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The Behavioral Effects of Carbon Pricing: Experimental Evidence on Fuel Consumption

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The Behavioral Effects of Carbon Pricing: Experimental Evidence on Fuel Consumption

February 28, 2025

Abstract

Carbon pricing is a key policy tool for mitigating climate change by increasing prices and thereby reducing demand for carbon-intensive products and activities. However, behavioral effects—such as crowding in or out of intrinsic motivation, moral licensing, or defiant behavior—can either amplify or weaken its standalone price effect. This study examines these behavioral effects of carbon pricing on fuel consumption using a multiple price list approach in an incentivized online survey experiment. The survey was conducted in 2024 in Germany in a general population sample of 3000 participants. The findings provide indicative evidence that carbon price salience crowds in intrinsic motivation, reinforcing the price effect, while certain sub-groups seem to exhibit defiant reactions that weaken it.

Keywords: carbon pricing; behavioral response; willingness to pay; fuel consumption

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1 Introduction

To reduce carbon emissions and achieve the climate change mitigation goals set in the Paris Agreement, Germany has introduced a carbon price in the transport and building sector in January 2021. The idea of the carbon price is to increase prices of fossil fuels used in the transport and building sector such as petrol, diesel, LPG, natural gas, and heating oil, and thereby incentivize consumers to switch to more sustainable alternatives. For example, consumers can choose to use public transport or the bike instead of driving their car, or they can replace their fossil fuel heating system with a heat pump run with green electricity. However, consumers do not feel well informed

about carbon pricing, and survey responses reveal low knowledge about the aims and mechanisms of carbon pricing, the impacted products, and, most notably, the financial implications for their households (Eßer et al., 2024). In addition, consumers' preference for green spending of carbon price revenues over redistribution mechanisms such as financial relieves for low-income households or a per-capita reimbursement (Bristow et al., 2010; Dütschke et al., 2023; Ewald et al., 2022; Gevrek & Uyduranoglu, 2015; Hammerle et al., 2021; Kotchen et al., 2017; Sommer et al., 2022) suggests that they see carbon pricing as effective only if revenues fund green initiatives, overlooking its price-driven steering effect—contrary to its economic rationale.

Therefore, the question arises whether carbon pricing can fully realize its steering effect when knowledge about the price, its mechanism, and financial consequences is low. From the economists' perspective, one can argue that carbon price literacy is irrelevant for the effectiveness of the policy instrument as a rational consumer will react to a price signal by adjusting consumption irrespective of the underlying reason for this signal. Yet, Chetty et al. (2009) show that consumers are less responsive to taxes that are not salient. Similarly, the received literature suggests that there are effects other than a plain price effect at work in the context of carbon pricing. Observational studies from British Columbia (Canada) and Sweden estimate that the carbon price elasticity is higher than the general price elasticity for fuel in the transport sector (British Columbia: Rivers & Schaufele (2015), Sweden: Andersson (2019)). In addition, evidence from experimental studies suggests that carbon pricing can have behavioral effects such as a moral licensing effect or a crowding out of intrinsic motivation (e.g., Grieder et al. (2021); Hartmann et al. (2023); Lanz et al. (2018); Perino et al. (2014); Soregaroli et al. (2021); Pizzo et al. (2024)).

This study investigates the effects of carbon pricing on driving in an incentivized online survey experiment. In detail, I examine whether carbon emissions and carbon price salience as well as information on the aims, mechanisms, and revenue recycling of carbon pricing affect consumers' willingness to pay and price elasticity of demand for fuel, and whether these effects are related to intrinsic motivation for sustainable

behavior. Further, I explore the underlying mechanisms such as crowding out of intrinsic motivation, moral licensing, and defiant behavior.

To elicit the willingness to pay for fuel, I used a multiple price list in which participants had to choose between a train trip and a car trip at increasing fuel prices while the price for the train trip remained unchanged. For the experiment, participants were assigned to four groups that received different information during and before the multiple price list task. While the multiple price list for group Price increase (P) only provided simple price information, group Carbon emissions (E) received information on the carbon emissions of both the train and the car trip. Group Carbon price (CP) was informed about the carbon price included in the fuel price which increased in each decision situation, while group Carbon price + information (CPI) additionally received information on the aims, mechanisms and revenue recycling of the carbon price.

The experimental design enables me to contribute to the literature in three ways. First, this study is the first to investigate the behavioral effects of carbon pricing on the willingness to pay and price elasticity of demand for fuel—a highly carbon intensive consumption good for which the price elasticity of demand is typically low. The received literature focuses on groceries (Lanz et al., 2018; Perino et al., 2014; Pizzo et al., 2024; Soregaroli et al., 2021) and electronic devices (Hartmann et al., 2023) that typically have a higher price elasticity of demand and lower carbon intensity, or uses a more abstract setting without naming a certain good or category of goods (Grieder et al., 2021). Second, using an information treatment on the aims, mechanisms, financial effects, and revenue recycling of carbon pricing, I account for the consumers' low knowledge about carbon pricing, and test whether increasing this knowledge affects reactions to carbon pricing and can counteract a potential moral licensing effect. Third, comparing the effects of carbon price and carbon emissions salience, and conducting sub-group analyses for respondents with high or low intrinsic motivation and those who do or do not support climate mitigation measures that impose costs for citizens, allows me to further investigate a potential crowding in or out of intrinsic motivation as well as potential defiant reactions to carbon pricing.

Results show indicative evidence that the behavioral effects of carbon pricing enhance the pure price effect by decreasing the average willingness to pay and increasing the price elasticity of demand for fuel. I do not find evidence for a crowding-out of intrinsic motivation, nor for a moral licensing effect of carbon price salience that would weaken the pure price effect. In contrast, just as carbon emissions salience, the salience of carbon pricing tends to enhance the pure price effect by triggering intrinsic motivation to reduce carbon emissions, at least in specific sub-groups of respondents that are more engaged in climate change mitigation. Nevertheless, the salience of carbon emissions and the carbon price also appears to have negative effects, leading to defiant reactions in certain sub-groups that increase fuel demand compared to a scenario without this salience.

Sections 2 and 3 outline the experimental design and the hypotheses, respectively. Section 4 describes the study sample, while section 5 presents the results of the experiment. Section 6 concludes.

2 Experimental Design

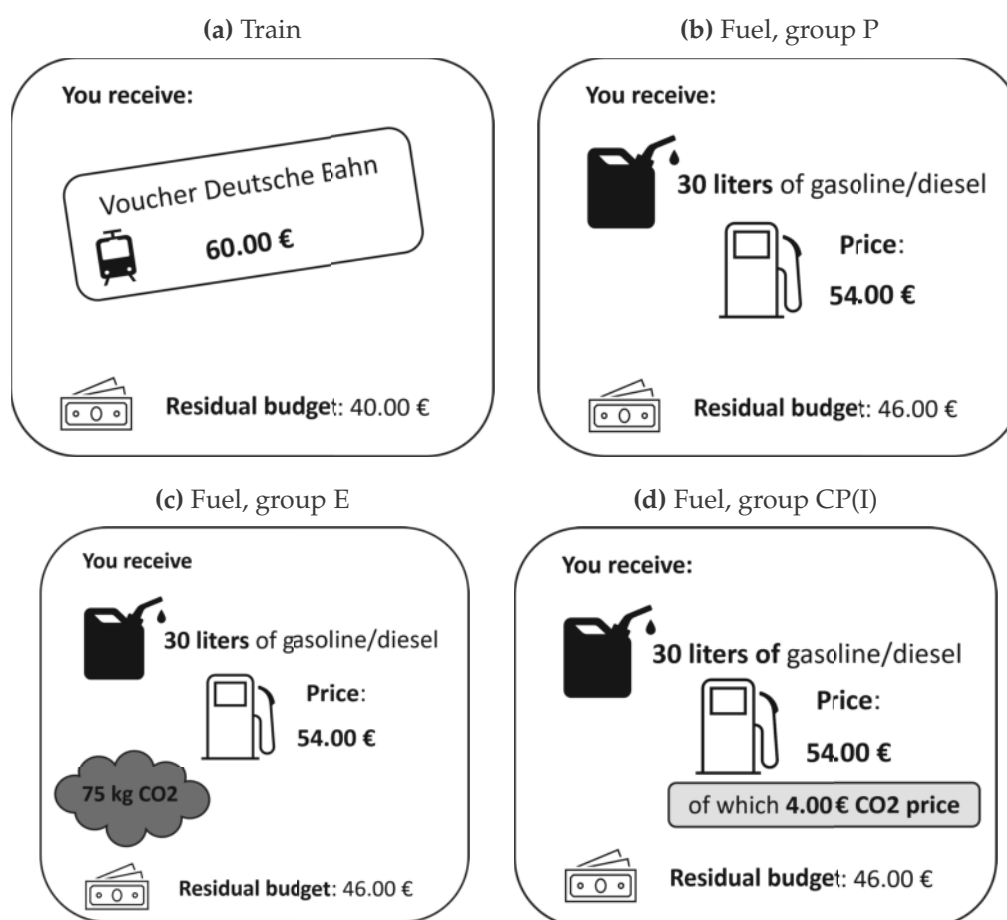
I conducted an online survey experiment with roughly 3,400 respondents. To elicit the willingness to pay for fuel, participants receive a multiple price list with 9 decision situations in which they can choose between a voucher for fuel and a voucher for a train trip. While the price for fuel increases with each decision situation, the price for the train trip remains unchanged. In detail, participants can choose between a voucher for 30 liters of petrol/diesel and a voucher for the Deutsche Bahn worth 60 Euro. Accordingly, the price for the train voucher is 60 Euro, while the price for fuel is 54 Euro in the beginning and increases up to 100 Euro. For the fuel price I rely on the mean of the average prices for petrol and diesel in 2024 (as of May 2024). The starting price of 54 Euro for 30 liters of fuel include a carbon price of 45 Euro, according to the current carbon price in Germany. I then increase the carbon price by roughly 6 Euro in each step of the multiple price list up to a total price of 100 Euro for 30 liters of

fuel. This upper bound is based on survey results on the willingness to pay for fuel in Germany in 2022 (Boneva et al., 2022). For a translation of the exact wording of the instructions and questions, see Appendix C.

To incentivize the decisions, participants are told that they have a budget of 100 Euro which they can use to either buy 30 liters of fuel or the train voucher, and that they will receive the remaining budget in form of a voucher for Wunschgutschein.de. In the end, 40 participants will be randomly drawn to actually receive the vouchers chosen in one randomly selected decision situation. Participants who do not own a car that runs with fossil fuel are excluded from the experiment. That is, I only include participants that own at least one car with a diesel, petrol or hybrid drive system.

Participants are randomized into four equally sized experimental groups: price increase (P), carbon emissions (E), carbon price increase (CP), and carbon price information (CPI). While in group P participants see the plain price for gasoline and the train voucher, and the price for fuel increases without any further information, groups E and CP receive additional information on the carbon emissions of the car trip and the train ride, and the carbon price, respectively. Before filling in the multiple price list, group E is informed that the car trip will cause 75 kg of carbon emissions. These carbon emissions and the zero carbon emissions of the train trip are shown in each decision situation. In a similar vein, Group CP is informed that fuel prices in the multiple price list include the carbon price. In addition, in each decision situation, the carbon price included in the total price is explicitly shown. To visualize the decision situations and make it easier to imagine them, the multiple price lists included pictograms for each situation.

Figure 1: Examples of illustrations in the Multiple Price Lists



Note: Examples of pictograms used to illustrate information in the multiple price lists; from left to right: train voucher (same for all groups), fuel voucher for group Price Increase, fuel voucher for group Carbon Emissions, fuel voucher for groups Carbon Price Increase and Carbon Price Increase + Information.

In addition to this general information on a carbon price on fuel, group CPI receives more detailed information on the carbon price and its mechanisms immediately before filling in the multiple price list. To increase the participants' engagement with the information on carbon pricing, information is provided in form of a quiz. In a set of three multiple-choice questions, respondents were asked to select the correct answers. After each question, they then received an explanation of the correct answer. The provided information clarified that (i) the primary aim of the CO₂ price is to protect the climate by making products that emit CO₂ more expensive, such as petrol, diesel, and LPG, while climate-friendly alternatives remain cost-effective; (ii) the revenue generated from the carbon price is used to alleviate financial burdens on citizens, such as

reducing electricity costs through the abolition of the Renewable Energy Surcharge, and to fund climate protection measures like the expansion of renewable energy and sustainable transport infrastructure; (iii) while there is no direct compensation for CO₂ emissions, the CO₂ price encourages citizens to adopt more climate-friendly behaviors by making sustainable choices, like using public transport or bicycles, more affordable compared to climate-damaging alternatives.

