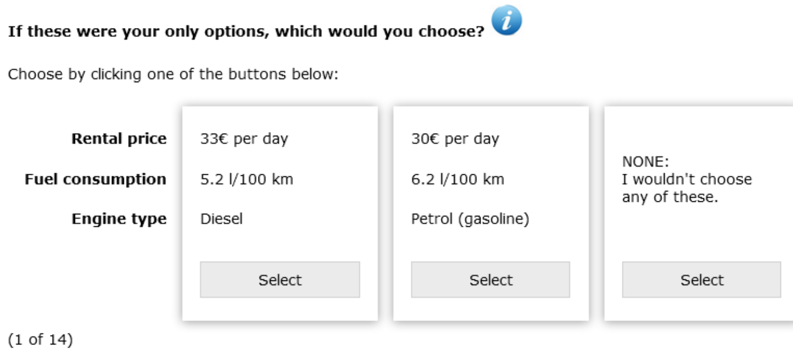
Attribute	Attribute levels
Engine	Diesel; gasoline
Price (€/day)	23; 26; 30; 33
Metric	FC, l/100 km (3.2; 4.2; 5.2; 6.2)
	CO2, g/100 km (8500; 11100; 13800; 16400)
	CO2, g/km (85; 111; 138; 164)
	CO2, kg/km (0.085; 0.111; 0.138; 0.164)

The metric (FC or CO_2) varied within subjects, whereas the CO_2 scale varied across subjects. The within-subject design enables this study to compare preferences for FC versus CO_2 for the same participants; the between-subject design makes it possible to eliminate learning effects while investigating the impact of various scales on choices. Based on the D-efficiency criterion, 14 choice tasks for each design were constructed. Each choice task consisted of two car alternatives and the no-choice option. The D-efficiency of the final experimental design with 14 choice tasks, 3 alternatives, linear effects of the attributes, and restrictions on the composition of the second option is 93.81% (compared to an unrestricted version, created by the shifting method). A test of the experimental designs based on the simulated choices, which were generated following random utility theory, indicated that a sample size of at least 400 individuals is sufficient to efficiently evaluate the effects of interest, including the interaction term (see Table A4 for the results).

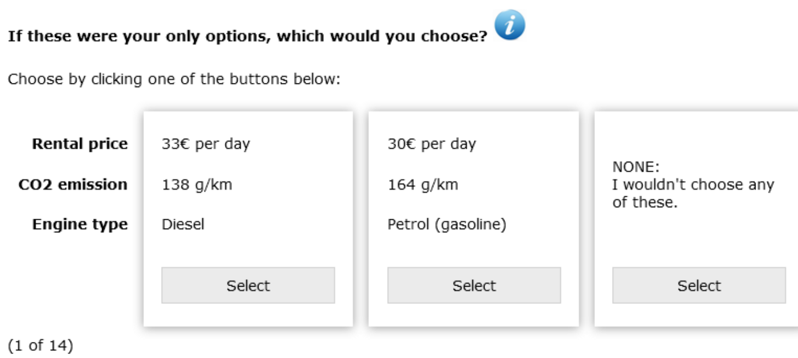
The examples of one choice task for the FC design and the CO_2 design are presented in Figure 1. The order of the presentation of the choice tasks for either the FC design or CO_2 design, the position of the displayed attributes within choice tasks, and the order of profiles were randomized across participants.

Figure 1: Example of choice tasks for both designs

(a) FC design



(b) CO_2 design (g/km)



3.3 Model specification

The choices between options in the experiments are modeled according to random utility theory (McFadden, 1973; Train, 2009). It states that a rational economic consumer selects the option among a finite set of alternatives that provides the highest utility, with utility being a latent construct modeled in a probabilistic way. Individual choices related to characteristics of the persons and/or alternatives are used to infer their contributions to the utility derived from products. Following standard notations in the literature, the utility U_{njt} that consumer $n \in \{1, ..., N\}$ obtains from alternative $j \in \{1, ..., J\}$ for a choice situation $t \in \{1, ..., T\}$ consists of two additive components: a deterministic part V_{njt} and a non-observable random part ε_{njt} (Train, 2009; McFadden and Train, 2000). The deterministic part is assumed to be a linear-additive utility function of observed product attributes. The random part is given by ε_{jnt} and reflects unobserved determinants that influence consumer choices. Given the attributes in the current study, the utility function is specified as in equation 2:

$$U_{njt} = V_{njt} + \varepsilon_{njt} = \alpha_{0n} \cdot \text{None}_{njt} + \alpha_{1n} \cdot \text{Engine}_{njt} - \alpha_{2n} \cdot \text{Metric}_{njt} + \alpha_3 \cdot \left(\text{Metric}_{njt} \cdot \text{Engine}_{njt}\right) - \beta_n \cdot P_{njt} + \varepsilon_{njt}, \tag{2}$$

where None_{njt} is the no-choice option, the utility of which is given by $U_{0nt} = \alpha_{0n} + \varepsilon_{0nt}$; P_{njt} indicates the rental price in €/day; Engine_{njt} stands for engine type (diesel vs. gasoline); Metric_{njt} represents either FC in l/100 km or CO_2 in g/km; α_n are the utility coefficients that reflect the associated importance weights assigned by consumers to each of the product attributes except price; and β_n is the price sensitivity. The unobserved term ε_{njt} is assumed to be *iid* extreme value. While α_{3n} is fixed for all individuals, the taste parameters α_{0n}, α_{1n}, $\ln(\alpha_{2n})$, and $\ln(\beta_n)$ are allowed to vary across individuals and are assumed to be multivariate normally distributed, with $\bar{\theta}$ being a vector of population means of the parameters and Σ being a variance-covariance matrix:

$$\theta_n = [\alpha_{0n}, \alpha_{1n}, \ln(\alpha_{2n}), \ln(\beta_n)]' \sim MVN(\bar{\theta}, \Sigma) \tag{3}$$

Engine type enters the utility function with a normally distributed coefficient because different people might prefer different fuels. The coefficient on the interaction term reflects differences in consumers' perceptions of improvements in the metric for diesel and gasoline vehicles and can take either signs. The coefficients for the price β_n and the metric α_{2n} are restricted to be non-positive for all individuals by assuming log-normal distributions for these parameters. The mean of the metric coefficient is also allowed to depend on the observed respondents' characteristics as presented in equation 4, where $\bar{\alpha}_2$ is the mean of the metric effect in the population, Z_{nk} is kth person-specific characteristic, π_k is its effect on the metric parameter, and $\sum_{m=1}^{4} \sigma_{2m}\eta_{2n}$ is a linear combination of $\eta_{2n} \sim N(0,1)$ and elements of a lower triangular (Cholesky) matrix σ_{2m} for all random utility parameters. The coefficient of the interaction term of engine type and metric is held constant across individuals.

$$\alpha_{2n} = \bar{\alpha}_2 + \sum_{k=1}^{K} \pi_k \cdot Z_{nk} + \sum_{m=1}^{4} \sigma_{2m}\eta_{2n} \tag{4}$$

The specified random coefficient or mixed logit (hereafter, MXL) model yields the probability that decision-maker n will choose a specific sequence of alternatives $\mathbf{j} = \{j_1, ..., j_{Tn}\}$, which is given by the integral of the standard logit formula over the density of θ_n parameters (equation 5).

$$MXLP_{nj} = \int_{-\infty}^{\infty} \prod_{t=1}^{T_n} \left(\frac{\exp(V_{njt})}{\sum_l \exp(V_{nlt})} \right) f(\theta) d\theta \tag{5}$$

The parameters in equation 5 remain constant within decision-makers, but vary across persons. To estimate the parameters of the density distribution of θ_n, the present study uses a Maximum Simulated Likelihood approach (Train, 2009; Bhat, 2001), whereby 2000 Halton draws are employed to approximate the log-likelihood function[6].

To ease the interpretation of the estimation results, measures of relative attribute importance (RAI) weights and WTP for two metrics are used. The RAI equals the relative range in the utility estimates for an attribute, computed for each person (Verlegh et al., 2002). The WTP for an improvement in FC or CO_2 is given by the negative of the ratio of the coefficients for the metric and price (Train, 2009):

$$WTP_n = -\frac{\alpha_{2n} + \alpha_3 \times \text{Engine}}{\beta_n} \tag{6}$$

All derived measures (RAI, WTP, shares) are computed from 10,000 draws from the estimated population distribution of the taste parameters. Additionally, to reflect the estimation error, standard errors and confidence intervals for all measures are evaluated by using 300 bootstrap samples of the draws (Efron and Tibshirani, 1986). Because of the interdependence between the FC and CO_2 values, the WTP for one of these environmentally important car characteristics implies the WTP values for the other metric. For example, the implied WTP (FC) values based on the estimated WTP (CO_2) can be computed as WTP (CO_2)$\times$24.85 for both engine types on average. The reciprocal functional relationship holds for the implied WTP (CO_2) based on the estimated WTP for fuel consumption.

[6] Train (2009) argues that Halton draws provide better approximations to the integral than (pseudo-) random draws. In the case of many explanatory variables, a number of draws greater than 1000 is recommended to reduce a simulation noise (Elshiewy et al., 2017b). See also Elshiewy et al. (2017a) for a good overview of implementation of the discrete choice models.

4 Data and Initial Insights

This section describes the data and presents initial (model-free) evidence for metric and scale effects on consumer preferences for environmental benefits.

4.1 Summary statistics

This study uses a convenience sample of 586 eligible respondents that were randomly and equally distributed across the experimental designs. Participants were recruited online from July to November 2017 via social media networks, networks of students from German universities, and various online platforms to collect data (e.g., PollPool, SurveyCircle). No statistically significant differences in the respondents' socio-demographic characteristics (e.g., gender, age, income) or car rental experience were found across the designs (see Table 2). On average, it took 16 minutes for the participants to complete the questionnaire. The sample consists predominantly of participants from Germany, with an average age of 29 years, of both genders in similar proportion, and an average net monthly income of €1,000 – €1,500. More than 60% of the participants have experience with a car rental service, and more than 80% of them had rented a car within the previous two years. Those participants who had rented a car for a holiday or tourism (approximately 80% of the sample) had driven, on average, 151 kilometers over nine days. Hence, the proposed scenario for the choice experiment is consistent with real-world experiences of car rentals for holiday trips.

Additional variables related to the respondents' environmental attitudes, financial motives, and knowledge served as potential covariates in the discrete choice models to control for the observed consumer heterogeneity. For example, a majority of the respondents (78%) reported being willing to pay higher prices for products that pollute less (see Table 3). The participants also evaluated their personal knowledge on climate issues as average and their perception of the importance of problems related to climate change as slightly higher than average. On the other hand, for 67% of respondents, improvements in a car's FC were foremost linked to financial savings. Moreover, only 12% of the respondents were aware of the link between values of FC and CO_2 emissions.

Table 2: Summary statistics of the sample by choice design

Characterisitcs	Units	CO_2 in g/100 km (N = 194) Mean	SD	CO_2 in g/km (N = 196) Mean	SD	CO_2 in kg/km (N = 196) Mean	SD	Total Sample (N = 586) Mean	SD
First shown (FC Design = 1)	0/1	0.53	0.50	0.48	0.50	0.47	0.50	0.49	0.50
Time spent	minutes	17.82	13.30	15.64	10.93	13.61	8.59	15.69	11.22
Country of residence (Germany = 1)	0/1	0.98	0.15	0.97	0.17	0.93	0.25	0.96	0.19
Gender (Male = 1)	0/1	0.46	0.50	0.47	0.50	0.49	0.50	0.47	0.50
Age	years old	28.37	10.36	28.84	9.76	28.68	9.93	28.63	10.00
Net monthly income	group	2.67	1.68	3.11	1.79	3.14	1.81	2.97	1.77
Children under 18 (Yes = 1)	0/1	0.12	0.33	0.16	0.37	0.10	0.30	0.13	0.33
University degree (Yes = 1)	0/1	0.51	0.50	0.59	0.49	0.62	0.49	0.57	0.50
Own car (Yes = 1)	0/1	0.36	0.48	0.35	0.48	0.37	0.48	0.36	0.48
Rental experience (Yes = 1)	0/1	0.64	0.48	0.63	0.48	0.62	0.49	0.63	0.48
Rent for holidays/tourism (Yes = 1)	0/1	0.77	0.42	0.76	0.43	0.84	0.37	0.79	0.41
N days (holidays)	number	8.97	10.71	8.13	5.71	8.77	6.95	8.63	8.03
Km per day (holidays)	kilometers	145.22	103.94	163.82	153.71	144.27	126.73	150.93	129.64

NOTE: The average monthly income was computed without responses for income group 8 ("Prefer not to answer") and corresponds to "€1,000 to under €1,500" (group 3). There are no statistically significant differences in the respondents' socio-demographic characteristics or car rental experience across the designs. SD stands for standard deviation.

Table 3: Summary statistics for variables related to the environmental attitudes and knowledge

	Units	Mean	SD	Min	Max
Environmental consciousness$^{(a)}$	score	0	1	-4.67	1.91
"WTP for less pollution"'$^{(b)}$	0/1	0.78	0.41	0	1
"Financial motive"'$^{(c)}$	0/1	0.67	0.47	0	1
"FC-CO_2 knowledge"'$^{(d)}$	0/1	0.12	0.32	0	1
"Self-reported knowledge"$^{(e)}$	(1): Not at all - (7): Expertly	4.44	1.00	2	7
"Self-reported importance"$^{(f)}$	(1): Not at all - (7): Extremely	5.10	1.29	1	7

NOTE: *(a)* A score from the confirmatory factor analysis for the "General Environmental Consciousness" scale (UBA, 2016); *(b)* = 1 if a person responded "somewhat agree" or "strongly agree" to the statement "I am willing to pay higher prices for products that are less polluting"; *(c)* = 1 if a person responded "somewhat agree" or "strongly agree" to the statement "For me, improvements in fuel consumption of a car are foremost linked to savings in my expenses"; *(d)* = 1 if a person responded "somewhat disagree" or "strongly disagree" to the statement "It is possible to improve the fuel consumption of a car, while keeping its CO_2 emission constant"; *(e)* How well informed would you say you are about issues related to climate change? *(f)* How important is the issue of climate change to you personally?

In the choice experiments, the average share of the no-choice option did not exceed 5% for both designs. This implies that respondents substituted between the two car options and did not exit the market in response to choice set compositions. The average choice shares for the first and second alternatives were 51.3% and 44.19% in the FC design and 46.42% and 48.76% in the CO_2 design, respectively.

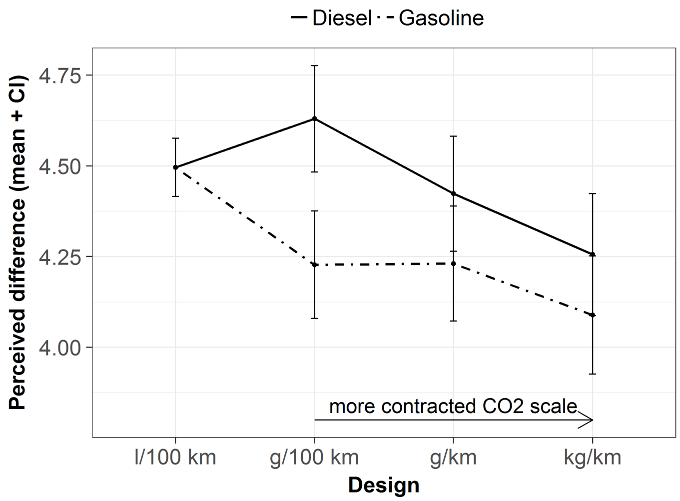
4.2 Model-free evidence

The metric and scale effects on consumers' preferences for environmental benefits are explored by looking at various outcome measures. Here, model-free evidence is presented. The next section then discusses the results derived from the discrete choice model estimation.

Similar to Pandelaere et al. (2011) and Aribarg et al. (2017), respondents were asked to indicate their perceptions of differences between two values of one attribute (FC or CO_2). In the FC design, the question was *"In your perception, how much is a car with FC of 5.2 l/100 km ecologically better than a car with 6.2 l/100 km?"*, with seven possible responses ranging from 1 ("Not at all") to 7 ("Extremely"). For the CO_2 design, similar questions with two pairs of the corresponding CO_2 values were offered, which varied with the scale and engine type. For example, a car with a FC of 5.2 l/km emits 138 grams of CO_2 per kilometer (0.138 kg/km or 13,780 g/100 km) in the case of a diesel engine and 121 g CO_2/km (0.121 kg/km or 12,064 g/100 km) in the case of a gasoline engine. For all pairs, the first option was 16% ecologically better. Figure 2 presents average values of the perceived differences for all pairs of the comparison along with the confidence interval. The results are in line with the prediction that a more expanded scale induces greater perceived differences in the values of attribute levels. Thus, the scale effect occurs due to shifts in mental representations of attribute values. Few statistically significant differences in the responses among the designs are due to the respondents' tendency to select a middle response option if they have difficulty to compare the attribute values. Therefore, it is essential to also indirectly elicit the metric and scale effects on consumer decisions, for example through choice experiments.

The analysis of the choice data (see Figure 3a) demonstrates that respondents selected the highest level of the metric (FC or CO_2) that corresponds to higher fuel costs and environmental costs more often 1) under the CO_2 design than under the FC design (metric

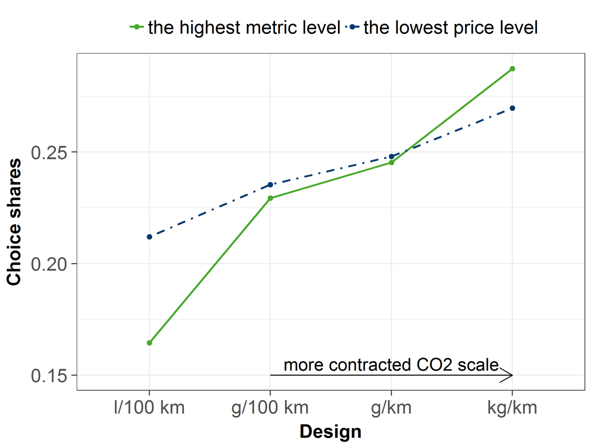
Figure 2: Perceived differences between attribute values



NOTE: Based on responses to the question *"In your perception, how much is [Attribute value 1] ecologically better than [Attribute value 2]?"* on the scale ranging from 1 ("Not at all") to 7 ('Extremely"). Average values with the 90%-confidence interval over all pairs of the comparison are depicted.

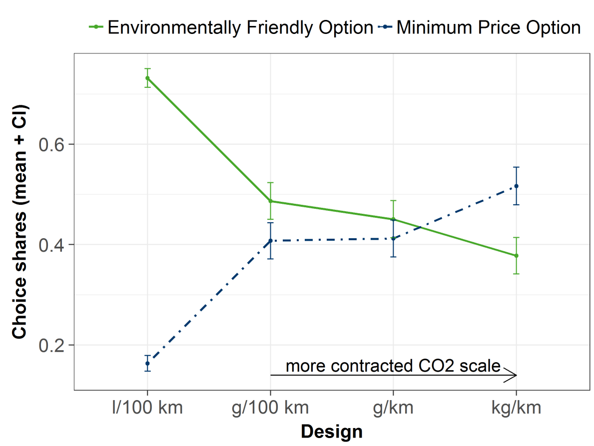
Figure 3: Model-free evidence for the metric and scale effects

(a) Choices of attribute levels



NOTE: The figure shows the choice shares of the highest metric level (FC or CO_2) and the lowest price level across experimental designs.

(b) Choices in identical sets



NOTE: The figure shows the mean choice shares of two car options from identical choice sets across experimental designs. Environmentally friendly option has the minimum environmental costs (kg of CO_2), while the other option has the lowest rental price. The CI stands for 95%-confidence interval.

effect) and 2) under the more contracted CO_2 scale (scale effect). The first finding suggests that the two metrics are perceived differently, despite their interdependence; and the second finding implies that the shift in the mental representation of attribute values due to the scale effect results in different choices for the same person. Furthermore, the choice of the lowest rental price increases for the more contracted CO_2 scale.

A comparison of the choices between two vehicles from identical choice sets across designs (Figure 3b) also indicates that under a more contracted CO_2 scale, the appeal of the environmentally friendly option decreases, and respondents' focus shifts towards the option with the lowest rental price. As a consequence, more respondents make suboptimal choices in terms of both personal financial costs and social environmental costs. A sharp decline in the choice share in the CO_2 design suggests that the participants place greater weight on financial costs than on the environmental impact of the chosen vehicles. To better understand these preferences and the potential for preference reversal from the framing of information, the following section presents the findings from the discrete choice model estimation.

5 Estimation Results

5.1 Model fit

To econometrically explore the metric and scale effects on consumer preferences, discrete choice models are estimated under different model assumptions. First, the standard multinomial logit (MNL) models are estimated as a benchmark for comparing more complex models. Tables C1 and C2 present the parameter estimates from models based on data for the FC design and CO_2 design, respectively. The first column in both tables corresponds to the MNL models that do not include the respondents' observed heterogeneity. The other columns show how the parameter estimates for product attributes change after controlling for various sets of individual-specific variables. The last column in each table shows the results of the best fitted MNL model that serves to determine what individual-specific covariates to include in the MXL models.[7] The variables that capture observed heterogeneity enter the

[7] For an explanation of how the variables were constructed, please refer to the appendix.

models via their interaction with the metric. Because income may directly affect consumers' price sensitivity, additional interaction terms between the rental price and dummy variables that identify respondents with below- or above-average monthly net income are included. All individual-specific variables (except for the two income dummies) are mean-centered prior to estimation.

Overall, the MNL parameter estimates are in line with expectations. The effects of price and metric (FC or CO_2) on choices are negative and statistically significant.[8] There is no significant effect of respondents' preferences for diesel versus gasoline engines. The interaction term between the metric and engine type is also statistically insignificant in both designs. As a result, the hypothesis on the differential metric effect for cars with different engine types (H3) is not supported. Hence, in the following models, the interaction term is not considered. The results from the model that includes an interaction between price and CO_2 scale reveals that the more contracted the CO_2 scale is, the more price sensitive respondents become. The corresponding price elasticity values indicate that a 1% price increase results in a 1.22% decrease in choice share for the FC design and a 1.73%, 1.99%, and 2.10% decrease for the CO_2 design with CO_2 measured in g/100 km, g/km, and kg/km, respectively.[9]

In addition to the observed individual heterogeneity, unobserved consumer heterogeneity in tastes is accounted for by estimating MXL for both designs, as described in Section 3.3. The price and metric effects are specified to be log-normally distributed since every respondent is likely to prefer a lower level of these attributes, whereas taste parameters for other characteristics are normally distributed. In the MXL estimation, the maximum simulated likelihood method with 2000 Halton draws was used in all specifications. A likelihood ratio test rejects the standard logit specification (MNL1) relative to the mixed logit specification (MXL1) for both designs (FC design: $\chi^2(4) = 2178.7$, $p < 0.001$; CO_2 design: $\chi^2(4) = 3288.9$, $p < 0.001$). Furthermore, a mixed logit specification with correlated utility coefficients and correlation over choice situations results in a significant improvement in the

[8] Additionally, MNL models with the price and the metrics entering as separate dummy variables for each attribute level were estimated. No curvilinear effects in the price or metric coefficients were found. These estimation results are available upon request.

[9] The elasticity values are computed for the MNL model without individual-specific covariates.

model fit compared to the MXL that does not account for such correlation (Table 4). In the remainder of the paper, the focus is on the best fitting model, MXL3 (the estimation results are in Table C3) – the model that allows for all sources of correlation in tastes, including scale heterogeneity (Hess and Train, 2017). The estimated standard deviations of many of the coefficients are significant, which implies a substantial heterogeneity in the preferences for the attributes, even after controlling for the observed consumer characteristics. The estimated correlation among the taste parameters (Table C4) indicates moderate to strong associations among the tastes for product attributes. For example, the respondents who prefer diesel cars are also more price-sensitive and have higher utility from better (lower) FC or CO_2 values.