Before the experimental part of the questionnaire, I elicited the respondents' attitudes toward climate mitigation measures. In particular, I asked them

- (1) to what extent they agree with the statement that political measures should be taken to limit climate change, and
- (2) whether they approve or reject climate protection measures that impose costs on citizens.

After the experiment, I asked participants whether they approve or reject carbon pricing. The responses may be influenced by participation in the Multiple Price List, but I did not want to confound the main outcome of the willingness to pay for fuel by making participants aware of carbon pricing before the Multiple Price List task. At the end of the questionnaire, I measure the participants' environmental behavior in multiple contexts to approximate their intrinsic motivation to behave sustainably. That is, I ask them whether they

- (1) donate money to environmental organizations,
- (2) use public transportation or their bike for trips in the surrounding area (up to 30 km),
- (3) purchase groceries from certified organic cultivation,
- (4) draw the attention of someone who is behaving in a way that is harmful to the environment.

These items were selected from the General Ecological Behavior (GEB) Scale (Kaiser, 2020). In addition, the questionnaire collects data on participants socioeconomic and demographic characteristics as well as on trait reactance.

3 Hypotheses

The following hypotheses are based on the general idea that at least some people have an intrinsic motivation to reduce carbon emissions. In addition, I expect that carbon pricing not only exerts a pure price effect but also has a behavioral impact on demand for climate damaging products. This behavioral effect can operate in both directions: the salience of carbon pricing may stimulate the consumers' intrinsic motivation to reduce carbon emissions, resulting in a stronger effect on demand than the pure price effect. Conversely, assigning a price to carbon emissions could crowd out intrinsic motivation, lead to moral licensing, or provoke defiant behavior among consumers who oppose climate mitigation measures. In particular, regarding intrinsic motivation, Jakovcevic et al. (2014) and Sharpe et al. (2021) find that people behave pro-environmentally to express their intrinsic motivation. Therefore, I assume that people have an intrinsic motivation to reduce carbon emissions. To test this, I can compare those individuals who report voluntary sustainable behavior in general with those who score low on this scale. I expect those individuals with high intrinsic sustainability motivation to switch from fuel for a car trip to the train trip at a lower fuel price level than individuals with low motivation.

H1: Individuals with high intrinsic motivation for pro-environmental behavior show a lower willingness to pay for fuel than those with low intrinsic motivation in the pure price setting (Group P).

Putting a label on environmentally friendly products has been shown to increase intrinsic motivation to purchase these products (e.g., Schwartz et al. (2020)). Therefore, making carbon emissions from burning 30 liters fuel salient during the decision situation and simultaneously highlighting the low emissions of the train option may trigger the participants' intrinsic motivation and make them switch from the car to the train trip at lower fuel prices than in a situation without information on carbon emissions. Thus, I hypothesize that

H2a: The willingness to pay for fuel is lower when carbon emissions are salient (Group E) than when there is no information on carbon emissions (Group P).

In addition, I expect that individuals will respond more strongly to a price increase when they are aware of the carbon emissions. That is, the price elasticity of demand for fuel is higher when carbon emissions are salient.

H2b: The decrease in the percentage of participants choosing fuel for the car trip resulting from a price increase is higher in the carbon emissions setting (Group E) than in the pure price setting (Group P).

A problem of carbon emissions labels can be that consumers have on average a low carbon literacy (e.g. Kretschmer (2024); Schleich et al. (2024) and may thus not be able to estimate whether a certain amount of carbon is high or low. However, like a carbon emissions label, a carbon price label can signal negative climate impact and provoke intrinsic motivation to reduce carbon emissions in addition to the pure price effect (e.g. Nyborg (2010); Jakovcovic et al. (2014)). If this is true, participants in the carbon price setting will switch from the train trip to fuel for a car trip at lower fuel prices than in the pure price setting. On the other hand, crowding out of intrinsic motivation, moral licensing, and defiant behavior can result in an opposite and undesirable effect of carbon pricing on demand for fuel. That is, instead of decreasing the willingness to pay for fuel compared to a pure price setting, a carbon price label may increase consumers' willingness to pay. This leads me to hypothesize that

H3a: The willingness to pay for fuel is lower or higher when the carbon price is salient (Group CP) than in the pure price setting (Group P).

In line with that, I expect that individuals will respond more or less strongly to a price increase if they are aware that the price increases due to higher carbon prices.

H3b: The decrease in the percentage of participants choosing fuel for a car trip resulting from a price increase is higher or lower in the carbon price setting (Group CP) than in the pure price setting (P).

Based on the assumption that not only the salience of carbon emissions but also carbon price salience can activate consumers' intrinsic motivation to reduce carbon emissions, and considering consumers' low carbon literacy, I hypothesize that

H4a: The willingness to pay for fuel is lower when the carbon price is salient (Group CP) than in a situation without salience of the carbon price but information on carbon emissions (Group E).

H4b: The decrease in the percentage of participants choosing fuel for a car trip resulting from a price increase is higher when the carbon price is salient (Group CP) than in a situation without salience of the carbon price but information on carbon emissions (Group E).

I will further investigate the potential underlying reasons for an increase in the willingness to pay for fuel as a response to carbon price salience, namely crowding out of intrinsic motivation, moral licensing, and defiant behavior.

Crowding out of intrinsic motivation

External incentives or interventions such as rewards or regulations can undermine intrinsic motivation (Frey, 1994). In the context of carbon pricing, this means that consumers may be intrinsically motivated to reduce their carbon emissions, but setting a price on carbon emissions crowds out this intrinsic motivation by signaling that "the government has taken over responsibility for the issue at stake" (Nyborg et al., 2006, p.359). Carbon pricing may thus lead to a higher willingness to pay for fuel than in the pure price setting, that is, subjects switch from car to train at higher fuel prices. To investigate whether a potential positive effect of carbon price salience on the willingness to pay for fuel is driven by a crowding out of intrinsic motivation, I will look at differences in the effect of carbon price salience on the willingness to pay for fuel between individuals with high versus low intrinsic motivation for sustainable behavior. If study participants show a higher willingness to pay for fuel when the carbon price is salient than in the pure price setting and the underlying reason for this behavior is a crowding out of intrinsic motivation, the difference between group CP and P

should be driven by subjects who report an intrinsic motivation for sustainable behavior in general, while there should be no or at least a lower effect for subjects without such intrinsic motivation (see Pizzo et al. (2024) for a similar approach). To measure intrinsic motivation for sustainable behavior, I rely on four selected items of the General Ecological Behavior Scale (Kaiser, 2020) which measures self-reported (voluntary) pro-environmental behavior in multiple areas of action.

H5a: Participants with high intrinsic motivation for pro-environmental behavior show a higher willingness to pay for fuel in the carbon price setting (Group CP) than in the pure price setting (Group P), while this difference is lower or even absent for participants with low intrinsic motivation.

H5b: Among participants with high intrinsic motivation, the decrease in the percentage of participants choosing fuel for a car trip resulting from a price increase is lower when the carbon price is salient (Group CP) than in the pure price setting (Group P), while this difference is lower or even absent for participants with low intrinsic motivation.

If the carbon price salience effect on the willingness to pay for fuel is higher for individuals with an intrinsic motivation for pro-environmental behavior, this can be the result of a crowding out of intrinsic motivation in terms of a reduction of individual responsibility, but it may also be due to a moral licensing effect. To disentangle these two effects, I included an information treatment.

Moral licensing

Subjects with a positive attitude towards climate mitigation policies may engage in moral licensing and thus switch to the train trip at a higher fuel price than in the pure price setting. Merritt et al. (2010) define moral licensing or moral self-licensing as the fact that "[p]ast good deeds can liberate individuals to engage in behaviors that are immoral, unethical, or otherwise problematic" (p. 344). This effect has been shown, for instance, in the context of climate friendly behavior (Burger et al., 2022) or pro-social behavior (Jordan et al., 2011). See also Blanken et al. (2015) for a meta-analysis.

When I transfer this definition to fuel consumption and carbon pricing, consumers could interpret the price as a donation for climate mitigation or as carbon offsetting, which may lead them to think they are doing something good when paying the price and as a result increase instead of decreasing their fuel consumption. I thus expect that informing participants about the goals, mechanisms, and revenue use of the German carbon price decreases the moral licensing effect. To test this, I estimate the effect of an information treatment on demand for fuel. If the potential positive effect of carbon price salience on fuel demand is driven by moral licensing, informing participants that the carbon price is not used to offset carbon emissions directly and that the idea of the carbon price is a steering effect may reduce the moral licensing effect. Thus, I expect that the information treatment decreases the willingness to pay for fuel compared to the carbon price setting without additional information.

H6a: Participants that are informed about the goals and mechanisms of the carbon price show a lower willingness to pay for fuel than those in the carbon price setting without additional information.

H6b: The decrease in the percentage of participants choosing fuel for a car trip resulting from a price increase is lower in the carbon price salience setting (Group CP) than in a situation where the carbon price is salient and additional information on goals and mechanisms of the carbon price are provided (Group CPI).

Defiant behavior

A third mechanism that may lead to a higher willingness to pay for fuel in the carbon price than in the pure price setting is defiant behavior (Michels et al., 2023) of individuals who oppose climate mitigation policies. Subjects who do not favor climate change mitigation measures that come with costs for the citizens may show a defiant behavior when the carbon price is salient because it restricts their freedom for a reason they do not consider legitimate. To test this, I estimate the effect of carbon price salience on the willingness to pay for fuel among individuals with a negative attitude towards climate mitigation measures. If the positive effect of carbon price salience on the willingness

to pay for fuel is at least partly driven by defiant behavior, the estimated effect should be positive.

4 Sample description

The experiment was embedded in a more extensive online survey on preferences for and the effect of policies in the context of the German energy, heating, and mobility transition. The survey was conducted from September 25 to October 15, 2024, in cooperation with the professional survey institute forsa. forsa maintains an online panel of more than 100,000 individuals that is representative of the German-speaking internet users aged 14 and above - the forsa.omninet panel. Participants of the forsa.omninet panel are recruited actively, randomly, and offline. That is, forsa uses a dual frame telephone sampling procedure to randomly recruit participants offline via their mobile or landline phone. Participants cannot register for the panel without being actively invited to participate by forsa. This leads to high data quality and largely reduces the occurrence of speeders and straight liners. The offline recruitment mechanism ensures that people who use the internet only occasionally or for specific purposes have the same probability of being recruited for the panel. In addition, the random sampling makes possible reweighting of the sample to achieve representativeness for the base population. The data was collected online using a state-of-the-art online survey tool and participants were able to interrupt and resume the survey at any time.

For this survey, forsa selected 4,040 participants of the forsa.omninet. Of these, 3,362 owned at least one petrol- or diesel-powered car, making them eligible to participate in the experiment. These participants were randomly assigned to four experimental groups, each consisting of 818 to 853 individuals. In all four experimental groups, roughly 20 percent of the respondents opted out of the experiment by stating that they would not like to win a voucher (Figure A.1). Another 4 percent in each group made inconsistent choices. That is, they either switched from choosing the train trip to choosing fuel for the car trip at higher fuel prices, or they switched more than once

between the two options. As these choices cannot be easily interpreted, I exclude them from further analyses. There are no statistically significant differences between the experimental groups in exclusions from the original sample for any of these three reasons. Exclusions due to non-participation in the multiple price list task and inconsistent responses resulted in a final sample of 2,562 respondents, with experimental groups ranging from 614 to 661 participants.

The sample is highly educated, with 55 percent having obtained their German Abitur (A-levels). In terms of income, participants have a relatively high net household income, with only 27 percent earning less than 2,700 EUR per month. Meanwhile, 34 percent earn between 2,700 and 4,200 EUR, and 40 percent earn more than 4,200 EUR. Experimental groups do not differ significantly in these characteristics. However, some group differences are observed regarding environmental attitudes (Table A.1). To address this, I will test the robustness of my results to the inclusion of the respondents' environmental attitudes. In the following, I provide a more detailed description of the sample, focusing on participants' sustainability motivation, policy acceptance, mobility behavior, and knowledge about the German carbon price.