Table 4: Choice model fit comparison

	MNL1	MNL2	MXL1	MXL2	MXL3
	FC design				
log-Likelihood	-6021.34	-5437.49	-4932.01	-4756.84	-4244.40
AIC	12050.68	10908.97	9880.02	9541.68	8538.80
McFadden R^2	0.105	0.191	0.267	0.293	0.369
number of parameters	4	17	8	14	25
obs. heterogeneity	No	**Yes**	No	No	**Yes**
unobs. heterogeneity	No	No	**Yes**	**Yes**	**Yes**
taste correlation	No	No	No	**Yes**	**Yes**
	CO_2 design				
log-Likelihood	-6463.056	-5770.40	-4817.16	-4571.59	-4192.69
AIC	12942.11	11582.80	9658.32	9179.18	8443.38
McFadden R^2	0.023	0.128	0.272	0.309	0.366
number of parameters	8	21	12	18	29
obs. heterogeneity	No	**Yes**	No	No	**Yes**
unobs. heterogeneity	No	No	**Yes**	**Yes**	**Yes**
taste correlation	No	No	No	**Yes**	**Yes**

5.2 Attributes' importance weights and WTP

In the following, the metric and scale effects are discussed based on the relative attribute importance (RAI), WTP values, and predicted choice shares derived from the parameter estimates of the best fitted choice model (MXL3). Figure 4 provides an overview of the median RAI and WTP values for the attributes of interest with bootstrapped 95%-confidence interval for an average sample person.[10]

The previously reported model-free findings for the metric and scale effects are confirmed. The highest importance of the rental price and the lowest importance of an environmentally related attribute (metric) are observed for the CO_2 design with the most contracted scale (Figure 4a). The participants are also found to be willing to pay substantially more for improvements in the FC of vehicles than for a comparable reduction in CO_2 emissions (metric effect), and the discrepancy between these values increases as the CO_2 scale contracts (scale effect). The median WTP for a reduction in FC by one l/100 km is estimated to be €45 under the FC design, while the values for the same improvement based on the CO_2 design do not exceed €24 on average (Figure 4b). According to the choice scenario, one less liter of fuel per 100 kilometers would result in saving 20 liters of fuel over ten days and 2000 kilometers or fuel savings of €24 for both engine types, on average.[11] Hence, the estimated WTP values suggest an overvaluation of fuel savings under the FC design and an almost exact or undervaluation of fuel savings under the CO_2 design, depending on the CO_2 scale. Concerning environmental costs, a 20-liter fuel reduction would reduce emissions by 50 kilograms of CO_2 for both engine types, on average. The assumed fuel prices also imply prices for CO_2. In the given scenario, one kilogram of CO_2 emitted by diesel and gasoline vehicles costs €0.42 and €0.56, respectively. The estimated WTP for reducing CO_2 by one g/km yielded €0.48, €0.35, and €0.27 per one kilogram of CO_2 for the three investigated CO_2 scales, ranging from the most expanded (g/100 km) to the most contracted (kg/km), respectively.[12] Therefore, the more contracted the CO_2 scale is, the more likely respondents are to undervalue the fuel savings and the corresponding environmental costs (after also accounting for the estimation errors).

The estimated median WTP for the product category, or the costs at which a consumer is indifferent between purchasing and not purchasing a product (computed as in Gensler et al., 2012) lies between €466 and €671 across the products in the experiment.[13] These

[10] Summary statistics for the RAI and WTP are given in Table C5 and Table C6, respectively.

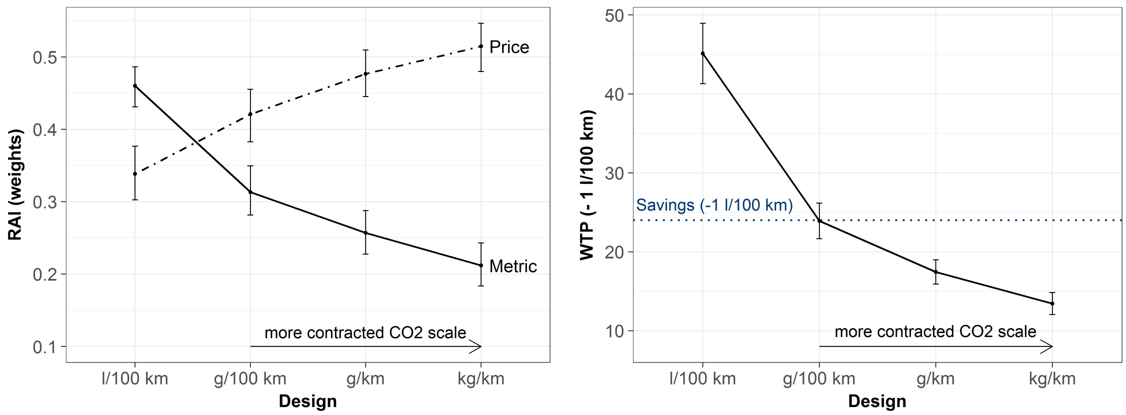
[11] In the choice scenarios, respondents were informed that fuel prices are €1.10 and €1.30 for a liter of diesel and gasoline, respectively.

[12] These values are computed by dividing the median WTP (1 g/km) from Table C6 by 2000 kilometers and converting them into euro values per kilogram of CO_2.

[13] The median WTP for the product category is computed for each presented product based on the estimates of the FC design. The WTP values for the CO2 design have a greater overlap with the implied total financial costs of the products in the experiment.

Figure 4: Metric and scale effects from the choice model results

(a) Relative importance weights (b) WTP (€) for one l/100 km less



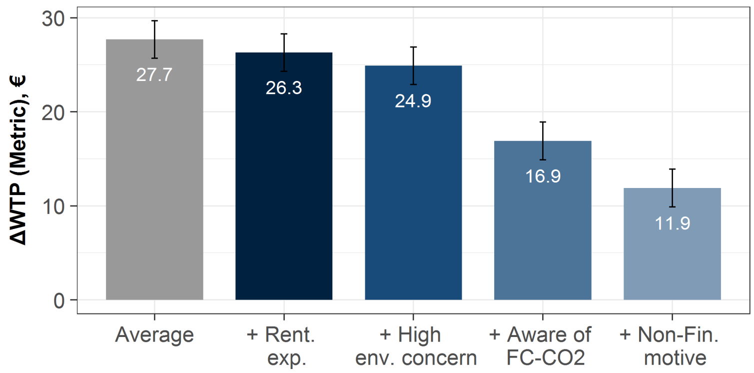
NOTE: The figures show the median RAI and WTP values with bootstrapped 95%-confidence interval for an average sample person. Metric is fuel consumption in the FC design and CO_2 emission in the CO_2 designs.

values are on average 1.5 higher than the total financial costs of these products, but do not exceed the implied costs more than 2.2 times. Hence, first, the budget constraint for the participants in the survey is non-binding, and the estimated WTP for the metrics reflects consumers' preferences and not their financial inability to invest in a preferred car quality; second, the fact that the WTP values are close to the implied costs suggests an adequate choice setting for the experiment.

However, there is also substantial variation in the WTP for FC and CO_2 in the population. Many individual-specific variables help to explain this variation. On average, consumers value improvements in FC by €27.7 more than a comparable reduction in CO_2 emissions (see Figure 5).[14] This finding indicates that respondents perceive identical improvements in these two metrics from different perspectives – reductions in FC are mainly linked to financial savings, whereas improvements in CO_2 are primarily related to the environmental impact of cars. The respondents fail to understand the correlation between these two measures. However, there is a substantial variation in the WTP for FC and CO_2 in the population due to the observed consumer characteristics. While the rental experience ("+ Rent. exp.") does not significantly effect the metric effect, it reduces to €24.9 for individuals with a higher

[14]See also Table C7 that reports the average differences in WTP for a one-unit improvement in each metric for individuals described by various observed characteristics.

Figure 5: Differences in WTP for FC and CO_2



NOTE: ΔWTP (Metric) stands for the average difference between the estimated WTP for FC and CO_2 for each population sub-group of interest holding all other individual-specific variables at their sample averages.

environmental concern ("+ High env. concern") and further decreases to €16.9 with their knowledge of the correlation between FC and CO_2 ("+ Aware of FC-CO_2") . Moreover, if environmentally conscious individuals perceive improvements in the FC of a car to represent more than just savings in financial costs ("+ Non-fin. motive"), the metric effect constitutes only €11.9. Men without rental experience, with low environmental concern, and who are unaware of the correlation between FC and CO_2 values have the highest metric effect (€36) in the sample, while the smallest difference in the WTP for these two environmentally important attributes is observed for women with rental experience, high environmental concern, and awareness of the correlation between FC and CO_2 (€9). Table C8 contains further results on population sub-groups of interest.

5.3 Market simulation

A market simulation was additionally performed to explore how choice shares among alternatives that trade off on the rental price per day, total financial costs, and environmental costs vary across the metrics and scales. The simulated data include all possible choice sets of two car options that are described by a rental price per day ranging from €23 to €33 by €1; FC ranging from 3.0 l/100 km to 6.2 l/100 km by 0.2 l/100 km; and two engine types (diesel and gasoline). These values were employed to compute the CO_2 emissions, total financial costs, and environmental costs for both car options in the choice tasks. All simulated choice sets also include the no-choice option. From all possible combinations of the selected car attributes, three types of choice sets for the market simulation are considered: (1) the choice sets in which one car has the minimum rental price, but the other option has the minimum total financial and environmental costs (10,698 sets); (2) the choice sets in which one car has the minimum rental price and the lowest total financial costs, but the other option has the lowest environmental costs (20,142 sets); and (3) the choice sets in which one car has the minimum rental price and the lowest environmental costs, but the other option has the lowest financial costs (1,195 sets). These three cases allow for an evaluation of the interplay of financial and environmental motives in consumers' decison-making. Overall, there are 32,035 choice sets for the simulation. Table 5 describes how two options differ in their financial and environmental characteristics in each case. In all cases, there are choice sets with a substantial trade-off between total financial and environmental costs.

In the subsequent discussion, the focus is on the environmentally friendly option (EFO), i.e., the car with the minimum environmental costs over the whole trip. Three cases are considered. In the first case, this option also minimizes the total financial costs, while in the other two cases, it is not financially optimal. Additionally, in the third case, the environmentally friendly option has the lowest rental price. Figure 6 displays how the average choice share of the EFO changes across the experimental designs in these three cases.[15]

Overall, the results indicate that the share of the EFO is higher when its benefits in terms of the incurred financial costs and environmental characteristics are more apparent compared to the other option in the choice set, and differences in the monetary attributes are greater than the differences in the environmental costs. The results of the first two cases are in line with previous conclusions on the metric and scale effects – the EFO share is the highest under the FC design and the most expanded scale for the CO_2 design. The third case additionally illustrates that when the EFO is not cost-minimizing but has the lowest price, the choice between two alternatives becomes more difficult for consumers, and in 50%

[15]The regression analysis offers a more formal investigation of the relationship between EFO choice shares and the characteristics of the choice sets and the framing of information. The results of the regression analysis are given in Table C9. All effects have the expected signs. The results additionally show that in the case 3, the EFO choice shares under the CO_2 design with the most contracted scale (kg/km) are significantly different from the shares with CO_2 in g/km, after controlling for differences in financial and environmental costs and their interaction.

Table 5: Characteristics of the simulated choice sets

	Mean	Minimum	25%	Median	75%	Maximum
	Case 1 (N sets = 10,698) Option 1: Min P vs. Option 2: Min EnvC & Min TC					
△P (€)	-2.38	-9.00	-3.00	-2.00	-1.00	-1.00
△FC (l/100 km)	1.75	0.40	1.20	1.80	2.20	3.20
△CO_2 (g/km)	39.87	0.06	23.20	37.84	55.68	94.70
△TC (€)	22.77	0.00	8.40	19.60	33.20	85.20
△EnvC (CO_2 kg)	79.75	0.12	46.40	75.68	111.36	189.40
△EnvC (€)	32.28	0.06	22.27	36.33	53.45	90.91
	Case 2 (N sets = 20,142) Option 1: Min P & Min TC vs. Option 2: Min EnvC					
△P (€)	-4.86	-10.00	-7.00	-5.00	-3.00	-1.00
△FC (l/100 km)	0.78	-0.60	0.20	0.60	1.20	3.20
△CO_2 (g/km)	25.22	0.06	10.60	21.20	37.10	94.70
△TC (€)	-37.12	-138.00	-53.60	-32.80	-15.60	0.00
△EnvC (CO_2 kg)	50.44	0.12	21.20	42.40	74.20	189.40
△EnvC (€)	24.21	0.06	10.18	20.35	35.62	90.91
	Case 3 (N sets = 1,195) Option 1: Min EnvC & Min P vs. Option 2: Min TC					
△P (€)	-1.47	-3.00	-2.00	-1.00	-1.00	-1.00
△FC (l/100 km)	0.21	-0.40	0.00	0.20	0.40	0.60
△CO_2 (g/km)	-11.05	-29.74	-16.50	-9.86	-4.56	-0.60
△TC (€)	9.98	0.00	4.00	8.40	14.80	28.00
△EnvC (CO_2 kg)	-22.11	-59.48	-33.00	-19.72	-9.12	-1.20
△EnvC (€)	-10.61	-28.55	-15.84	-9.47	-4.38	-0.58

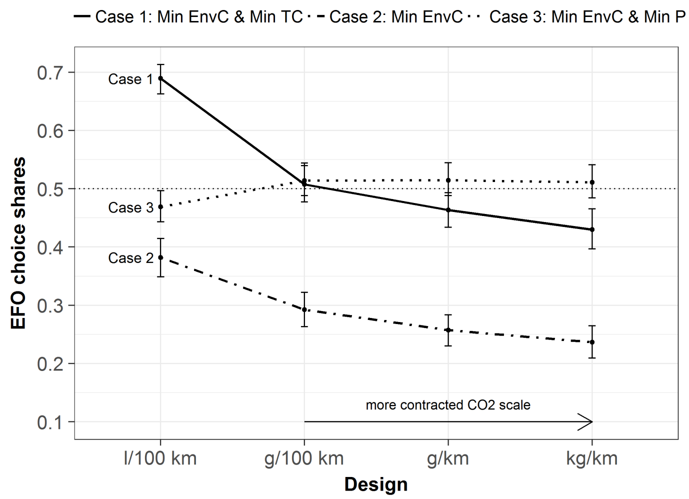
NOTE: △P, △FC, △CO_2, △TC, and △EnvC refer to the differences in rental price per day, FC, CO_2 emissions, total financial coats, and total environmental costs between the first and the second options in the simulated choice sets. Total financial and environmental costs are computed for the whole trip (10 days, 2000 kilometers). △EnvC (€) refers to the monetary values of the environmental costs computed for both engines on average based on the assumed fuel prices in the choice scenario (a diesel price of €1.10/liter and gasoline price of €1.30/liter). The values for the mean, the first and the third quartiles, the median, the minimum, and the maximum are given for each case of the simulated choice sets.

of the cases, they select the option with the lowest price.