Sustainability attitudes and behavior

To approximate respondents' intrinsic motivation for pro-environmental and climate friendly behavior, I rely on four selected items of the General Ecological Behavior Scale ((Kaiser, 2020)). I add up the responses to these items and calculate the average such that a higher score indicates a higher intrinsic sustainability motivation with minimum and maximum possible values of 1 and 5, respectively. I then construct a binary variable for high and low intrinsic motivation that equals 1 for participants with an average score of 3 or higher and 0 otherwise.

Respondents show a medium sustainable behavior in the context of environmental and climate protection which suggests that they have at least some intrinsic motivation to reduce carbon emissions (Figure A.2). Based on the binary variable, about one third can be characterized as having a high intrinsic motivation. Looking at the sus-

tainable behavior in each domain separately, reveals that a majority of respondents of 78 percent buy food from controlled organic cultivation at least occasionally with a lot of them even doing so often or very often (Figure A.3). When it comes to drawing the attention of someone who is behaving in an environmentally harmful way, there are still 55 percent that do so at least occasionally, but very few of these draw someone's attention (very) often. Even less respondents reported to use public transport or a bike for trips in the surrounding area at least occasionally (42 percent). Donating money to environmental organizations is the least popular activity with only 29 percent of respondents doing so occasionally or more often.

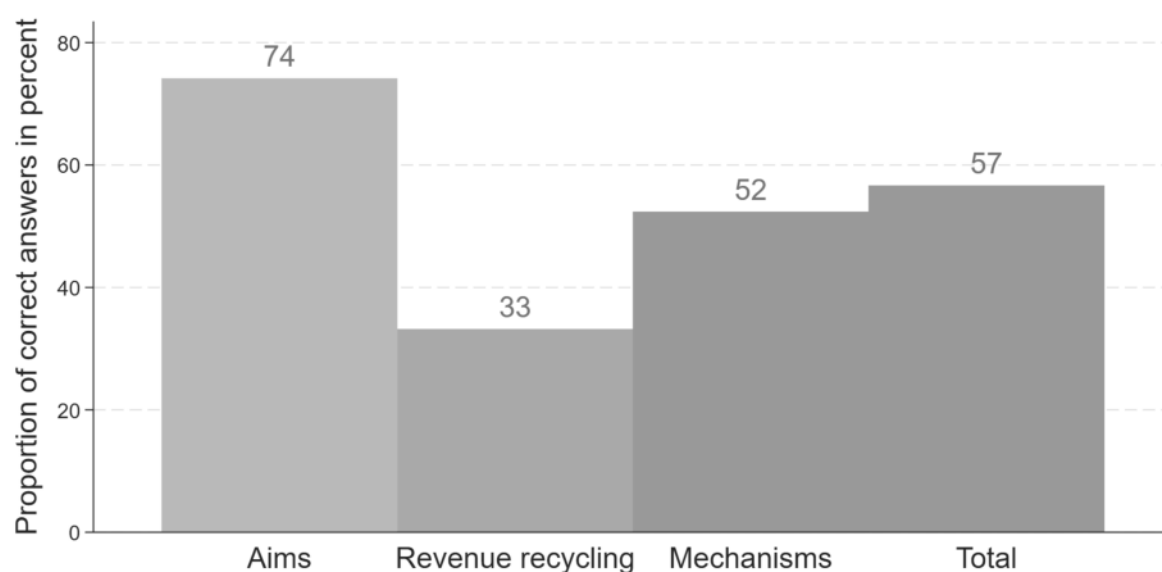
When asked for their acceptance of climate mitigation measures in another question, a large majority of 77 percent of respondents agree that policy should implement measures to mitigate climate change in general. Yet, when it comes to measures that impose costs on citizens, support decreases to 62 percent.

Mobility behavior

On average, participants own 1.5 cars with 57 percent owning one car, 35 percent owning 2 cars, and 8 percent owning 3 or more. Roughly half of the sample uses their car for commuting to work, school, university, etc. The median annual distance driven is 10,000 kilometers. Concerning public transport use, 14 percent reported to own a DeutschlandTicket, 8 percent own another ticket for public transport, while the majority of 78 percent does not own any ticket for public transport. Overall, while some respondents seem to heavily depend on their cars, others use them less frequently, opting instead for public transport.

Knowledge about carbon pricing

Figure 2: Knowledge about carbon pricing



Participants assigned to group Carbon price + information received questions on the aims, mechanisms, and revenue recycling of the German carbon price. On average, respondents were able to correctly answer 57 percent of all 12 items on carbon pricing – 74 percent of those on its aims, 33 percent of those on revenue recycling, and 52 percent of the items on the mechanisms and financial effects of carbon pricing (Figure 2).

The majority of participants in group CPI correctly identified the objective of carbon pricing of increasing the cost of carbon-intensive activities and mitigating climate change (Figure A.4). Still, one third of respondents seem to believe that the policy aims to increase tax revenues, while a minority assumes carbon pricing to target congestion and air pollution in city centers and environmental problems such as plastic waste.

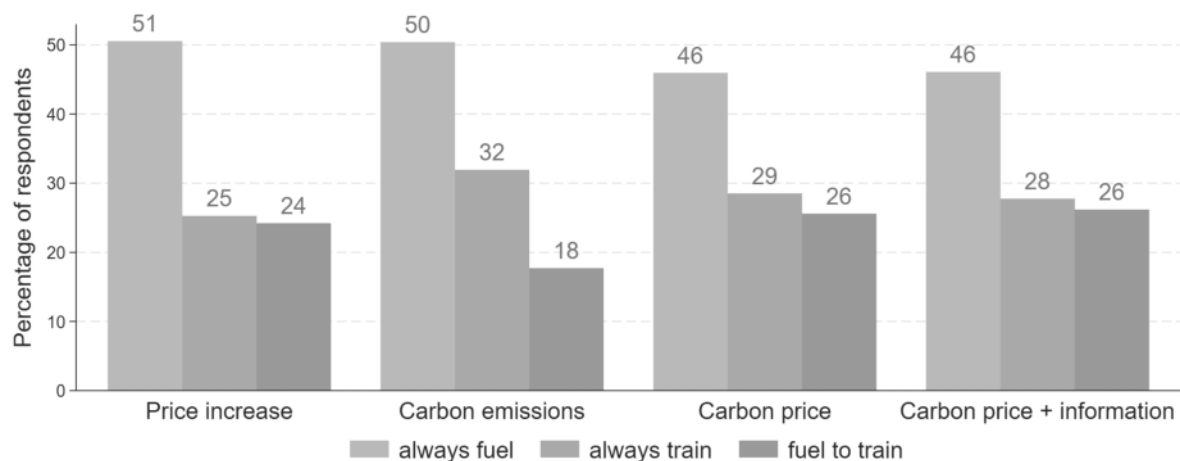
Regarding the revenue recycling of carbon pricing, a majority of 60 percent of respondents correctly believe that carbon price revenues are used to finance climate mitigation measures, but only 12 percent believe or know that revenues are also used to relieve the financial burden for consumers. On the other hand, 28 percent falsely think that carbon price revenues are used to offset carbon emissions.

Concerning the mechanisms and financial effects of carbon pricing, most participants seem to be well informed. 69 percent are aware that the idea of the carbon price is to reduce carbon emissions. 59 and 44 percent know that the carbon price increases the price of and thereby demand for carbon intensive products, and reduces the price of products with low carbon emissions relative to carbon intensive products. However, more than one third also believe that the carbon price can only be effective when revenues are used for climate mitigation measures. This finding implies that respondents may perceive the carbon price as a kind of donation for climate mitigation, which could result in a moral licensing effect of carbon pricing or a crowding out of intrinsic motivation as pointed out in the hypotheses.

5 The behavioral effects of carbon pricing

5.1 Analysis of switching points

Figure 3: Distribution of types of switchers excluding non-response and inconsistent respondents



In the MPL task, survey participants decided between a trip by train or by car at different fuel prices. Of those participants who filled in the MPL and showed consistent switching behavior, a proportion of roughly 50 percent preferred fuel for the car trip to the train trip at all price levels in all four experimental groups, while between 25 and 32 percent always chose the train trip (Figure 3). 18-26 percent chose the fuel for

the car trip at the lowest fuel price and switched to the train trip at some higher price level. While these percentages do not differ between group P and groups CP and CPI, respondents in group E were significantly more likely to choose the train trip at all price levels than in group P, and less likely to switch from fuel to train (Table B.1). This suggests that respondents who received information on the carbon emissions of the car and the train trip reduced their willingness to pay for fuel.

In the following, I will further investigate the effects of carbon emissions and carbon price salience on the average willingness to pay as well as on the demand function for fuel.

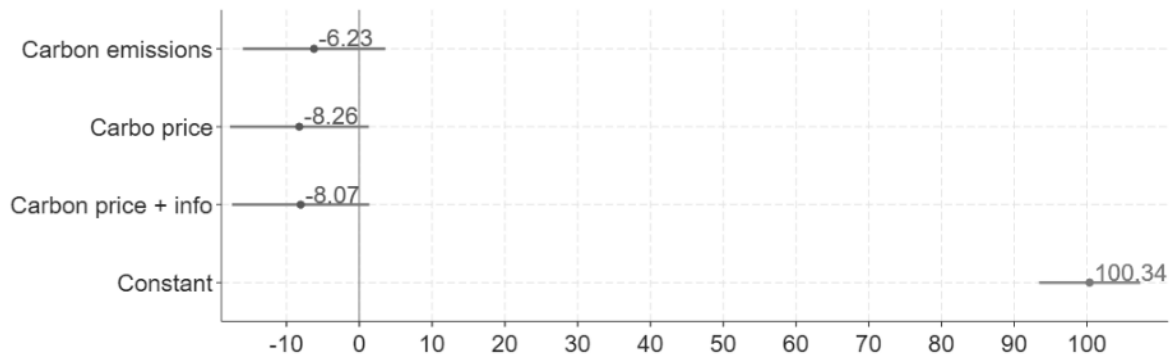
5.2 Willingness to pay for fuel

To estimate the average willingness to pay, I use an interval regression to account for a higher and lower willingness to pay of those participants who still chose the car trip at the highest price level and those who already opted for the train trip at the lowest price level, respectively. I regress the switching interval on group assignment. Due to random assignment to the four groups, I do not use control variables in my main specification to rely on the largest possible sample. This yields an average willingness to pay of 100 EUR for 30 liters of fuel in group P (Figure 4). The salience of carbon emissions in group E decreased the willingness to pay by 6 EUR, and making the carbon price salient (group CP) and additionally providing information on the carbon pricing mechanism (group CPI) both decreased the willingness to pay by 8 EUR.

Even though these differences are not statistically significant at the 5 percent level, there tends to be a negative effect of all salience and information treatments, with confidence intervals ruling out positive effects larger than 3.6 EUR for carbon emissions salience and larger than 1.3 EUR and 1.4 EUR percentage points for carbon price salience and the information treatment, respectively. Thus, carbon price salience rather tends to decrease the willingness to pay instead of increasing it, and this effect is similar to that of carbon emissions salience. This suggests that carbon price salience works as a signal for environmental quality and triggers participants' intrinsic motivation to

reduce carbon emissions, as does salience of carbon emissions. Additionally informing participants about the mechanisms of carbon pricing does not change this effect.

Figure 4: The effect of carbon emissions and carbon price salience, and information on carbon pricing on the willingness to pay for fuel; interval regression



Note: The plot shows point estimates and 95% confidence intervals of an interval regression of the switching interval on treatment assignment. A red coloring indicates statistical significance at the 5% level, while blue-colored results are not statistically significant at this level. Number of observations: 2,562.