6 General Discussion

The current study found significant metric and scale effects in consumer preferences for environmental benefits (i.e., hypotheses H1 and H2 are supported) but no differences in the investigated effects between two engine types (i.e., fail to reject the null hypothesis for H3)

Figure 6: Average predicted shares for the environmentally friendly option



NOTE: The figure depicts average choice shares of the environmentally friendly option and bootstrapped 95%-confidence interval computed from draws of the taste parameters for the FC and CO_2 designs. MinEnvC stands for minimum environmental costs; MinTC stands for minimum total (financial) costs; and MinP stands for minimum (rental) price.

– the participants of the study value identical savings in fuel and CO_2 emissions differently but do so to the same extent for both engine types. Since relationships between metrics and scales and not average values are of interest, any hypothetical bias (Hensher, 2010) is of minor importance in this study, and the results are informative of the relative impact of the framing of information on choices.

The observed differences in WTP across metrics and scales relate to the premise of "bounded or limited rationality" that may manifest in limitations in individuals' ability to process information and limited personal experience (Simon, 1955). Prior research provides mixed evidence on the effects of individual education and knowledge and of information provision on pro-environmental behavior and the correct valuation of energy savings (Flamm, 2009; Meyer, 2015; Frederiks et al., 2015; van den Bergh, 2008). The present study found no significant effect of the completion of university education on the framing effects. In contexts similar to that of the current study, Camilleri and Larrick (2014) also found a statistically insignificant effect of consumers' numerical abilities on choices, and Cadario et al. (2016) showed that highly numerate individuals, for whom the framing of numerical information should have smaller effects (Peters et al., 2006), could even be more prone to the scale effect.

To test the importance of personal experience, the presence and magnitude of the metric and scale effects were also evaluated for the sample of individuals who have rental experience (63% of the full sample). The parameter estimates of the MXL model for this sample (Table C10) result in a lower overvaluation of fuel savings (WTP is closer to the actual fuel savings of €24) for the FC design but greater undervaluation of savings on the environmental costs for the CO_2 design. Although there is no significant scale effect for those with rental experience, the difference in WTP for identical improvements in FC and CO_2 is still present and constitutes €17 for one l/100 km, on average.

Scale effect. The scale effect occurs because people fail to take into account the unit in which quantitative information is expressed and, as a result, may perceive the CO_2 emissions on a contracted scale as being of lower and insignificant importance to the environment and personal decisions. Conversely, because perceptions of attribute differences tend to be inflated on expanded scales, consumers' sensitivity to losses or gains in attribute values increases. This difference in the evoked meaning of the CO_2 emissions on various scales is comparable to the denomination effect (Raghubir and Srivastava, 2009) but with the opposite conclusion. Under the denomination effect, consumers tend to value a certain amount of money more when it is expressed in fewer units or on a contracted scale (e.g., in euros) than in more units or on an expanded scale (e.g., in cents) despite their equivalence in monetary value. Thus, the findings in the current study indicate that the scale effect can also occur in situations in which the different types of units entail differences in associated meaning, in contrast to the suggestions by Pandelaere et al. (2011), who investigated scales with limited evoked meaning (e.g., a 1,000-point scale versus a 10-point scale).

The assignment of a higher weight to an attribute on expanded scales can also result from the perceived existence of intermediate levels. This is similar to the number-of-levels (NOL) effect that indicates an increased derived importance weight of an attribute as the number of intervening attribute levels increases (Wittink et al., 1990; Verlegh et al., 2002; Hensher, 2006). This distortion of attribute importance measures in favor of attributes with more levels might have significant consequences for product-related decisions. To mitigate the NOL effect, the present study equalized the number of levels for two quantitative characteristics in the choice experiments (the rental price and the metric). However, to distinguish between the scale and the NOL effects perceived by consumers, more research is needed that studies the underlying psychological causes of the two effects.

The observed differences in the WTP for CO_2 across three scales could also be affected by a default unit (or familiarity) effect – for some attributes, individuals could be accustomed to processing quantitative information in particular units (Lembregts and Pandelaere, 2013). For example, in Germany, the values of CO_2 emissions on car labels are expressed in g/km. If the default unit effect is present, then a product with CO_2 presented in g/km may generate a higher WTP despite its representation being more contracted compared to another scale. Whereas the higher WTP for CO_2 expressed in g/km compared to CO_2 in kg/km (the most contracted scale) could be a result of both the scale and default unit effects, the default and scale effects for CO_2 in g/100 km (the most expanded scale) compared to g/km have the opposite signs. Because the estimated WTP for CO_2 in g/100 km is higher on average than that for CO_2 in g/km, the default unit effect should be smaller than the scale effect in the present study. The importance of the default unit can also be assessed by examining participants' responses to a survey's question regarding what units they find the most convenient to understand a car's CO_2 emission values.[16] If individuals do not have a preference for a particular scale for the CO_2 information, then their answers to this question should be significantly affected by the CO_2 design they experienced in the choice experiment. On average, only approximately half of the respondents selected "g/km" as the preferred CO_2 scale. The other half of the respondents selected the same units as they encountered during the experiment – "g/100 km" and "kg/km" were 3.2 and 3.4 times more likely to be preferred, respectively, under the CO_2 design with the same CO_2 units than under other designs. These patterns also hold for individuals who have rental car experience or own a car and suggest that the default unit effect is not substantial for the respondents in this study.

Metric effect. The metric effect occurs because people perceive improvements in FC and CO_2 from different perspectives. Whereas consumers appear to directly associate improvements in FC with financial savings, they fail to perceive the link between reductions in

[16] The question was asked after the choice experiments and had 7 response options: "g/km", "kg/km", "g/100 km", "kg/l", "g/l", "others", and "do not know".

CO_2 emissions and in FC. As a result, when presented with information on CO_2 emissions, consumers shift their focus to other monetary values (e.g., price) and may make suboptimal choices that yield higher financial and environmental costs. Regarding prior research on consumer perceptions of various metrics that convey the same information, Camilleri and Larrick (2014), for example, also observed that people tended to select a more fuel-efficient (and, thus, a more environmentally friendly) vehicle when fuel economy was expressed in terms of the fuel costs rather than the amount of fuel consumed, as consumers were primarily motivated to minimize their costs. Determining the effect of presenting the information in terms of fuel costs was not of interest in the present study, but the findings would most probably be replicated and could suggest a correct valuation of fuel savings.

However, there are also individuals who are interested in better fuel economy for reasons other than cost minimization, such as environmental attitudes. The effects of individual-specific variables on the metric and scale effects demonstrate that individuals with more knowledge and higher environmental concerns can better assess the potential benefits of a more fuel-efficient and environmentally friendly option. When confronted with CO_2 emissions instead of FC, environmentally consciousness individuals could also better align their choices with personal objectives (Ungemach et al., 2017). Thus, the current study also relates to the stream of literature on the determinants of pro-environmental behavior (Poortinga et al., 2004; Hines et al., 1987; Kollmuss and Agyeman, 2002) but analyzes decision-makers' choices instead of self-reported importance weights of environmental issues or intentions to engage in pro-environmental behavior. Greater environmental knowledge and environmental concerns do not necessarily translate into pro-environmental behavior (the "attitude-action gap" and "knowledge-action gap"; Kollmuss and Agyeman, 2002; Frederiks et al., 2015). In the current study, participants evaluated their personal knowledge on climate issues as average and their perception of the importance of problems related to climate change as slightly higher than average (see Table B3). Both self-reported measures were uninformative in explaining differences in choices between levels of FC or CO_2. Therefore, the investigation of the observed choices provided a more accurate understanding of consumer behavior in terms of subsequent policy implications.

The values of FC may also be weighed more heavily (or be more salient) in the decision process than CO_2 emissions because consumers are more familiar with FC and thus may have some reference value to which they can compare the presented car offers (Bordalo et al., 2013; Busse et al., 2015). However, as the results demonstrate, if environmental issues become essential for consumers, and consumers are aware of the correlation between FC and CO_2, then CO_2 also becomes a salient attribute, and the valuations of the two attributes approach the actual values of fuel savings and environmental benefits.

Implications and future research. Taken as a whole, the findings of the present study provide several implications for managers and policy-makers and raise several avenues for future research. First, expansion of the scale for attributes related to environmental pollution, if wisely employed, could be used to nudge consumers' choices towards more fuel-efficient and low-emission car options (Camilleri and Larrick, 2014; Thaler and Sunstein, 2008). Doing so would be especially important when consumers have limited knowledge of the correlation between FC and CO_2 and lower environmental concerns. Although the current study finds no diminishing effect of scale expansion for the three investigated scales of CO_2 emissions (in contrast to Aribarg et al., 2017), the appropriateness of further expansion of the scale should be carefully investigated in each particular case. Having more units for the CO_2 values could lead to greater difficulties in processing the given numerical information even in the presence of the desired scale effect on consumer behavior. Future work could study in greater detail the interplay between scale expansion and ease of processing the provided information.

Second, as the present study shows, demand for vehicles with low FC and low emissions are driven by different preferences. If individuals are unaware of the correlation between these two metrics, they would fail to recognize how transport-related CO_2 emissions translate into 'private' costs and thus may end up incurring higher financial costs than under their optimal choices and cause higher environmental costs for society. Although a sensible choice architecture may nudge consumers in a financially and environmentally optimal direction, it would do so through intuitive and impulsive processes of the automatic thinking system and would not encourage an active change in behavior (Avineri, 2012). The results of this study suggest that it is crucial not only to provide information about transport-related CO_2 emissions to increase the likelihood of more sustainable choices by individuals but also to implement campaigns needed to stimulate knowledge, interest, and awareness of the personal impact on the environment when choosing energy-using and CO_2-emitting products.

The metric presented to consumers may also serve as a signpost that enables individuals to activate personal objectives aligned with societal goals (Ungemach et al., 2017) and thus help to reduce the attitude-behavior gap. With a better alignment of personal goals with choices, consumers may experience higher satisfaction from their product choice and usage. Consequently, depending on the product or service provided by a firm, higher satisfaction may lead to competitive and financial advantages through better firm image, higher customer loyalty, and repeat purchases from the firm (Miles and Covin, 2000). Further study on this premise is needed.

Furthermore, the type of metric used to express environmental benefits may affect consumers' processing of the given information. While information on FC may trigger consumer choices to be driven by cognition, that on CO_2 emissions may encourage the processing of numerical information to be driven by feelings. Thus, different types of information provision may suit each metric better for promoting more fuel-efficient and low-carbon choices – e.g., a promotion or prevention focus of the product message and rounded or nonrounded presentation of attribute levels (Wadhwa and Zhang, 2015; Grankvist et al., 2004). Future studies could test this assertion. Future research could also investigate whether detailed verbal cues, as opposed to numerical values, have a more significant positive impact on choices of more environmentally friendly car options, as Gleim et al. (2013) showed for green products in the retail setting.