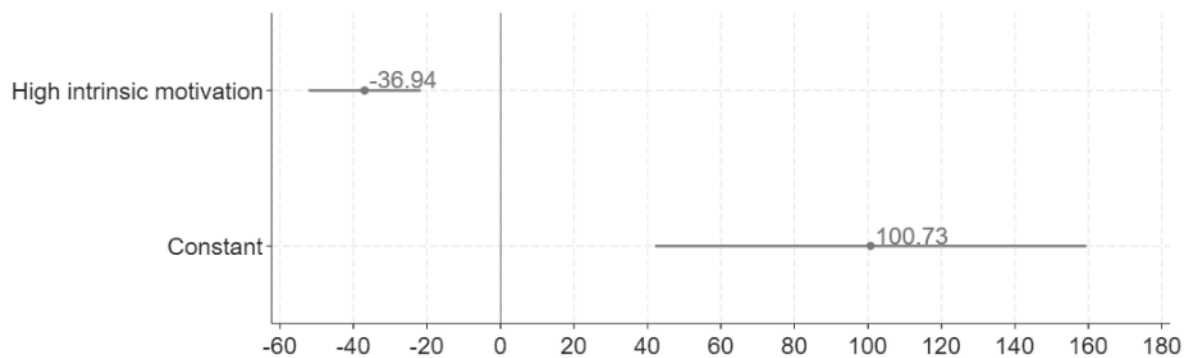
Mechanisms

Besides the effect of carbon emissions and carbon price information on the willingness to pay for fuel, I am also interested in the mechanisms underlying these effects. First, I investigate whether effects differ between individuals with different levels of intrinsic sustainability motivation. Therefore, in a first step, I test whether this intrinsic motivation influences the willingness to pay. Using an interval regression in which I control for socioeconomic and demographic characteristics, environmental and climate change attitudes, attitudes towards the implementation of political measures to mitigate climate change, and psychological reactance, I estimate a willingness to pay of 100 EUR for participants with a low intrinsic motivation, while respondents with a high index for intrinsic motivation show a significantly lower willingness to pay of 63 EUR (Figure 5). In a second step, I compare the treatment effects on the willingness to pay for fuel between individuals with low and high intrinsic motivation. Contrary to the expectation, there is no differential effect of carbon price salience on the willingness to pay (Figure B.1). Participants in both sub-groups tend to reduce their willingness to pay in response to carbon price salience. Similarly, an exploratory heterogeneity

analysis reveals that there is no difference in the effect of carbon emissions salience and that of carbon price salience + information, either (Table B.1).

Second, I explore whether carbon emissions or carbon price salience trigger defiant behavior among individuals who do not support climate mitigation measures that impose costs on citizens, that is, whether those individuals show a higher willingness to pay for fuel when carbon emissions or the carbon price are salient. While respondents who reject such policies have a much higher willingness to pay for fuel than those who support them, I do not find evidence for defiant behavior (Figure B.2). Similar to participants who support costly policy measures, those who oppose them also tend to decrease their willingness to pay for fuel as response to all three treatments, even though none of these effects is statistically significant at the 5 percent level.

Figure 5: Relationship between intrinsic motivation and willingness to pay for fuel; interval regression



Note: The plot shows point estimates and 95% confidence intervals of an interval regression of the switching interval on a binary variable for intrinsic motivation, controlling for socioeconomic and demographic characteristics, environmental and climate change attitudes, preferences for climate change mitigation policies, and psychological reactance. A red coloring indicates statistical significance at the 5% level, while blue-colored results are not statistically significant at this level. Number of observations: 419.

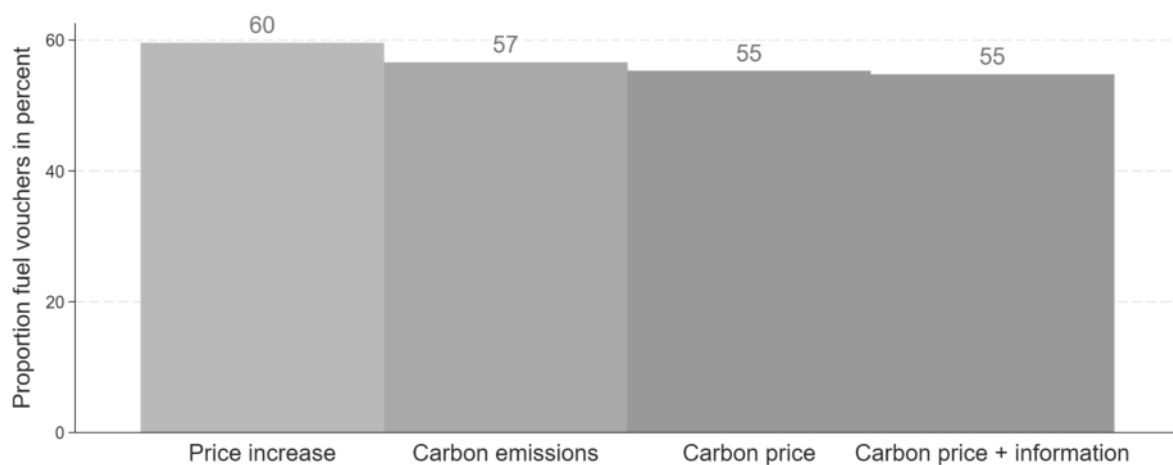
5.3 Demand curve and price elasticity

An alternative measure to the average willingness to pay for fuel as outcome of the MPL is the change in the percentage of respondents choosing fuel for the car trip when fuel prices increase, i.e., the change in the demand for fuel. In the following, I will

have a closer look at this change in demand and how it is affected by the different treatments.

Over all decision situations, participants were more likely to choose the car trip than the train trip (Figure 6). On average, respondents chose the fuel for a car trip in 60 percent of all choice situations in the pure price increase setting (group P). The share decreases slightly at each step when transitioning from the price increase group to the carbon emissions, carbon price, and carbon price + information groups, with significant differences observed in pairwise comparisons across all groups (Table B.2). This implies that, on average, all salience and information treatments decrease demand for fuel compared to the pure price setting.

Figure 6: Proportion of car trips chosen in all decision situations

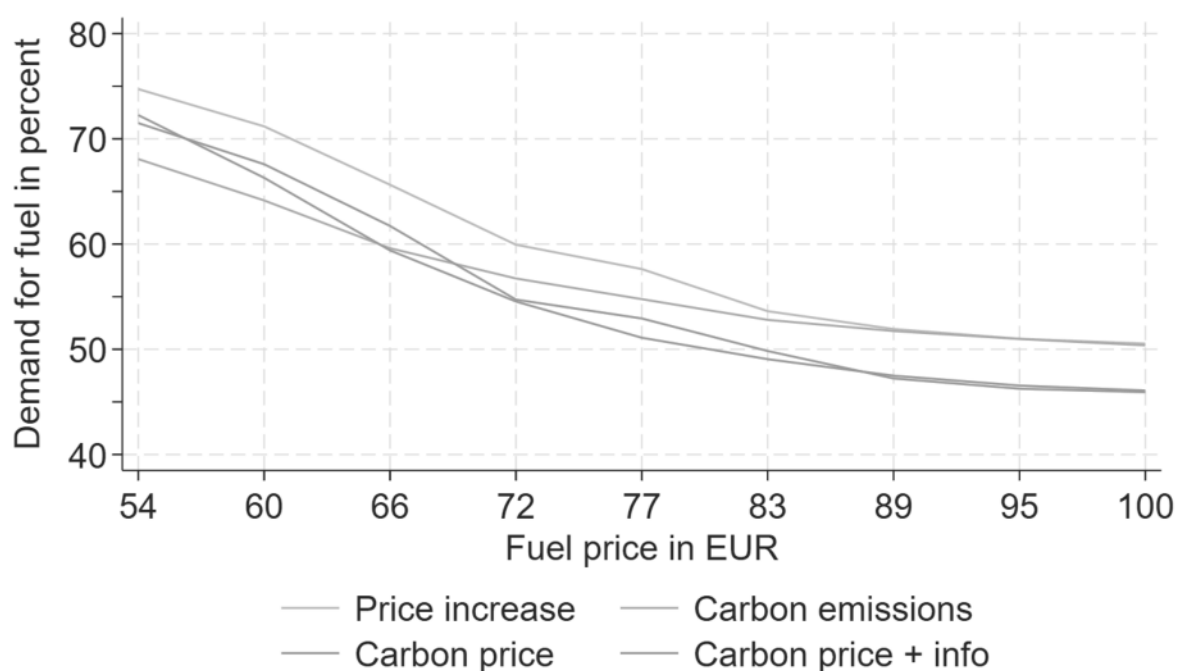


Plotting the percentage of respondents choosing the car trip instead of the train trip over the 9 choice situations yields decreasing demand curves for all four groups (Figure 7). In group P, demand for fuel decreased from 75 percent at the lowest fuel price of 54 EUR to 51 percent at the highest fuel price of 100 EUR. That is, as the fuel price increased by 85 percent, demand decreased by 32 percent, which implies a price elasticity of -0.38.

While demand for fuel is lower at all price levels in groups CP and CPI by roughly 5 percentage points, curves move largely in parallel to that of group P. That is, there is no difference in the change in demand neither between group P and groups CP

and CPI, nor between the latter two: in both groups, demand decreases by 36 percent when moving from the lowest to the highest fuel price, implying a price elasticity of -0.42. In contrast, in group E, demand is lower than in all other groups at the lowest price level (50 percent), but respondents react less to the increasing fuel price such that demand decreases by 26 percent only and equals that in group P at the highest price. The implied price elasticity of demand is -0.31.

Figure 7: Demand for fuel at different decision situations



Estimating the differences in the changes in demand between groups using a difference-in-differences regression with fixed effects and including dummy variables for each decision situation in the MPL, confirms these descriptive results (Figures 8, B.3): In general, the demand for fuel significantly decreases with increasing fuel prices in the pure price increase group (Figure 8). This reduction in demand decreases with increasing prices. Making the carbon price included in fuel prices salient, does not affect the change in demand.

Conversely, compared to all other groups, respondents who received information on the carbon emissions show a weaker reaction to price increases for high price increases

from 54 to 83 EUR and higher. The salience of carbon emissions shifts the demand curve to the left, i.e., it reduces demand for fuel, and simultaneously flattens it.

Comparing the changes in demand in groups Carbon price and Carbon emissions reveals that the salience of carbon emissions results in lower reactions to almost all price increases (B.3). Providing information on the aims and mechanisms of carbon pricing in addition to a salient carbon price, however, does not change the price elasticity. There is also no difference in the effect of carbon price salience on fuel demand between respondents with high and intrinsic motivation for environmentally and climate friendly behavior (Table B.4).

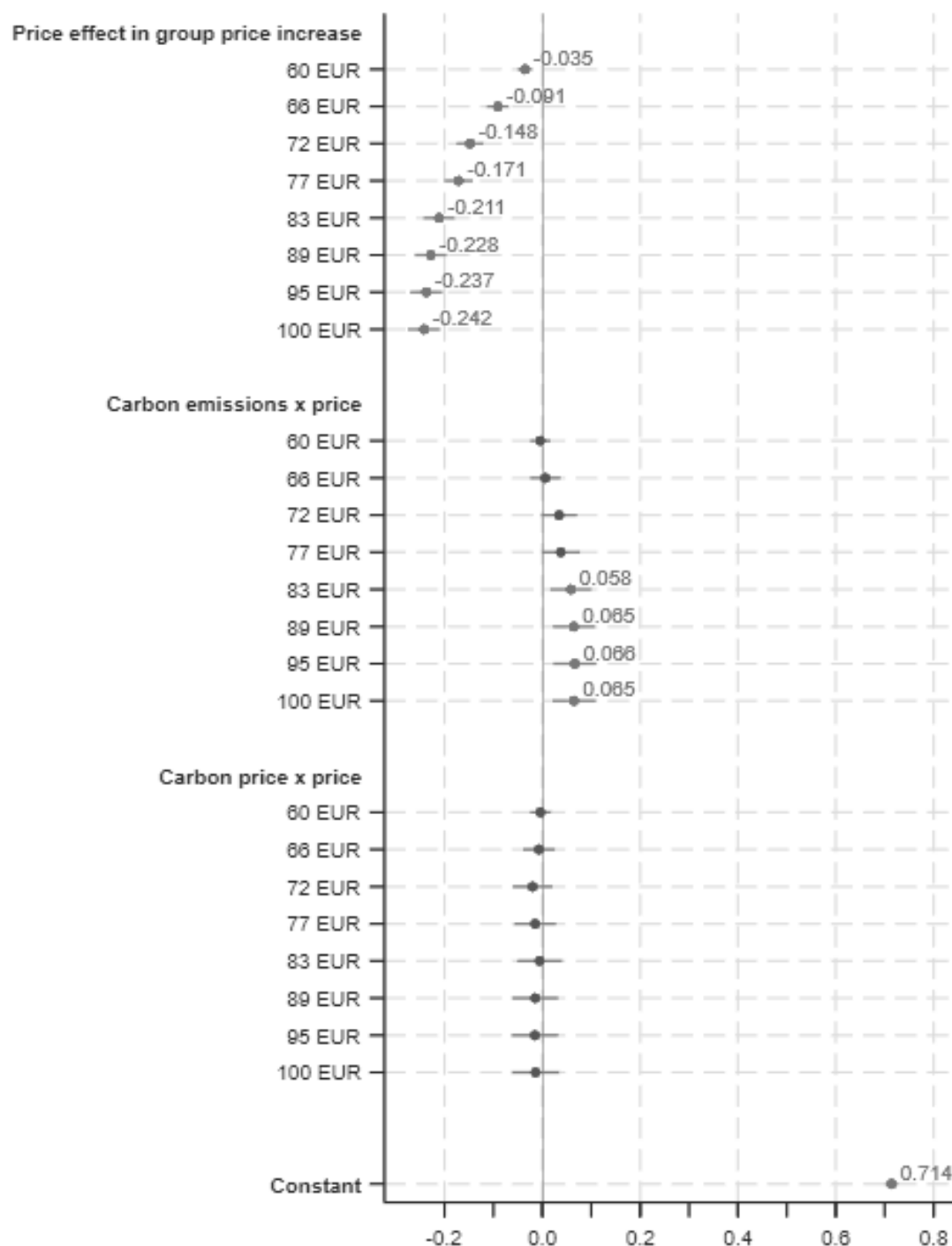
In summary, all three treatments decrease overall demand for fuel compared to the pure price setting, which is in line a decrease in the willingness to pay. In addition, the salience of carbon emissions leads to a weaker demand response to price changes, while there is no such effect for the carbon price salience groups.

Mechanisms

To explore the mechanisms behind the effects of carbon emissions and carbon price salience on demand for fuel, I have a closer look at effect heterogeneity with respect to intrinsic motivation and acceptance of climate mitigation policies that impose costs on citizens. First, with respect to the former, I find that respondents with low and high intrinsic sustainability motivation react less to increasing fuel prices when carbon emissions are salient. This effect tends to be slightly stronger among respondents with high intrinsic motivation. In addition, while there is no effect of carbon price salience (+ information) for respondents with low intrinsic motivation, among those with high intrinsic motivation the reaction to increasing fuel prices tends to be stronger when the carbon price is salient (and they receive additional information on carbon pricing). This suggests that carbon price salience does not crowd out intrinsic motivation but rather signals environmental quality and triggers intrinsic motivation to reduce carbon emissions.

Second, respondents tended to react differently to carbon emissions and carbon price salience depending on whether they reject or accept costly climate policies. While those who reject such policies show a significantly weaker reaction to fuel price increases when carbon emissions are salient, this effect is much weaker and not statistically significant for respondents who accept such policies (Figure B.5). With respect to carbon price salience (+ information) I find that rejecting respondents tend to react weaker to fuel price increases when the carbon price is salient, while this salience tends to lead to a stronger price elasticity among accepting respondents. These results provide suggestive evidence for a defiant reaction of participants who do not support costly climate policies to carbon emissions and carbon price salience. Among those who accept such policies, carbon price salience rather tends to trigger intrinsic motivation to reduce carbon emissions.

Figure 8: The effect of carbon emissions and carbon price salience compared to a pure price increase on the price elasticity of demand for fuel; FE regression



Note: The plot shows point estimates and 95% confidence intervals of a difference-in-differences regression with individual fixed effects of a binary variable for choosing the fuel (yes/no) on the price levels of the MPL, group assignment, and the interaction of these. Standard errors are clustered at the individual level. A red coloring indicates statistical significance at the 5% level, while blue-colored results are not statistically significant at this level. Number of observations: 17,316.

6 Discussion

Using a multiple price list approach with the choice being between a train trip and fuel for a car trip at increasing fuel prices, this study investigates the effects of carbon emissions salience, carbon price salience, and carbon price salience with additional information on carbon pricing on the average willingness to pay and the price elasticity of demand for fuel.

There is no statistically significant evidence that salience of the carbon price included in the fuel price, or a combination of the latter with additional information on the aims, mechanisms, and revenue recycling of carbon pricing affect the average willingness to pay for fuel. However, there is tentative evidence of a negative effect of carbon emissions salience. In addition, carbon emissions salience leads to a significantly weaker reaction of fuel demand to increases in fuel prices. While this result is rather counter-intuitive, it may be driven by respondents with a low willingness to pay for fuel decreasing their demand when carbon emissions are salient, whereas those with a high willingness to pay do not react to a carbon emissions label, or even show a defiant behavior and increase instead of decrease their demand for fuel.

An investigation of the mechanisms underlying the treatment effects reveals heterogeneity in the response to fuel price increases with respect to intrinsic sustainability motivation and acceptance of costly climate mitigation policies. These results imply that carbon emissions and carbon price salience trigger intrinsic motivation to reduce carbon emissions among respondents who tend to have a high motivation for sustainable behavior in general, and among those who are willing to bear costs for climate mitigation measures, while it tends to lead to a defiant reaction among respondents who do not support costly climate mitigation policies. There is no evidence for a crowding-out of intrinsic motivation, nor for a moral licensing effect of carbon price salience.

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Appendices

A Descriptive results

Table A.1: Balance Table

	Total	Price Increase	Carbon Emissions	Carbon Price	Carbon Price + Info	P vs. E (p-value)	P vs. CP (p-value)	E vs. CP (p-value)	CP vs. CPI (p-value)
Male (%)	59.8	62.0	60.2	57.3	59.6	0.513	0.088	0.285	0.409
Age									
under 45 (%)	14.9	14.9	15.6	13.5	15.5	0.749	0.468	0.297	0.316
45-64 (%)	44.7	43.8	46.3	46.1	42.8	0.357	0.405	0.942	0.240
65 and older (%)	40.4	41.3	38.1	40.4	41.7	0.241	0.744	0.408	0.640
A-levels (%)	55.0	53.0	56.9	55.5	54.5	0.157	0.367	0.624	0.725
Net hh income									
under 2700 EUR (%)	26.9	26.6	25.5	28.2	27.3	0.658	0.534	0.291	0.730
2700-4200 EUR (%)	33.5	35.2	34.8	32.4	31.4	0.891	0.314	0.385	0.737
4200 EUR or more (%)	39.6	38.2	39.7	39.4	41.2	0.594	0.684	0.907	0.526
Climate change att									
does not exist (%)	5.3	6.1	4.6	5.1	5.1	0.228	0.455	0.661	0.992
anthropogenic (%)	61.5	60.5	61.4	65.8	58.6	0.755	0.056	0.107	0.009
natural (%)	26.6	25.0	26.5	24.1	30.7	0.549	0.709	0.335	0.010
both (%)	6.7	8.3	7.5	5.0	5.6	0.598	0.018	0.063	0.621
High sust motivation (%)	32.1	33.3	30.4	33.0	32.0	0.284	0.930	0.333	0.710
Accept climate policies									
general policies (%)	77.0	76.6	75.3	79.5	76.8	0.599	0.212	0.077	0.245
costly policies (%)	62.2	61.0	63.4	64.5	59.9	0.431	0.246	0.704	0.123
Environ awareness	3.4	3.5	3.4	3.5	3.4	0.315	0.399	0.070	0.083
Reactance	2.9	2.9	2.9	2.8	2.9	0.722	0.075	0.163	0.379
Number of observations	2562	649	661	614	638	1310	1263	1275	1252

Figure A.1: Distribution of switchers

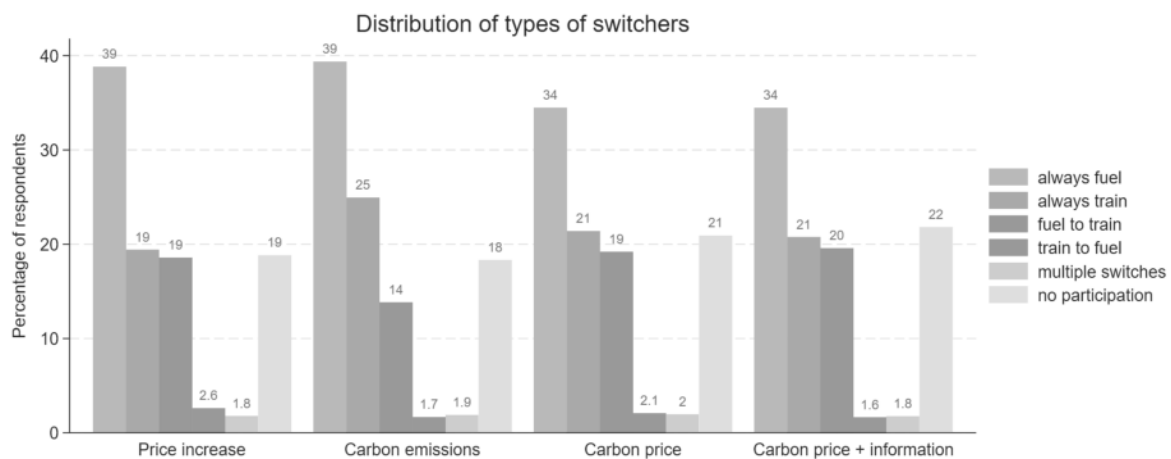


Figure A.2: Distribution of the index for environmentally friendly behavior

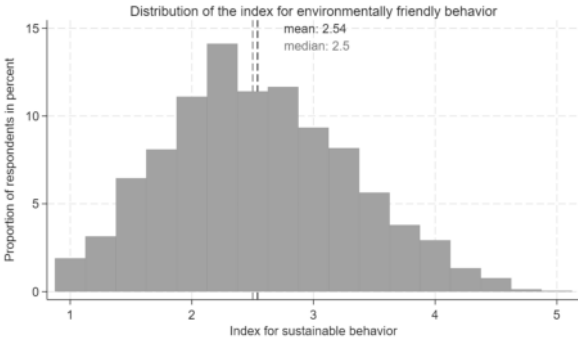


Figure A.3: Distribution of environmentally friendly behavior in different domains

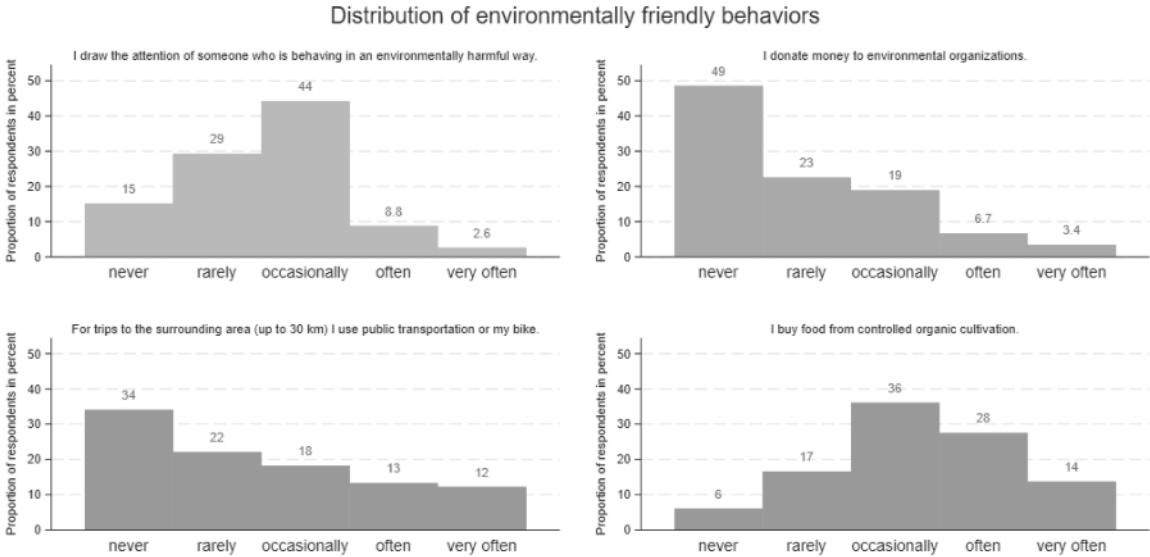
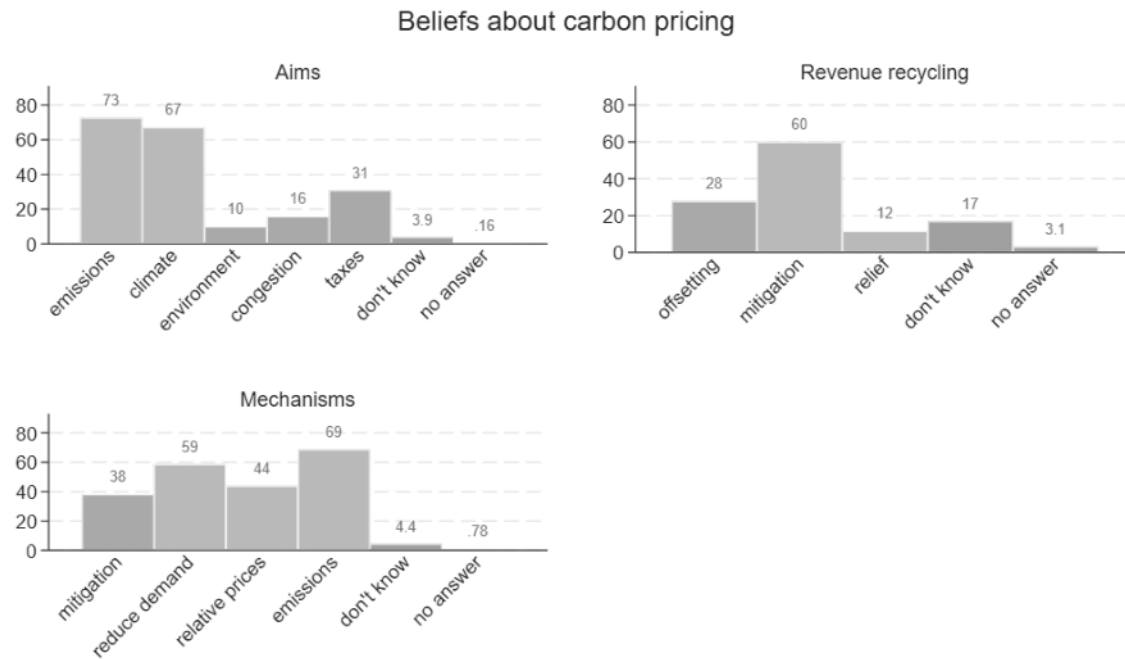