Although the present study relied on the responses of respondents from various socio-demographic backgrounds (e.g., age, education, and income), it would also be beneficial for further research to target a representative population of consumers in a similar environmentally important context.

7 Conclusion

The current study presented empirical evidence on the metric and scale effects in consumer preferences for environmental benefits. Within an online survey, individuals from various socio-economic backgrounds were presented with optimally designed choice experiments in which they had to choose a car to rent for a long holiday trip. Differences in choices, attribute importance weights, and willingness-to-pay for identical improvements in car characteristics related to the environmental impact were identified by varying the metrics (FC or CO_2) within subjects and the CO_2 scales between subjects. In an extension of many previous studies, the metric and scale effects were assessed while accounting for observed and unobserved heterogeneity in tastes for attributes in addition to the respondents' environmental attitudes and knowledge. This led not only to better statistical model fit but also to significant differences in the recovered willingness-to-pay values compared to models without consumer heterogeneity and correlation in tastes for product attributes.

A reduction in CO_2 concentration is the principal objective of climate policies. However, as the present findings indicated, consumers may significantly undervalue the benefits of more fuel-efficient vehicles when presented with information on CO_2. Under the most contracted CO_2 scale (in kg/km), individuals valued only 55% of the reduction in fuel or environmental costs. Because consumers do not understand the correlation between FC and CO_2, demand for vehicles with low fuel consumption and low emissions become two different decision-making processes – with a focus on either personal financial costs or societal environmental costs. Even in the absence of a conflict between a concern for environmental protection and a desire to reduce one's expenses, i.e., when the environmentally friendly product is also cost-minimizing, individuals were found to undervalue improvements in financially and environmentally important attributes if information on CO_2 emissions, instead of FC, was presented. However, CO_2 information on the most expanded scale (here, in g/100 km) was able to nudge individuals towards optimal choices and the correct valuations of fuel efficiency and environmental costs. The impact of individual-specific variables on the metric and scale effects further demonstrated that the proportion of fuel-efficient and environmentally friendly choices could be increased by activating pro-environmental attitudes and expanding consumers' knowledge of the environmental impact of vehicles.

As car rentals and various forms of collective car ownership are gaining popularity as an alternative to private cars and public transportation, it is increasingly important to make attributes with negative externalities, which might otherwise be neglected for these services, more salient. In summary, the current study provides insights for policy-makers and marketing managers on how to effectively communicate with consumers to facilitate the desired behavior.

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Metric and Scale Effects in Consumer Preferences for Environmental Benefits

WEB APPENDIX

The web appendix contains information on (A) the development of the choice experiment design used in this study; (B) indicators related to respondents' knowledge of and attitudes towards environmental issues and car use; and (C) additional descriptive analysis and estimation results of the study.

A Experimental Design

This section provides details on the development of the choice experiment design used in this study. The combinations of attribute levels within tasks were identical for FC and CO_2 designs. Hence, it was only necessary to develop one experimental design. Table A1 shows how the D-efficiency varies among the designs with different numbers of choice tasks. The design with 14 tasks has higher D-efficiency than a design with 12 tasks and lower correlations for the attributes compared to the designs with 12 or 16 choice tasks. As a result, the experiment with 14 tasks was used in this study. Table A2 further confirms that the selected experimental design is efficient because all of the off-diagonal elements of the variance matrix are small relative to the variances on the diagonal. Table A3 describes the 14 choice tasks and provides the corresponding total financial and environmental costs for each option in the tasks.

Table A4 provides the results of testing the experimental designs on the responses of 400 persons simulated according to random utility theory (McFadden, 1973; Train, 2009). For ease of interpretation, theoretical values for the parameters are expressed as willingness-to-pay values per day. The FC parameter corresponds to the actual fuel savings of €26 from one l/100 km for gasoline cars over 10 days and 2000 kilometers. The interaction term of FC and Diesel correspondents to the difference in fuel savings for gasoline and diesel vehicles. The parameters for CO_2 and its interaction with Diesel correspond to the actual reductions in CO_2 emissions from one g/km for gasoline (€1.12 over 10 days) and diesel vehicles (€0.83 over 10 days), respectively. The parameter for the no-choice option is set to result in its share of approximately 15%. The scale parameter μ transforms the utility in preference space into the utility in WTP-space and reflects how precise the respondents' choices between options are – the higher the μ, the higher the choice precision, while $\mu = 0$ suggests that the choices are made randomly. In the test of the experimental design, the scale parameter is set at the level of 0.3. This level corresponds to a reasonable value of the price elasticity evaluated at the average price and choice share. The results of 400 resamples of the simulated responses indicate that all parameter estimates can be efficiently recovered for the experimental designs.

Table A1: Efficiency characteristics of SAS designs with various numbers of choice tasks

N of choice tasks	D-Efficiency	Canonical Correlations				Correlation coefficients		
12	75.62		Engine	Price	Metric	Engine	Price	Metric
		Engine	1	0.59	0.24	1	0.35	0.06
		Price	0.59	1	0.55	0.35	1	0.30
		Metric	0.24	0.55	1	0.06	0.30	1
14	83.40		Engine	Price	Metric	Engine	Price	Metric
		Engine	1	0.29	0	1	0.08	0
		Price	0.29	1	0.58	0.08	1	0.34
		Metric	0	0.58	1	0	0.34	1
			Engine	Price	Metric	Engine	Price	Metric
16	89.11	Engine	1	0.35	0	1	0.12	0
		Price	0.35	1	0.61	0.12	1	0.37
		Metric	0	0.61	1	0	0.37	1

NOTE: "Engine" refers to the engine type and has two attribute levels (diesel and gasoline); "Price" is the rental price per day and has four attribute levels; "Metric" refers to either FC or CO_2 values and has four attribute levels.

Table A2: The variance-covariance matrix for the SAS design with 14 choice tasks

	Intercept	x1	x21	x22	x23	x31	x32	x33	x1*x31	x1*x32	x1*x33
Intercept	0.102	0.008	0.018	0.026	0.044	0.068	0	0	-0.005	0.013	-0.022
x1	0.008	0.086	0.018	0.026	0	0.014	0	0	0.023	-0.006	-0.011
x21	0.018	0.018	0.125	0	0	0.031	-0.044	0.026	-0.01	-0.015	-0.026
x22	0.026	0.026	0	0.125	0	0.044	0.031	-0.018	-0.015	-0.021	-0.036
x23	0.044	0	0	0	0.125	0.077	0	0	0	0.054	-0.031
x31	0.068	0.014	0.031	0.044	0.077	0.180	0	0	-0.008	0.022	-0.038
x32	0	0	-0.044	0.031	0	0	0.086	-0.014	0	0	0
x33	0	0	0.026	-0.018	0	0	-0.014	0.07	0	0	0
x1*x31	-0.005	0.023	-0.01	-0.015	0	-0.008	0	0	0.112	0.004	0.006
x1*x32	0.013	-0.006	-0.015	-0.021	0.054	0.022	0	0	0.004	0.091	-0.005
x1*x33	-0.022	-0.011	-0.026	-0.036	-0.031	-0.038	0	0	0.006	-0.005	0.086

NOTE: x1 is the first level of the attribute "engine type"; x21, x22, and x23 are the corresponding levels of the attribute "price per day"; x31, x32, and x33 are the corresponding levels of the metric (FC or CO_2). In an efficient design, all of the off-diagonal elements of the variance matrix should be small relative to the variances on the diagonal.

Table A3: Experimental designs with total financial and environmental costs

FC design										
Task	Engine 1	Price 1 (€/day)	FC 1 (l/100 km)	Engine 2	Price 2 (€/day)	FC 2 (l/100 km)	TC[(a)] 1 (€)	TC[(a)] 2 (€)	EnvC[(b)] 1 (CO_2 kg)	EnvC[(b)] 2 (CO_2 kg)
1	Diesel	33	5.2	Gasoline	30	6.2	444.40	461.20	275.60	287.68
2	Diesel	30	4.2	Gasoline	26	5.2	392.40	395.20	222.60	241.28
3	Diesel	26	5.2	Diesel	30	3.2	374.40	370.40	275.60	169.60
4	Gasoline	30	5.2	Diesel	33	4.2	435.20	422.40	241.28	222.60
5	Gasoline	23	4.2	Diesel	26	3.2	339.20	330.40	194.88	169.60
6	Gasoline	26	5.2	Gasoline	30	3.2	395.20	383.20	241.28	148.48
7	Gasoline	33	3.2	Diesel	30	6.2	413.20	436.40	148.48	328.60
8	Diesel	33	6.2	Gasoline	33	5.2	466.40	465.20	328.60	241.28
9	Gasoline	26	4.2	Gasoline	23	6.2	369.20	391.20	194.88	287.68
10	Gasoline	23	3.2	Diesel	23	4.2	313.20	322.40	148.48	222.60
11	Gasoline	33	6.2	Diesel	33	6.2	491.20	466.40	287.68	328.60
12	Diesel	30	3.2	Gasoline	23	6.2	370.40	391.20	169.60	287.68
13	Diesel	23	3.2	Gasoline	23	3.2	300.40	313.20	169.60	148.48
14	Diesel	33	4.2	Diesel	30	6.2	422.40	436.40	222.60	328.60
CO_2 design (g/km)[(c)]										
Task	Engine 1	Price 1 (€/day)	CO_2 1 (g/km)	Engine 2	Price 2 (€/day)	CO_2 2 (g/km)	TC[(a)] 1 (€)	TC[(a)] 2 (€)	EnvC[(b)] 1 (CO_2 kg)	EnvC[(b)] 2 (CO_2 kg)
1	Diesel	33	138	Gasoline	30	164	444.57	483.79	276.00	328.00
2	Diesel	30	111	Gasoline	26	138	392.15	414.66	222.00	276.00
3	Diesel	26	138	Diesel	30	85	374.57	370.57	276.00	170.00
4	Gasoline	30	138	Diesel	33	111	454.66	422.15	276.00	222.00
5	Gasoline	23	111	Diesel	26	85	354.40	330.57	222.00	170.00
6	Gasoline	26	138	Gasoline	30	85	414.66	395.26	276.00	170.00
7	Gasoline	33	85	Diesel	30	164	425.26	436.15	170.00	328.00
8	Diesel	33	164	Gasoline	33	111	466.15	454.40	328.00	222.00
9	Gasoline	26	111	Gasoline	23	164	384.40	413.79	222.00	328.00
10	Gasoline	23	85	Diesel	23	111	325.26	322.15	170.00	222.00
11	Gasoline	33	164	Diesel	33	164	513.79	466.15	328.00	328.00
12	Diesel	30	85	Gasoline	23	164	370.57	413.79	170.00	328.00
13	Diesel	23	85	Gasoline	23	85	300.57	325.26	170.00	170.00
14	Diesel	33	111	Diesel	30	164	422.15	436.15	222.00	328.00

NOTE: (a) The total financial costs are TC = $(€/\text{Day}) \times \text{Days} + \text{FC} \times \text{FP} \times \text{KM}$. (b) The environmental costs are EnvC = $CO_2 \times \text{KM}$. (c) Designs for other CO_2 scales differ only in presentation of the CO_2 emission values and are identical to the presented CO_2 design for g/km values in terms of total financial and environmental costs.

Table A4: Test of the experimental design on simulated choices

	FC design				CO_2 design		
	Theoretical values	MNL estimates (nR = 400) Mean	SE		Theoretical values	MNL estimates (nR = 400) Mean	SE
μ	0.300	0.299	0.013	μ	0.300	0.301	0.014
no-choice	-45.000	-45.064	0.491	no-choice	-45.000	-44.993	0.531
Diesel	1.000	1.018	0.512	Diesel	1.000	1.002	0.519
FC	-2.600	-2.611	0.085	CO_2	-0.112	-0.112	0.004
FC×Diesel	0.400	0.398	0.107	CO_2×Diesel	0.029	0.029	0.004
log-likelihood		-4964.189	35.115	log-likelihood		-4790.984	39.892
Choice Shares	Option 1	Option 2	No-choice option	Choice Shares	Option 1	Option 2	No-choice option
	45.32	40.55	14.13		44.89	39.11	16.00

NOTE: nR is the number of samples with 400 persons simulated according to random utility theory. μ is the scale parameter to transform the utility in preference space into the utility in WTP-space. All parameters are euro values per day of the trip for marginal improvements in attributes.