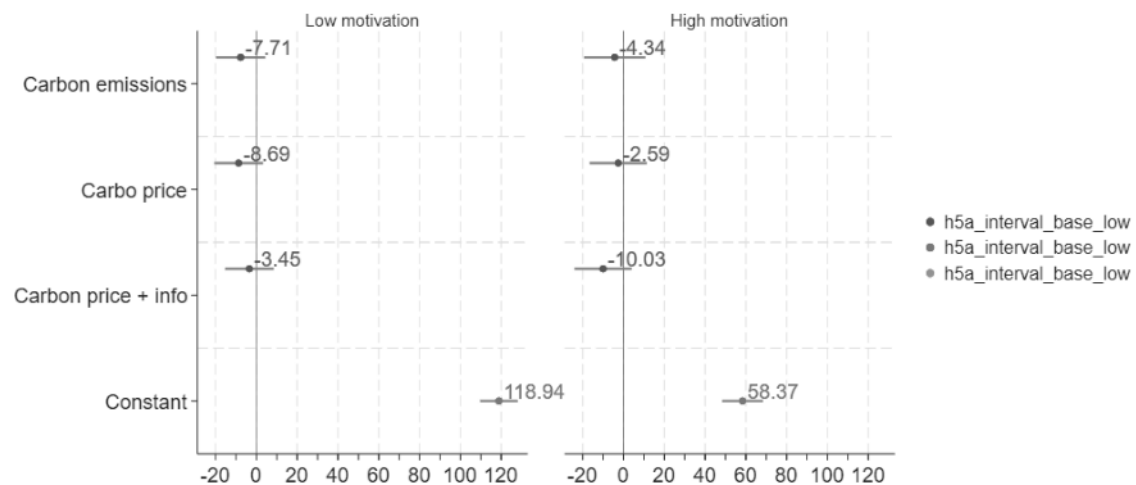
Figure A.4: Beliefs about the effects of carbon pricing



Note: For the wording of the items see questions C4_1 to C4_3 in Appendix C.

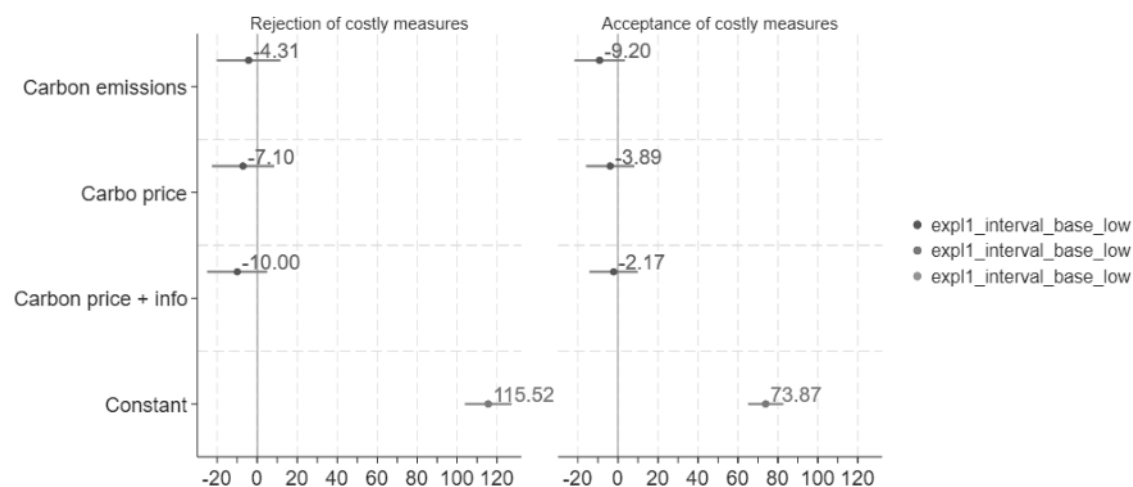
B Regression analyses

Figure B.1: Treatment effects on WTP by intrinsic motivation; interval regression



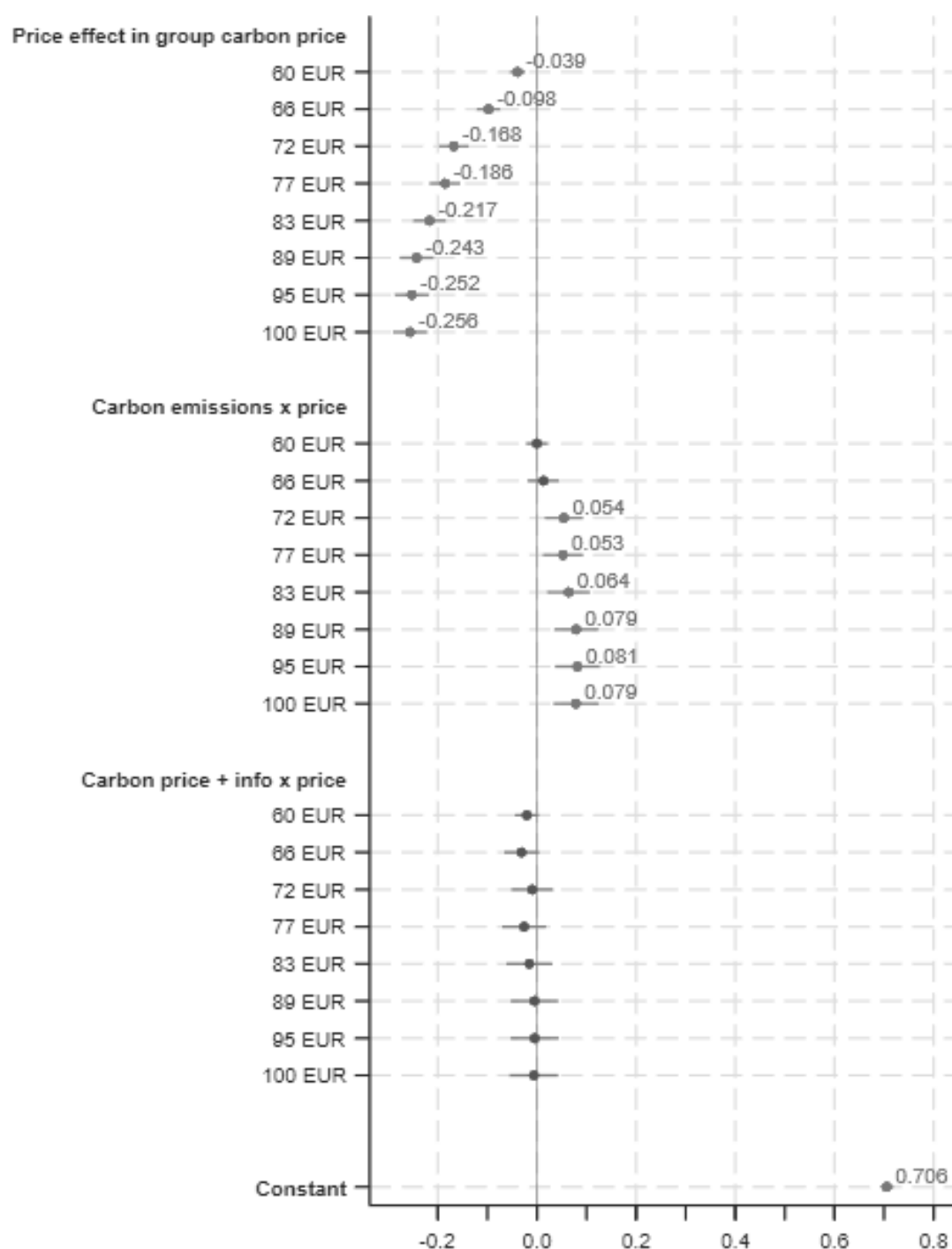
Note: The plot shows point estimates and 95% confidence intervals of an interval regression of the switching intervals on group assignment separately for the groups of individuals with a low and a high intrinsic motivation. A red coloring indicates statistical significance at the 5% level, while blue-colored results are not statistically significant at this level. Number of observations: 1,040; 626.

Figure B.2: Treatment effects on WTP by acceptance of costly climate mitigation measures; interval regression



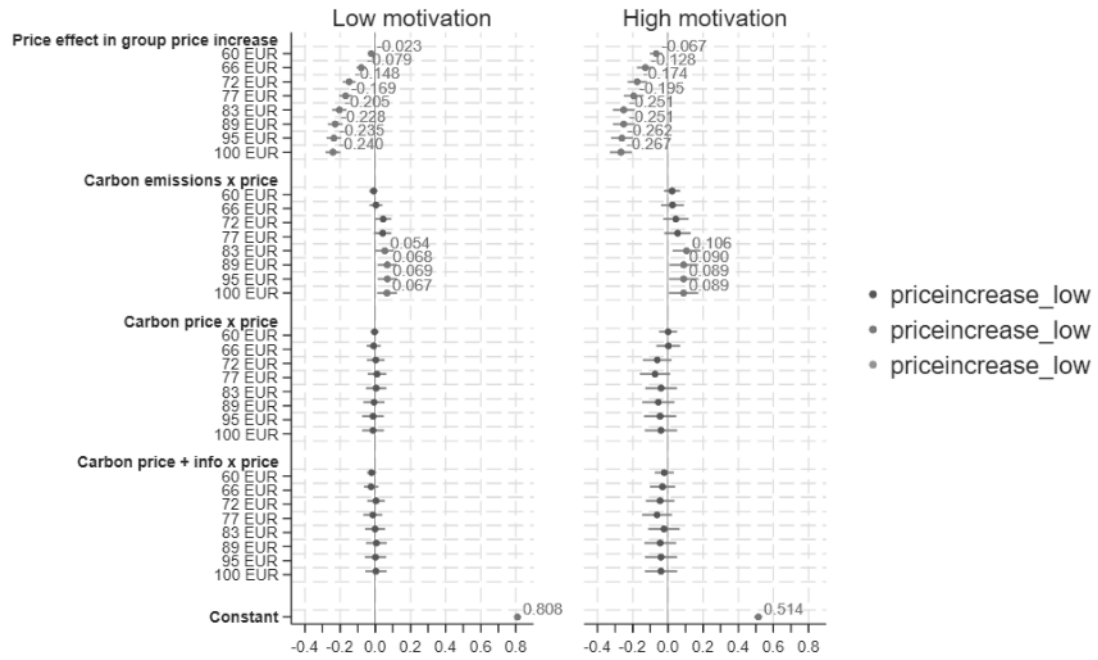
Note: The plot shows point estimates and 95% confidence intervals of an interval regression of the switching intervals on group assignment separately for the groups of individuals reject and accept costly climate mitigation policies. A red coloring indicates statistical significance at the 5% level, while blue-colored results are not statistically significant at this level. Number of observations: 809; 1,331.

Figure B.3: The effect of carbon emissions salience, and additional information on carbon pricing compared to the effect of carbon price salience on the price elasticity of demand for fuel; FE regression



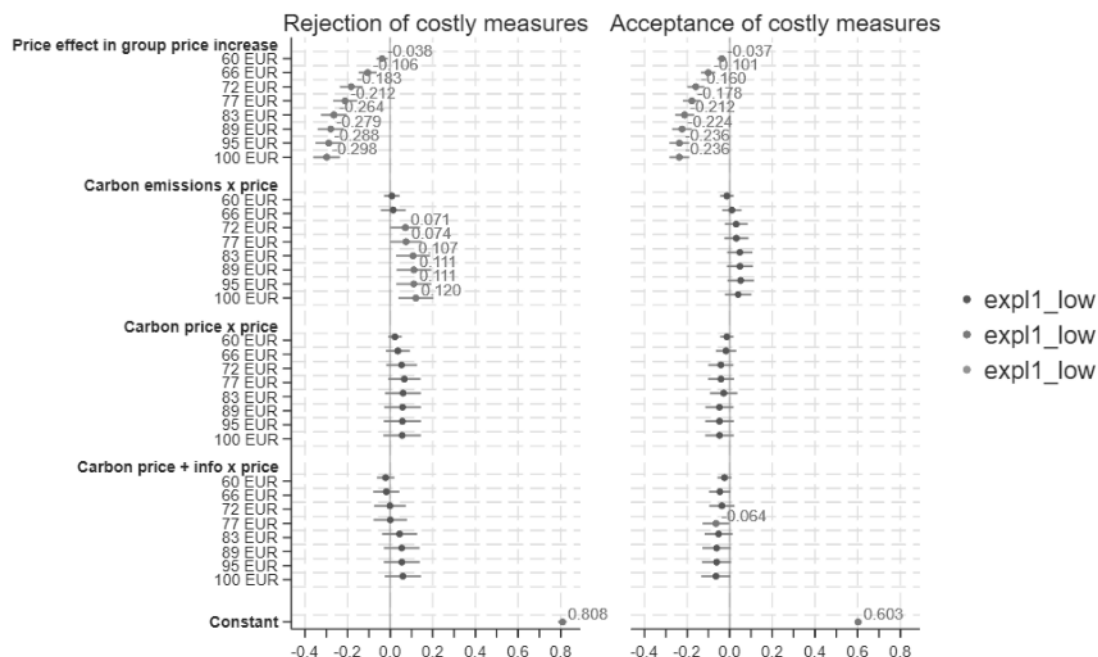
Note: The plot shows point estimates and 95% confidence intervals of a difference-in-differences regression with individual fixed effects of a binary variable for choosing the fuel (yes/no) on the price levels of the MPL, group assignment, and the interaction of these. Standard errors are clustered at the individual level. A red coloring indicates statistical significance at the 5% level, while blue-colored results are not statistically significant at this level. Number of observations: 17,217.

Figure B.4: Treatment effects on WTP by intrinsic motivation; FE regression



Note: The plot shows point estimates and 95% confidence intervals of a difference-in-differences regression with individual fixed effects of a binary variable for choosing the fuel (yes/no) on the price levels of the MPL, group assignment, and the interaction of these, separately for the groups of individuals with low and high intrinsic motivation. Standard errors are clustered at the individual level. A red coloring indicates statistical significance at the 5% level, while blue-colored results are not statistically significant at this level. Number of observations: 14,193; 6,723.

Figure B.5: Treatment effects on WTP by acceptance of costly climate mitigation measures; FE regression



Note: The plot shows point estimates and 95% confidence intervals of a difference-in-differences regression with individual fixed effects of a binary variable for choosing the fuel (yes/no) on the price levels of the MPL, group assignment, and the interaction of these, separately for the groups of individuals reject and accept costly climate mitigation policies. Standard errors are clustered at the individual level. A red coloring indicates statistical significance at the 5% level, while blue-colored results are not statistically significant at this level. Number of observations: 7,281; 11,979.

Table B.1: Group differences in switching types; average marginal effects of multinomial logit model

	Average marginal effects	
	Coeff.	SE
Carbon emissions		
always fuel	-0.002	(0.028)
always train	0.067**	(0.025)
fuel to train	-0.065**	(0.022)
Carbon price		
always fuel	-0.046	(0.028)
always train	0.032	(0.025)
fuel to train	0.014	(0.024)
Carbon price + info		
always fuel	-0.045	(0.028)
always train	0.025	(0.025)
fuel to train	0.020	(0.024)
Observations	2562	

Note: *, ** and *** indicate statistical significance at the 5%, 1% and 0.1% level, respectively.

Table B.2: Group differences in demand for fuel; Pooled OLS regression results

	Coeff.	SE
Carbon emissions	-0.030***	(0.009)
Carbon price	-0.043***	(0.009)
Carbon price + info	-0.048***	(0.009)
Constant	0.596***	(0.006)
Observations	23058	
Wald test: p-value		
E vs. CP	0.000	
E vs. CPI	0.000	
CP vs. CPI	0.000	

Note: *, ** and *** indicate statistical significance at the 5%, 1% and 0.1% level, respectively. Standard errors are clustered at the individual level.

C Questionnaire

C.1 Climate

Question Klima4_1

To what extent do you agree with the statement that political measures should be taken to limit climate change?

- strongly disagree
- tend to disagree
- neither
- tend to agree
- Agree completely
- Don't know
- no answer

[If Klima4_1 does not equal "strongly disagree" or "somewhat disagree"]

Question Klima4_2

Climate protection measures can result in costs for citizens. What is your opinion of such measures?

- I strongly oppose (=1)
- I tend to reject them
- neither
- I am rather in favor
- I am strongly in favor (=5)
- I do not know
- no answer

C.2 Energy

Question CP0

Prices for diesel and petrol are subject to strong fluctuations in some cases. For example, prices have risen sharply as a result of Russia's attack on Ukraine: from an average of EUR 1.52 for a liter of Super E10 in 2021 to EUR 1.86 in 2022. Please use the slider to indicate the percentage by which you estimate that such a price increase would reduce car use by drivers on average.

[Slider from "no reduction in car use (0 %)" to "halving of car use (reduction by 50 %)" to "no car use (reduction by 100 %)", 5 % increments]

- no answer

C.3 Steering Effects and Use of CO2 Price

PROGRAMMING:

Division into four equally sized groups: P, C, PE and CI Group P is further subdivided into P_Info (1/3) and P_Control (2/3) Group C is further subdivided into C_Info (1/3) and C_Control (2/3) Group PE is further subdivided into PE_Info (1/3) and PE_Control (2/3) If group CI: Show questions C3 - C4_2 and corresponding information. Groups P, C and PE: Continue with Multiple Price List.]

Question C3

The CO2 price was introduced in Germany on January 1, 2021. How well informed do you feel about this?

- Not informed at all
- Rather poorly informed
- Neither well nor poorly informed
- Rather well informed
- very well informed
- I do not know

- no answer

In the following, we would like to find out how well informed you are about the CO2 price. Knowing how well informed the population is can help to create transparency and eliminate possible misunderstandings. We would therefore like to ask you to indicate on the following pages which statements you think apply to the CO2 price.

Question C4

In your opinion, which of the following statements apply to the CO2 price? You can select one or more answers. [*Multiple selection; randomize items*]

- The CO2 price makes some activities that emit CO2 more expensive.
- One aim of the CO2 price is to protect the climate.
- One aim of the CO2 price is to solve environmental problems such as the pollution of the oceans by plastic waste or the extinction of species.
- One aim of the CO2 Prize is to reduce traffic jams and improve air quality in cities.
- One aim of the CO2 price is to generate higher tax revenues.
- I do not know
- no answer

The aim of the CO2 price is to protect the climate. To this end, the CO2 price makes products whose production or use emits CO2 more expensive. For example, petrol, diesel and LPG, and therefore driving, become more expensive, while the use of climate-friendly means of transport does not become more expensive.

Question C4_1

In your opinion, which of the following statements apply to the CO2 price? You can select one or more answers. [*Multiple selection; randomize items*]

- The CO2 price offsets the CO2 emissions emitted, i.e. CO2 emissions of the same amount are saved elsewhere.

- The revenue generated by the CO2 price is used to finance climate protection measures.
- The revenue generated by the CO2 price is used to ease the financial burden on consumers.
- I do not know
- no answer

The **revenue** generated by the carbon price is used, among other things, to **relieve the financial burden on citizens**, for example by reducing the price of electricity (abolition of the EEG levy).

They are also used to **finance climate protection measures**, such as the expansion of renewable energies or investments in sustainable transport infrastructure. **There is no direct compensation for CO2 emissions.**

Question C4_2

In your opinion, which of the following statements apply to the CO2 price? You can select one or more answers. [*Multiple selection; randomize items*]

- For the CO2 price to be effective, the revenue must be used for climate protection measures.
- The CO2 price works by making CO2-intensive products more expensive and therefore less purchased.
- The CO2 price makes products that cause low CO2 emissions cheaper than products with high CO2 emissions.
- The CO2 price is intended to ensure that less CO2 is emitted.
- I do not know
- no answer

The CO2 price can have an effect simply by increasing the price of climate-damaging products. It does not matter what the revenue is used for.

The CO₂ price makes climate-friendly activities and products cheaper than climate-damaging alternatives. This is intended to **steer citizens away from climate-damaging behavior and towards climate-friendly behavior**, thereby **reducing CO₂ emissions**. For example, the aim is to encourage people to use climate-friendly means of transportation such as buses, trains and bicycles more often instead of cars.

[From here on all groups again, but new filter:

The following information page and multiple price lists (tables) only if M1 greater or equal to 1 (at least 1 car) and M4 = petrol, diesel, plug-in hybrid or hybrid without external charging option]

[Multiple Price List]

You can take part in a **voucher prize draw** below. You have a **budget of 100 euros** at your disposal. You can use this to **buy a voucher for a car journey or a train journey**. **The remaining budget will be given to you in the form of a voucher of your choice** *[Info button: You will receive a voucher from the provider WUNSCHGUTSCHEIN, which can be redeemed in over 500 partner stores. These include electronics suppliers, clothing brands, drugstores, food delivery services and furniture stores. Further details on the WUNSCHGUTSCHEIN can be found at <https://www.wunschgutschein.de/>]* paid out. We are about to show you a list of different decision situations and would like to ask you to choose either the voucher for a car journey or the voucher for Deutsche Bahn (DB).

A total of 40 winners will be drawn from among all participants, for whom one of the chosen decisions will actually be implemented. If you are drawn, one of the decision situations will be chosen at random and you will receive the voucher you chose in this situation.

Decision options

- (A) If you choose the **train journey (option A)**, you will receive a **voucher for Deutsche Bahn worth 60 euros**. *[Info button: You will receive a voucher for Deutsche Bahn, which you can redeem on the website or in the DB app. The voucher can be used for DB*

tickets for regional and long-distance travel, but not for the DeutschlandTicket or other travelcards]. Your remaining budget corresponds to 40 euros and will be paid out to you in the form of a voucher of your choice.

- (B) If you decide to **travel by car (option B)**, you will always receive a **fuel voucher for around 30 liters of petrol/diesel**. *[Info button: Note: You will receive a fuel voucher for the value that you can use to fill up with 30 liters of petrol or diesel at the time of the prize draw. The voucher can be redeemed at Aral, Esso, JET, Shell and TOTAL ENERGIES filling stations].* Your remaining budget depends on the price of the fuel voucher for 30 liters of petrol/diesel **in the respective decision situation** and will be paid out to you in the form of a voucher of your choice.
















[GROUP “P: PRICE INCREASE”]













In the following table you can see the different decision situations. In each of these situations, you can **choose whether you want to buy a voucher for a car journey or for a train journey from your budget of 100 euros**. The remaining budget will be paid out to you in the form of a voucher of your choice.