B Individual-specific variables

Table B1: Indicators related to environmental attitudes, perception of a car use, and knowledge

	Wording	Source	Variable
General Environmental Consciousness			
1.	If things continue on their present course, we will soon experience a major ecological catastrophe.	UBA (2016)	"Affective 1"
2.	When I read newspaper reports or watch TV broadcasts on environmental problems, I get frustrated and angry.	UBA (2016)	"Affective 2"
3.	It worries me to think about the environmental conditions, under which our children and grandchildren would probably have to live.	UBA (2016)	"Affective 3"
4.	There is a limit to the economic growth that our industrialized world has already crossed or will reach very soon.	UBA (2016)	"Cognitive 1"
5.	It is still the case that politicians are doing far too little for environmental protection.	UBA (2016)	"Cognitive 2"
6.	In my assessment, the so-called "ecological crisis" facing humankind has been greatly exaggerated by many environmentalists.	UBA (2016)	"Cognitive 3"
7.	For the benefit of the environment, we should all be prepared to restrict our current standard of living.	UBA (2016)	"Conative 1"
8.	Science and technological progress will solve many environmental problems without a need to change our way of life.	UBA (2016)	"Conative 2"
9.	Measures to protect the environment should be enforced even if this results in lost jobs.	UBA (2016)	"Conative 3"
Perception of a car use			
10.	Even if public transportation was more efficient than it is, I would prefer to drive my own car.	Milfont and Duckitt (2010)	"Cars preferred"
11.	People exaggerate the role of car traffic as the cause for climate change.	Peters et al. (2011)	"Cars as non-cause"
Financial motive			
12.	For me, improvements in fuel consumption of a car are foremost linked to savings in my expenses.	Own	"Financial motive"
13.	I am willing to pay higher prices for products that are less polluting.	Own	"WTP for less pollution"
Knowledge			
14.	Burning fossil fuels such as, for instance, gas and oil raises CO_2 levels in the atmosphere.	Kaiser et al. (1999)	
15.	It is possible to improve the fuel consumption of a car, while keeping its CO_2 emission constant.	Own	"FC-CO_2 knowledge"
16.	The burning of one liter of diesel does more harm to the environment and climate than the burning of one liter of petrol (gasoline).	Own	"Diesel perception"

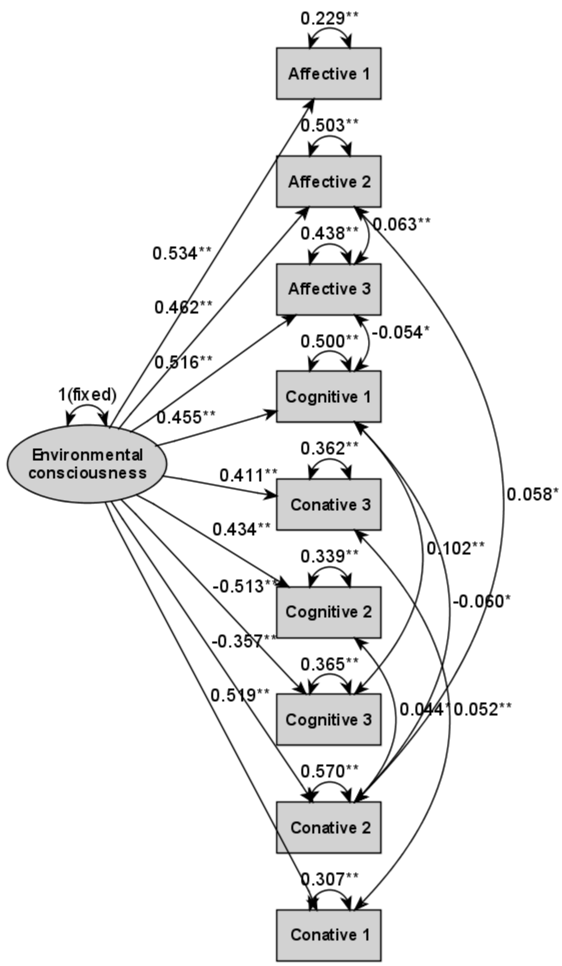
NOTE: Response options for all items included "strongly disagree", "somewhat disagree", "somewhat agree", "strongly agree", and "do not know". Statements 1-9 belong to the "General Environmental Consciousness" (GEC) scale.

Table B2: Percentage distributions for variables related to environmental attitudes, perception of a car use, and knowledge

Item	SD	SWD	SWA	SA	DnK
General Environmental Consciousness					
1. If things continue on their present course, we will soon experience a major ecological catastrophe.	2.59	8.87	36.6	48.8	3.14
2. When I read newspaper reports or watch TV broadcasts on environmental problems, I get frustrated and angry.	6.84	23.29	37.89	27.73	4.25
3. It worries me to think about the environmental conditions, under which our children and grandchildren would probably have to live.	5.73	14.23	36.6	41.59	1.85
4. There is a limit to the economic growth that our industrialized world has already crossed or will reach very soon.	6.84	15.71	33.83	33.46	10.17
5. It is still the case that politicians are doing far too little for environmental protection.	2.40	10.17	36.23	49.17	2.03
6. In my assessment, the so-called “ecological crisis” facing humankind has been greatly exaggerated by many environmentalists.	49.63	30.22	13.43	3.54	3.17
7. For the benefit of the environment, we should all be prepared to restrict our current standard of living.	3.54	16.42	43.66	33.21	3.17
8. Science and technological progress will solve many environmental problems without a need to change our way of life.	15.86	34.89	31.53	11.01	6.72
9. Measures to protect the environment should be enforced even if this results in lost jobs.	4.66	17.72	45.34	21.83	10.45
Perception of a car use					
10. Even if public transportation was more efficient than it is, I would prefer to drive my own car.	41.42	29.85	16.42	10.07	2.24
11. People exaggerate the role of car traffic as the cause for climate change.	43.44	32.53	13.86	7.02	3.14
Financial motive					
12. For me, improvements in fuel consumption of a car are foremost linked to savings in my expenses.	7.76	27.91	38.63	18.48	7.21
13. I am willing to pay higher prices for products that are less polluting.	3.73	20.15	47.01	25.00	4.10
Knowledge					
14. Burning fossil fuels such as, for instance, gas and oil raises CO_2 levels in the atmosphere.	0.74	2.77	27.36	63.77	5.36
15. It is possible to improve the fuel consumption of a car, while keeping its CO_2 emission constant.	2.99	8.96	32.09	12.69	43.28
16. The burning of one liter of diesel does more harm to the environment and climate than the burning of one liter of petrol (gasoline).	5.22	15.67	29.29	12.31	37.5

NOTE: SD is “Strongly disagree”; SWD is “somewhat disagree”; SWA is “somewhat agree”; SA is “strongly agree”; and DnK is “do not know”.

Figure B1: Path diagram for the "General Environmental Consciousness" scale



NOTE: The scale is based on UBA (2016) with response options ranging from 1: Strongly disagree to 4: Strongly agree. Based on the percentile method with 1000 bootstrap resamples of the size 400 from the initial 586 observations, the average Cronbach's α is 0.83 and the bootstrap confidence interval ranges from 0.80 to 0.86. $\chi^2(p) = 24.699$ (0.213); RMSEA= 0.020; AGFI= 0.980.

Table B3: Percentage distributions and average responses to the self-reported knowledge and importance of issues related to climate change

	Percentage distribution							Mean (SE)
How well informed would you say you are about issues related to climate change?[a]	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
	0	2.62	13.64	35.51	34.77	11.96	1.50	4.44 (0.04)
How important is the issue of climate change to you personally?[b]	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
	0.93	2.99	7.29	16.82	30.28	29.53	12.15	5.10 (0.06)

NOTE: (a) The wording of response options was (1): Not at all; (2): Very poorly; (3): Poorly; (4): Average; (5): Well; (6): Quite well; (7): Expertly. (b) The wording of response options was (1): Not at all; (4): Average; (7): Extremely.

Table B4: Definitions of the individual-specific variables

Variable	Definition
1. Male	= 1 if male, else 0
2. Age	Years old of a person
3. Kids under 18	= 1 if a person has children younger than 18 years old, else 0
4. University degree	= 1 if a person has a completed university degree, else 0
5. Own car/-s	= 1 if a person owns one or more cars, else 0
6. Income	A group for the personal net monthly income (1 =“<€500”; 2 =“€500 to under €1000”; 3 =“€1000 to under €1500”; 4 =“€1500 to under €2000”; 5 =“€2000 to under €3000”; 6 =“€3000 to under €4000”; 7 =“≥€4000”; 8 =“Prefer not to answer”)
7. Rental experience	= 1 if a person has a rental experience, else 0
8. GEC	A score from the confirmatory factor analysis for the “General Environmental Consciousness” scale
9. “WTP for less pollution”	= 1 if a person responded “somewhat agree” or “strongly agree” to the statement (13) in Table B2, else 0
10. “Financial motive”	= 1 if a person responded “somewhat agree” or “strongly agree” to the statement (12) in Table B2, else 0
11. “Cars as non-cause”	= 1 if a person responded “somewhat agree” or “strongly agree” to the statement (11) in Table B2, else 0
12. “Cars preferred”	= 1 if a person responded “somewhat agree” or “strongly agree” to the statement (10) in Table B2, else 0
13. “Diesel perception”	= 1 if a person responded “somewhat agree” or “strongly agree” to the statement (16) in Table B2, else 0
14. “FC-CO_2 knowledge”	= 1 if a person responded “somewhat disagree” or “strongly disagree” to the statement (15) in Table B2, else 0

Table B5: Correlation among individual-specific variables

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Male													
2. Age	0.093***												
3. Kids under 18	0.021***	0.269***											
4. University degree	-0.031***	0.245***	0.126***										
5. Own car/-s	-0.059***	0.252***	0.255***	0.042***									
6. Income	0.134***	0.395***	0.312***	0.398***	0.195***								
7. Rental experience	0.087***	0.375***	0.118***	0.257***	0.107***	0.239***							
8. GEC (score)	-0.233***	-0.057***	-0.111***	-0.124***	-0.186***	-0.106***	-0.057***						
9. "WTP for less pollution"	-0.152***	0.014**	0.004	-0.033***	-0.095***	-0.126***	-0.038***	0.400***					
10. "Financial motive"	0.049***	-0.050***	0.037***	0.017**	-0.022***	-0.058***	0.027***	-0.175***	-0.133***				
11. "Cars as non-cause"	0.104***	0.107***	0.041***	0.085***	0.182***	0.120***	0.008	-0.434***	-0.223***	0.094***			
12. "Cars preferred"	0.072***	0.033***	0.130***	-0.001	0.348***	0.126***	0.005	-0.271***	-0.212***	0.057***	0.238***		
13. "Diesel perception"	0.112***	0.069***	-0.002	0.012*	0.097***	0.008	0.042***	0.054***	-0.033***	0.012*	0.002	0.051***	
14. "FC-CO_2 knowledge"	0.103***	0.035***	-0.037***	0.004	0.062***	0.070***	-0.052***	-0.154***	-0.104***	-0.014**	0.155***	0.092***	0.063***

NOTE: Reported are the coefficients for the Pearson correlation for continuous variables and the tetrachoric correlation for dichotomous variables. GEC refers to the General Environmental Consciousness scale. $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

C Additional Tables

Table C1: MNL parameter estimates (FC design)

	Dependent Variable: Choices (FC design)			
	(1)	(2)	(3)	(4)
Price	−0.099***	−0.102***	−0.091***	−0.091***
	(0.013)	(0.014)	(0.015)	(0.015)
Price×(Income less than average)			−0.008	−0.011**
			(0.007)	(0.005)
Price×(Income more than average)			−0.021***	−0.019***
			(0.007)	(0.006)
Diesel	−0.103	−0.091	−0.091	−0.091
	(0.123)	(0.128)	(0.129)	(0.129)
none	−8.646***	−8.873***	−8.869***	−8.875***
	(0.522)	(0.562)	(0.562)	(0.562)
FC	−0.676***	−0.649***	−0.686***	−0.684***
	(0.029)	(0.035)	(0.039)	(0.031)
FC×Diesel	−0.001	−0.006	−0.006	−0.006
	(0.026)	(0.027)	(0.027)	(0.027)
FC×(First CO_2 design)		−0.038*	−0.038*	−0.037*
		(0.019)	(0.019)	(0.019)
FC×Male		0.0001	0.003	0.002
		(0.020)	(0.020)	(0.020)
FC×Age		0.001	−0.001	0.001
		(0.001)	(0.002)	(0.001)
FC×Age^2			0.0001	
			(0.0001)	
FC×(University degree)		0.087***	0.100***	0.097***
		(0.022)	(0.024)	(0.021)
FC×(Own car-/s)		−0.009	−0.007	−0.002
		(0.022)	(0.023)	(0.021)
FC×(Income less than average)		−0.046*	−0.026	
		(0.025)	(0.034)	
FC×(Income more than average)		−0.044	0.020	
		(0.029)	(0.037)	
FC×(Rental experience)		0.101***	0.110***	0.102***
		(0.022)	(0.023)	(0.022)
FC×GEC		−0.023**	−0.022**	−0.026***
		(0.010)	(0.010)	(0.009)
FC×(WTP for less pollution)		−0.028	−0.027	−0.029
		(0.026)	(0.026)	(0.025)
FC×(Financial motive)		−0.012	−0.011	−0.011
		(0.020)	(0.020)	(0.020)
FC×(Cars as non-cause)		0.013	0.012	
		(0.028)	(0.028)	
FC×(Cars preferred)		0.012	0.012	
		(0.024)	(0.024)	
FC×(Diesel perception)		−0.022	−0.023	−0.022
		(0.020)	(0.020)	(0.020)
FC×(FC-CO_2 knowledge)		−0.034	−0.031	−0.031
		(0.030)	(0.030)	(0.030)
Observations	7,950	7,280	7,280	7,280
Log Likelihood	-6,021.341	-5,441.049	-5,435.846	-5,437.465
Akaike Inf. Crit.	12,052.680	10,922.100	10,917.690	10,910.930

NOTE: All individual-specific variables but income are mean-centered. The average income group serves as a reference. *p<0.1; **p<0.05; ***p<0.01.