The price of the car journey increases with each line, which reduces your remaining budget. The price for the train journey, on the other hand, remains unchanged.

Please choose option A or option B in each situation.

Option A: Train journey - purchase of a voucher for Deutsche Bahn worth 60 euros	Option B: Car journey - purchase of a voucher for 30 liters of petrol/diesel
Situation 1	

<p>You receive:</p>  <p>Residual budget: 40.00 €</p>	<p>You receive:</p>  <p>30 liters of gasoline/diesel</p>  <p>Price: 54.00 €</p> <p>Residual budget: 46.00 €</p>
Situation 2	
<p>You receive:</p>  <p>Residual budget: 40.00 €</p>	<p>You receive:</p>  <p>30 liters of gasoline/diesel</p>  <p>Price: 60.00 €</p> <p>Residual budget: 40.00 €</p>
Situation 3	
<p>You receive:</p>  <p>Residual budget: 40.00 €</p>	<p>You receive:</p>  <p>30 liters of gasoline/diesel</p>  <p>Price: 66.00 €</p> <p>Residual budget: 34.00 €</p>
Situation 4	
<p>You receive:</p>  <p>Residual budget: 40.00 €</p>	<p>You receive:</p>  <p>30 liters of gasoline/diesel</p>  <p>Price: 72.00 €</p> <p>Residual budget: 28.00 €</p>
Situation 5	
<p>You receive:</p>  <p>Residual budget: 40.00 €</p>	<p>You receive:</p>  <p>30 liters of gasoline/diesel</p>  <p>Price: 77.00 €</p> <p>Residual budget: 23.00 €</p>

Situation 6	
<p>You receive:</p>  <p>Residual budget: 40.00 €</p>	<p>You receive:</p>  <p>30 liters of gasoline/diesel</p>  <p>Price: 83.00 €</p> <p>Residual budget: 17.00 €</p>
Situation 7	
<p>You receive:</p>  <p>Residual budget: 40.00 €</p>	<p>You receive:</p>  <p>30 liters of gasoline/diesel</p>  <p>Price: 89.00 €</p> <p>Residual budget: 11.00 €</p>
Situation 8	
<p>You receive:</p>  <p>Residual budget: 40.00 €</p>	<p>You receive:</p>  <p>30 liters of gasoline/diesel</p>  <p>Price: 95.00 €</p> <p>Residual budget: 5.00 €</p>
Situation 9	
<p>You receive:</p>  <p>Residual budget: 40.00 €</p>	<p>You receive:</p>  <p>30 liters of gasoline/diesel</p>  <p>Price: 100.00 €</p> <p>Residual budget: 0.00 €</p>





- I do not want to receive vouchers
- no answer


























[GROUP "C: CARBON PRICE INCREASE" &
"CI: CARBON PRICE INCREASE + INFO"]





In the following table you can see the different decision situations. In each of these situations, you can **choose whether you want to buy a voucher for a car journey or for a train journey from your budget of 100 euros**. The remaining budget will be paid out to you in the form of a voucher of your choice.

The price of the car journey is made up of **the price of petrol/diesel and a CO2 price**, which increases with each line. Your remaining budget therefore decreases with each line. The price for the train journey, on the other hand, remains unchanged.

Please choose option A or option B in each situation.

Option A: Train journey - purchase of a voucher for Deutsche Bahn worth 60 euros	Option B: Car journey - purchase of a voucher for 30 liters of petrol/diesel
Situation 1	
<p>You receive:</p>  <p>Residual budget: 40.00 €</p>	<p>You receive:</p>  <p>30 liters of gasoline/diesel</p> <p>Price: 54.00 €</p> <p>of which 4.00 € CO2 price</p> <p>Residual budget: 46.00 €</p>
Situation 2	
<p>You receive:</p>  <p>Residual budget: 40.00 €</p>	<p>You receive:</p>  <p>30 liters of gasoline/diesel</p> <p>Price: 60.00 €</p> <p>of which 10.00 € CO2 price</p> <p>Residual budget: 40.00 €</p>
Situation 3	

<p>You receive:</p>  <p>60.00 €</p>  <p>Residual budget: 40.00 €</p>	<p>You receive:</p>  <p>30 liters of gasoline/diesel</p>  <p>Price: 66.00 €</p> <p>of which 16.00 € CO2 price</p>  <p>Residual budget: 34.00 €</p>
Situation 4	
<p>You receive:</p>  <p>60.00 €</p>  <p>Residual budget: 40.00 €</p>	<p>You receive:</p>  <p>30 liters of gasoline/diesel</p>  <p>Price: 72.00 €</p> <p>of which 22.00 € CO2 price</p>  <p>Residual budget: 28.00 €</p>
Situation 5	
<p>You receive:</p>  <p>60.00 €</p>  <p>Residual budget: 40.00 €</p>	<p>You receive:</p>  <p>30 liters of gasoline/diesel</p>  <p>Price: 77.00 €</p> <p>of which 27.00 € CO2 price</p>  <p>Residual budget: 23.00 €</p>
Situation 6	
<p>You receive:</p>  <p>60.00 €</p>  <p>Residual budget: 40.00 €</p>	<p>You receive:</p>  <p>30 liters of gasoline/diesel</p>  <p>Price: 83.00 €</p> <p>of which 33.00 € CO2 price</p>  <p>Residual budget: 17.00 €</p>
Situation 7	
<p>You receive:</p>  <p>60.00 €</p>  <p>Residual budget: 40.00 €</p>	<p>You receive:</p>  <p>30 liters of gasoline/diesel</p>  <p>Price: 89.00 €</p> <p>of which 39.00 € CO2 price</p>  <p>Residual budget: 11.00 €</p>

Situation 8	
<p>You receive:</p>  <p>Residual budget: 40.00 €</p>	<p>You receive:</p>  <p>30 liters of gasoline/diesel</p> <p>Price: 95.00 €</p> <p>of which 45.00 € CO2 price</p> <p>Residual budget: 5.00 €</p>
Situation 9	
<p>You receive:</p>  <p>Residual budget: 40.00 €</p>	<p>You receive:</p>  <p>30 liters of gasoline/diesel</p> <p>Price: 100.00 €</p> <p>of which 50.00 € CO2 price</p> <p>Residual budget: 0.00 €</p>
















- I do not want to receive vouchers
- no answer






[GROUP "PE: PRICE INCREASE + EMISSIONS"]

In the following table you can see the different decision situations. In each of these situations, you can **choose whether you want to buy a voucher for a car journey or for a train journey from your budget of 100 euros**. The remaining budget will be paid out to you in the form of a voucher of your choice.






The price of the car journey increases with each line, which reduces your remaining budget. The price of the train journey, on the other hand, remains unchanged. If you opt for the **car journey**, you will emit **around 75 kg of CO₂**, whereas the train journey produces almost no CO₂ emissions [Info button: The emissions refer to a journey on Deutsche Bahn's long-distance services. This is powered by 100% green electricity and therefore causes virtually no CO₂ emissions (key figures, ratings and reports (deutschebahn.com))].

Please choose option A or option B in each situation.






Option A: Train journey - purchase of a voucher for Deutsche Bahn worth 60 euros	Option B: Car journey - purchase of a voucher for 30 liters of petrol/diesel
Situation 1	
<p>You receive:</p>  <p>0 kg CO₂</p>  <p>Residual budget: 40.00 €</p>	<p>You receive:</p>  <p>30 liters of gasoline/diesel</p>  <p>Price: 54.00 €</p> <p>75 kg CO₂</p>  <p>Residual budget: 46.00 €</p>
Situation 2	
<p>You receive:</p>  <p>0 kg CO₂</p>  <p>Residual budget: 40.00 €</p>	<p>You receive:</p>  <p>30 liters of gasoline/diesel</p>  <p>Price: 60.00 €</p> <p>75 kg CO₂</p>  <p>Residual budget: 40.00 €</p>
Situation 3	
<p>You receive:</p>  <p>0 kg CO₂</p>  <p>Residual budget: 40.00 €</p>	<p>You receive:</p>  <p>30 liters of gasoline/diesel</p>  <p>Price: 66.00 €</p> <p>75 kg CO₂</p>  <p>Residual budget: 34.00 €</p>
Situation 4	

<p>You receive:</p>  <p>0 kg CO₂</p>  <p>Residual budget: 40.00 €</p>	<p>You receive:</p>  <p>30 liters of gasoline/diesel</p>  <p>Price: 72.00 €</p> <p>75 kg CO₂</p>  <p>Residual budget: 28.00 €</p>
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Situation 5

<p>You receive:</p>  <p>0 kg CO₂</p>  <p>Residual budget: 40.00 €</p>	<p>You receive:</p>  <p>30 liters of gasoline/diesel</p>  <p>Price: 77.00 €</p> <p>75 kg CO₂</p>  <p>Residual budget: 23.00 €</p>
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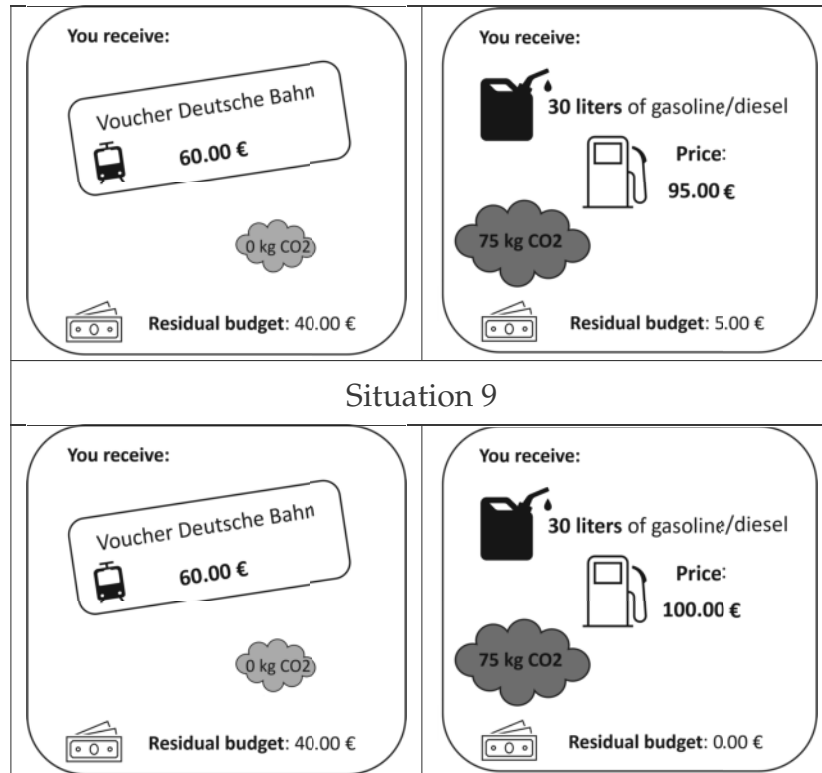
Situation 6

<p>You receive:</p>  <p>0 kg CO₂</p>  <p>Residual budget: 40.00 €</p>	<p>You receive:</p>  <p>30 liters of gasoline/diesel</p>  <p>Price: 83.00 €</p> <p>75 kg CO₂</p>  <p>Residual budget: 17.00 €</p>
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Situation 7

<p>You receive:</p>  <p>0 kg CO₂</p>  <p>Residual budget: 40.00 €</p>	<p>You receive:</p>  <p>30 liters of gasoline/diesel</p>  <p>Price: 89.00 €</p> <p>75 kg CO₂</p>  <p>Residual budget: 11.00 €</p>
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Situation 8



- I do not want to receive vouchers
- no answer

[From here on, all independent of M1 and M4, filtering according to the programming instructions]

Groups P_Info, C_Info, PE_Info receive the questions and information from C3 to C4_2 that group CI has already received.

Groups P_Control, C_Control, PE_Control should only receive question C3 and then continue with C2.

For groups C_Control and C_Info, the question text of C3 should be rearranged as follows if M1 greater or equal to 1 (at least 1 car) and M4 = petrol, diesel, plug-in hybrid or hybrid without external charging option: "The CO₂ price was introduced in Germany on January 1, 2021. How well informed do you feel about this?"

Group CI continues directly with question C2.]

Question C4_Akzeptanz

What is your opinion of the German CO₂ price?

- I strongly oppose (=1)
- I tend to oppose it
- neither nor
- I am rather in favor
- I am strongly in favor (=5)
- I do not know
- no answer