Table C2: MNL parameter estimates (CO_2 design)

	Dependent Variable: Choices (CO_2 design)			
	(1)	(2)	(3)	(4)
Price	−0.162***	−0.156***	−0.145***	−0.148***
	(0.013)	(0.014)	(0.015)	(0.015)
Price×(Income less than average)			−0.012**	−0.010**
			(0.006)	(0.005)
Price×(Income more than average)			−0.023***	−0.017***
			(0.007)	(0.006)
Price×(CO_2 design, g/km)	−0.002	0.003	0.005	0.004
	(0.005)	(0.006)	(0.006)	(0.006)
Price×(CO_2 design, kg/km)	−0.021***	−0.018***	−0.017***	−0.018***
	(0.005)	(0.006)	(0.006)	(0.006)
none	−8.886***	−9.075***	−9.073***	−9.078***
	(0.506)	(0.542)	(0.542)	(0.542)
Diesel	−0.099	−0.098	−0.099	−0.098
	(0.121)	(0.126)	(0.126)	(0.126)
CO_2	−0.155***	−0.142***	−0.157***	−0.146***
	(0.012)	(0.014)	(0.015)	(0.013)
CO2×(CO_2 design, g/km)	0.015	0.010	0.009	0.011
	(0.010)	(0.011)	(0.011)	(0.011)
CO2×(CO_2 design, kg/km)	0.070***	0.056***	0.055***	0.056***
	(0.010)	(0.011)	(0.011)	(0.011)
CO2×Diesel	0.016*	0.013	0.013	0.013
	(0.010)	(0.010)	(0.010)	(0.010)
CO2×(First CO_2 design)		0.031***	0.032***	0.032***
		(0.007)	(0.007)	(0.007)
CO2×Male		0.043***	0.044***	0.044***
		(0.007)	(0.008)	(0.007)
CO2×Age		−0.001***	−0.002***	−0.001**
		(0.0004)	(0.001)	(0.0004)
CO2×Age^2			0.00003	
			(0.00002)	
CO2×(University degree)		0.049***	0.054***	0.053***
		(0.008)	(0.008)	(0.007)
CO_2×(Own car-/s)		0.013	0.014*	0.018**
		(0.008)	(0.008)	(0.008)
CO_2×(Income less than average)		−0.009	0.003	
		(0.009)	(0.011)	
CO_2×(Income more than average)		−0.0004	0.023*	
		(0.011)	(0.013)	
CO_2×(Rental experience)		0.027***	0.030***	0.027***
		(0.008)	(0.008)	(0.008)
CO_2×GEC		−0.021***	−0.020***	−0.023***
		(0.004)	(0.004)	(0.004)
CO_2×(WTP for less pollution)		−0.132***	−0.130***	−0.133***
		(0.012)	(0.012)	(0.012)
CO_2×(Financial motive)		0.025***	0.026***	0.026***
		(0.007)	(0.007)	(0.007)
CO_2×(Cars as non-cause)		0.012	0.012	
		(0.011)	(0.011)	
CO_2×(Cars preferred)		0.010	0.011	
		(0.009)	(0.009)	
CO_2×(Diesel perception)		−0.014**	−0.015**	−0.015**
		(0.007)	(0.007)	(0.007)
CO_2×(FC-CO_2 knowledge)		−0.030***	−0.029***	−0.029***
		(0.011)	(0.011)	(0.011)
Observations	7,757	7,280	7,280	7,280
Log Likelihood	-6,461.606	-5,771.973	-5,765.251	-5,769.501
Akaike Inf. Crit.	12,941.210	11,591.950	11,584.500	11,583.000

NOTE: All individual-specific variables but income are mean-centered. The average income group serves as a reference. *p<0.1; **p<0.05; ***p<0.01.

Table C3: MXL parameter estimates (full sample)

	Dependent Variable: Choices	
	(1) FC design	(2) CO_2 design
NegPrice	−1.135***	−1.013***
	(0.100)	(0.073)
none	−29.393***	−37.277***
	(1.649)	(1.778)
Diesel	0.179	0.339***
	(0.116)	(0.129)
NegFC	0.367***	
	(0.049)	
NegCO2		−1.066***
		(0.076)
NegPrice×(CO_2 design, g/km)		0.107***
		(0.026)
NegPrice×(CO_2 design, kg/km)		0.138***
		(0.040)
NegPrice×(Income less than average)	0.055	0.138***
	(0.052)	(0.030)
NegPrice×(Income more than average)	0.081	0.202***
	(0.053)	(0.048)
NegFC×(First CO_2 design)	−0.022	
	(0.048)	
NegFC×Male	0.115**	
	(0.048)	
NegFC×(University degree)	−0.044	
	(0.047)	
NegFC×(Rental experience)	−0.168***	
	(0.054)	
NegFC×GEC	0.068***	
	(0.021)	
NegFC×(WTP for less pollution)	0.136**	
	(0.063)	
NegFC×(Financial motive)	−0.002	
	(0.051)	
NegFC×(Diesel perception)	0.014	
	(0.061)	
NegFC×(FC-CO2 knowledge)	−0.013	
	(0.076)	
NegCO2×(CO_2 design, g/km)		−0.203***
		(0.057)
NegCO2×(CO_2 design, kg/km)		−0.438***
		(0.065)
NegCO2×(First CO_2 design)		−0.329***
		(0.058)
NegCO2×Male		−0.009
		(0.045)
NegCO2×(University degree)		−0.310***
		(0.045)
NegCO2×(Rental experience)		−0.221***
		(0.054)
NegCO2×GEC		0.239***
		(0.032)
NegCO2×(WTP for less pollution)		1.170***
		(0.114)
NegCO2×(Financial motive)		−0.246***
		(0.063)
NegCO2×(Diesel perception)		0.083
		(0.053)
NegCO2×(FC-CO2 knowledge)		0.341***
		(0.087)

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	Dependent Variable: Choices	
	(1) FC design	(2) CO_2 design
sd.NegPrice.NegPrice	0.607***	−0.806***
	(0.030)	(0.028)
sd.NegPrice.none	−9.563***	23.071***
	(0.761)	(1.382)
sd.NegPrice.Diesel	0.976***	−1.092***
	(0.144)	(0.160)
sd.NegPrice.NegFC	−0.002	
	(0.036)	
sd.NegPrice.NegCO2		0.066
		(0.041)
sd.none.none	−8.464***	−12.290***
	(0.617)	(0.804)
sd.none.Diesel	−0.058	−0.219
	(0.165)	(0.173)
sd.none.NegFC	0.513***	
	(0.039)	
sd.none.NegCO2		0.738***
		(0.030)
sd.Diesel.Diesel	2.146***	2.551***
	(0.116)	(0.132)
sd.Diesel.NegFC	0.337***	
	(0.025)	
sd.NegFC.NegFC	0.065	
	(0.045)	
sd.Diesel.NegCO2		0.236***
		(0.036)
sd.NegCO2.NegCO2		0.322***
		(0.028)
Observations	7,280	7,280
Log Likelihood	-4,244.401	-4,192.690
Akaike Inf. Crit.	8,538.802	8,443.381
Bayesian Inf. Crit.	8,711.124	8,643.274

NOTE: The estimation of random coefficient logit model is based on maximum simulated likelihood method using the “gmnl” R package (version 1.1-3). Optimization of the log-likelihood is by BFGS maximization method. Simulation is based on 2000 Halton draws. Price, FC, and CO_2 enter the model as negative values. Individual-specific variables are mean-centered. $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

Table C4: Empirical correlation in taste parameters for attributes

	Price	None	Diesel	Metric
	FC design			
Price	1	0.68	-0.37	-0.02
None	0.68	1	-0.29	0.48
Diesel	-0.37	-0.29	1	-0.44
Metric	-0.02	0.48	-0.44	1
	CO_2 design			
Price	1	0.74	-0.27	0.09
None	0.74	1	-0.30	0.47
Diesel	-0.27	-0.30	1	-0.01
Metric	0.09	0.47	-0.01	1

NOTE: Correlations for the price and the metric are given for the negative variable values. A negative correlation suggests a larger coefficient in absolute terms.

Table C5: Relative attribute importance (MXL model)

Design \ Attribute	Price		Diesel		FC or CO_2	
	Median	SE	Median	SE	Median	SE
FC (l/100 km)	0.34	0.02	0.15	0.01	0.46	0.01
CO_2 (g/100 km)	0.42	0.02	0.19	0.01	0.31	0.02
CO_2 (g/km)	0.48	0.02	0.19	0.01	0.26	0.02
CO_2 (kg/km)	0.51	0.02	0.20	0.01	0.21	0.02

NOTE: The table reports the median RAI values for an average sample person computed based on draws from the population distribution of the taste parameters. Standard errors are computed from 300 bootstrap resamples of the taste parameter draws.

Table C6: WTP (€) for FC and CO_2 over the whole trip (MXL model)

Design \ Attribute	FC (1 l/100 km)					CO_2 (1 g/km)				
	Median	SE	2.5%	97.5%	SD	Median	SE	2.5%	97.5%	SD
FC (l/100 km)	**-45.11**	**3.83**	**-52.87**	**-37.91**	**71.06**	-1.80	0.15	-2.11	-1.52	2.84
CO2 (g/100 km)	-23.90	2.24	-28.75	-20.22	92.91	**-0.96**	**0.09**	**-1.15**	**-0.81**	**3.72**
CO2 (g/km)	-17.44	1.54	-20.54	-14.69	67.63	**-0.70**	**0.06**	**-0.82**	**-0.59**	**2.71**
CO2 (kg/km)	-13.42	1.40	-16.14	-10.99	51.96	**-0.54**	**0.06**	**-0.65**	**-0.44**	**2.08**

NOTE: The table reports the summary statistics for WTP values in € for the whole trip (10 days; 2000 km) for an average sample person based on 10,000 draws from the population distribution of the taste parameters. Standard errors (SE) and confidence interval (2.5% and 97.5%) of the median are computed from 300 bootstrap resamples of the draws. SD stands for standard deviation. **Bold values**: computed from the estimates. Non-bold values: implied by the values from other designs. The implied WTP (FC) values based on the WTP (CO_2) are computed as WTP(CO_2)×25 for both engine types on average. The implied WTP (CO_2) values based on the WTP (FC) are computed as WTP(FC)/25 for both engine types on average.

Table C7: Differences in WTP (€) for a reduction in FC and CO_2 by individual-specific variables

	△WTP, 1 l/100 km (FC design)		△WTP, 1 g/km (CO_2 design)	
	Mean	SE	Mean	SE
Gender (male = 1)	3.68	1.54	-0.01	0.11
University degree (yes = 1)	-1.41	1.44	-0.80	0.15
Rental Experience (yes = 1)	-5.45	1.88	-0.59	0.16
Environmental consciousness (score)	2.10	0.70	0.61	0.11
"WTP for less pollution" (yes = 1)	4.40	2.17	2.99	0.45
"Financial motive" (yes = 1)	-0.08	1.57	-0.65	0.18
"Diesel perception" (yes = 1)	0.47	1.97	0.23	0.14
"FC-CO_2 knowledge" (yes = 1)	-0.57	2.41	0.88	0.23

NOTE: The table presents the differences in WTP in € for FC and CO_2 for the whole trip (10 days; 2000 km) among respondents described by various characteristics. Values are computed based on 300 bootstrap resamples of draws for 10,000 random individuals from the estimated distribution of the taste parameters. Positive values mean higher WTP for a reduction in FC by 1 l/100 km or CO_2 emissions by 1 g/km compared to a reference group.

Table C8: Differences in the WTP for identical improvements in FC and CO_2 for various population sub-groups

Gender	GEC	Financial motive	Rental experience	FC-CO_2 knowledge	mean	SE
Male	Low GEC	Yes	No	No	36.21	5.67
Male	Average GEC	Yes	No	No	35.92	5.86
Male	High GEC	Yes	No	No	34.84	6.35
Male	Low GEC	No	No	No	32.32	6.09
Male	Low GEC	Yes	Yes	No	31.06	4.04
Male	Average GEC	Yes	Yes	No	30.98	4.24
Male	Average GEC	No	No	No	30.94	6.23
Female	Low GEC	Yes	No	No	30.56	4.83
Male	High GEC	Yes	Yes	No	30.30	4.76
Female	Average GEC	Yes	No	No	29.85	4.97
Male	Low GEC	Yes	No	Yes	29.64	6.54
Male	High GEC	No	No	No	28.47	6.69
Female	High GEC	Yes	No	No	28.33	5.40
Male	Low GEC	No	Yes	No	27.97	4.35
Male	Average GEC	Yes	No	Yes	27.73	7.01
Male	Average GEC	No	Yes	No	27.02	4.50
Female	Low GEC	No	No	No	26.66	5.46
Female	Low GEC	Yes	Yes	No	26.33	3.58
Female	Average GEC	Yes	Yes	No	25.91	3.75
Male	Low GEC	Yes	Yes	Yes	25.80	4.99
Male	High GEC	No	Yes	No	25.22	4.98
Female	Average GEC	No	No	No	24.85	5.58
Female	High GEC	Yes	Yes	No	24.85	4.23
Male	High GEC	Yes	No	Yes	24.61	7.88
Male	Average GEC	Yes	Yes	Yes	24.44	5.45
Male	Low GEC	No	No	Yes	24.07	6.85
Female	Low GEC	Yes	No	Yes	24.04	5.74
Female	Low GEC	No	Yes	No	23.23	4.07
Male	High GEC	Yes	Yes	Yes	22.11	6.30
Female	High GEC	No	No	No	21.93	6.01
Female	Average GEC	No	Yes	No	21.93	4.22
Female	Average GEC	Yes	No	Yes	21.72	6.17
Male	Low GEC	No	Yes	Yes	21.36	5.20
Female	Low GEC	Yes	Yes	Yes	21.12	4.51
Male	Average GEC	No	No	Yes	20.62	7.32
Female	High GEC	No	Yes	No	19.76	4.69
Female	Average GEC	Yes	Yes	Yes	19.41	4.95
Male	Average GEC	No	Yes	Yes	18.77	5.68
Female	Low GEC	No	No	Yes	18.45	6.27
Female	High GEC	Yes	No	Yes	18.14	7.02
Female	High GEC	Yes	Yes	Yes	16.70	5.77
Female	Low GEC	No	Yes	Yes	16.67	4.91
Male	High GEC	No	No	Yes	15.52	8.28
Male	High GEC	No	Yes	Yes	14.87	6.62
Female	Average GEC	No	No	Yes	14.57	6.74
Female	Average GEC	No	Yes	Yes	13.72	5.39
Female	High GEC	No	Yes	Yes	9.43	6.36

NOTE: The average values of the metric effect for various sub-groups of interest are presented, with standard errors computed based on 300 bootstrap resamples of draws from the distribution of the taste parameters. The metric effect is given by differences in the WTP for 1 l/100 km computed for the FC-design and CO_2-design (in g/km), for both engine types on average : ΔWTP(FC-CO_2) = WTP(FC) - WTP(CO_2, g/km)$\times$25. All other individual-specific variables are held at their sample averages.

Table C9: Effects of choice set characteristics on choice shares of the environmentally friendly option

	Dependent Variable: $\ln(S_{EFO}) - \ln(1 - S_{EFO})$		
	Case 1 (Min EnvC & Min TC)	Case 2 (Min EnvC)	Case 3 (Min EnvC & Min P)
Design CO_2 (g/100 km)	0.186***	0.216***	−0.002
	(0.003)	(0.004)	(0.004)
Design CO_2 (kg/km)	−0.145***	−0.132***	−0.013***
	(0.003)	(0.004)	(0.004)
Design FC (l/100 km)	1.002***	0.643***	−0.185***
	(0.003)	(0.004)	(0.004)
$\triangle$EnvC	0.003***	0.006***	−0.002***
	(0.0001)	(0.0001)	(0.0002)
$\triangle$TC	0.012***	0.013***	−0.015***
	(0.0001)	(0.0001)	(0.0004)
Design CO_2 (g/100 km)×$\triangle$EnvC	0.001***	0.001***	−0.002***
	(0.0001)	(0.0001)	(0.0003)
Design CO_2 (kg/km)×$\triangle$EnvC	−0.001***	−0.001***	0.002***
	(0.0001)	(0.0001)	(0.0003)
Design FC (l/100 km)×$\triangle$EnvC	0.004***	0.004***	−0.006***
	(0.0001)	(0.0001)	(0.0003)
Design CO_2 (g/100 km)×$\triangle$TC	−0.001***	−0.001***	0.001
	(0.0002)	(0.0001)	(0.001)
Design CO_2 (kg/km)×$\triangle$TC	0.001***	0.0001	−0.0001
	(0.0002)	(0.0001)	(0.001)
Design FC (l/100 km)×$\triangle$TC	0.001***	0.004***	−0.005***
	(0.0002)	(0.0001)	(0.001)
$\triangle$EnvC×$\triangle$TC	0.00003***	−0.0001***	−0.0001***
	(0.00000)	(0.00000)	(0.00002)
Constant	−0.132***	−1.159***	0.062***
	(0.002)	(0.003)	(0.003)
Observations	42,792	80,568	4,780
Adjusted R^2	0.858	0.700	0.767
F Statistic	21,622.970***	15,655.500***	1,311.870***

NOTE: The dependent variable is the natural logarithm of the average EFO choice share relative to the shares of other options ($\ln(S_{EFO}) - \ln(1 - S_{EFO})$). To account for uncertainty in the dependent variable, the (feasible) generalized least squares regression is estimated with the weights being (squared) bootstrapped standard errors of the average choice shares. The regression analysis is performed for each case separately, pooling observations from the four designs. The reference category in each case is the CO_2 design (g/km). $\triangle$TC and $\triangle$EnvC refer to differences in the total financial and environmental costs between the first and the second options in the simulated choice sets, respectively. The total financial and environmental costs are computed for the whole trip (10 days; 2000 kilometers). $\triangle$TC and $\triangle$EnvC are mean-centered for each case. Standard errors are in parentheses. *p<0.1; **p<0.05; ***p<0.01

Table C10: MXL parameter estimates (sample with rental experience)

	Dependent Variable: Choices	
	(1) FC design	(2) CO_2 design
NegPrice	-0.534^{***}	-0.802^{***}
	(0.098)	(0.098)
none	-51.236^{***}	-50.207^{***}
	(3.379)	(3.074)
Diesel	0.523^{***}	0.698^{***}
	(0.146)	(0.176)
NegFC	0.605^{***}	
	(0.059)	
NegCO2		-1.186^{***}
		(0.109)
NegPrice×(CO_2 design, g/km)		-0.037
		(0.053)
NegPrice×(CO_2 design, kg/km)		-0.043
		(0.049)
NegPrice×(Income less than average)	-0.008	0.380^{***}
	(0.073)	(0.044)
NegPrice×(Income more than average)	-0.004	0.169^{**}
	(0.072)	(0.069)
NegFC×(First CO_2 design)	0.001	
	(0.052)	
NegFC×Male	0.106^{**}	
	(0.053)	
NegFC×(University degree)	-0.073	
	(0.055)	
NegFC×GEC	0.060^{**}	
	(0.025)	
NegFC×(WTP for less pollution)	0.132^{**}	
	(0.065)	
NegFC×(Financial motive)	-0.041	
	(0.060)	
NegFC×(Diesel perception)	0.124^{**}	
	(0.059)	
NegFC×(FC-CO_2 knowledge)	-0.037	
	(0.093)	
NegCO2e×(CO_2 design, g/km)		-0.204^{**}
		(0.084)
NegCO2e×(CO_2 design, kg/km)		-0.268^{***}
		(0.069)
NegCO2×(First CO_2 design)		-0.576^{***}
		(0.060)
NegCO2×Male		-0.677^{***}
		(0.073)
NegCO2×(University degree)		-0.497^{***}
		(0.053)
NegCO2×GEC		0.353^{***}
		(0.041)
NegCO2×(WTP for less pollution)		1.110^{***}
		(0.125)
NegCO2×(Financial motive)		-0.040
		(0.064)
NegCO2×(Diesel perception)		0.151^{***}
		(0.056)
NegCO2×(FC-CO_2 knowledge)		0.138
		(0.098)

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	Dependent Variable: Choices	
	(1) FC design	(2) CO_2 design
sd.NegPrice.NegPrice	−0.648***	0.856***
	(0.032)	(0.037)
sd.NegPrice.none	24.788***	−23.862***
	(1.903)	(1.641)
sd.NegPrice.Diesel	−0.727***	1.272***
	(0.148)	(0.195)
sd.NegPrice.NegFC	−0.343***	
	(0.034)	
sd.NegPrice.NegCO2		0.003
		(0.031)
sd.none.none	−0.574**	−14.773***
	(0.287)	(1.165)
sd.none.Diesel	2.213***	−0.290
	(0.144)	(0.235)
sd.none.NegFC	0.232***	
	(0.033)	
sd.none.NegCO2		0.723***
		(0.027)
sd.Diesel.Diesel	0.253	2.726***
	(0.297)	(0.169)
sd.Diesel.NegFC	−0.191***	
	(0.032)	
sd.NegFC.NegFC	0.414***	
	(0.035)	
sd.Diesel.NegCO2		0.130***
		(0.031)
sd.NegCO2.NegCO2		0.626***
		(0.047)
Observations	4,620	4,620
Number of persons	362	354
Log Likelihood	-2,681.846	-2,588.445
Akaike Inf. Crit.	5,411.691	5,232.889
Bayesian Inf. Crit.	5,566.207	5,413.158

NOTE: The estimation of random coefficient logit model is based on maximum simulated likelihood method using the “gmnl” R package (version 1.1-3). Optimization of the log-likelihood is by BFGS maximization method. Simulation is based on 2000 Halton draws. Price, FC, and CO_2 enter the model as negative values. Individual-specific variables are mean-centered. *p<0.1; **p<0.05; ***p<0.01.

Table C11: WTP (€) for FC and CO_2 (MXL model: sample with rental experience)

Design \ Attribute	FC (1 l/100 km)					CO_2 (1 g/km)				
	Median	SE	SD	2.5%	97.5%	Median	SE	SD	2.5%	97.5%
FC (l/100 km)	**-31.31**	**2.35**	**24.69**	**-36.40**	**-27.02**	-1.25	0.09	0.99	-1.46	-1.08
CO_2 (g/100 km)	-17.38	2.25	81.97	-22.18	-13.51	**-0.70**	**0.09**	**3.28**	**-0.89**	**-0.54**
CO_2 (g/km)	-14.68	2.00	69.48	-18.58	-11.36	**-0.59**	**0.08**	**2.78**	**-0.74**	**-0.45**
CO_2 (kg/km)	-13.92	1.72	65.54	-17.59	-10.89	**-0.56**	**0.07**	**2.62**	**-0.70**	**-0.44**

NOTE: The table reports the summary statistics for WTP values in € for the whole trip (10 days; 2000 km) for the sample of persons with rental experience. The WTP is computed based on the population distribution of the taste parameters for 10,000 randomly drawn individuals. Standard errors and confidence intervals are computed from 300 bootstrap resamples of the taste parameter draws. **Bold values**: computed from the estimates. Non-bold values: implied by the values from other designs. The implied WTP (FC) values based on the WTP (CO_2) are computed as WTP(CO_2)$\times$25 for both engine types on average. The implied WTP (CO_2) values based on the WTP (FC) are computed as WTP(FC)/25 for both engine types on average.