Supporting Document for the AEA RCT Pre-Registration AEARCTR-0009305, "A large-scale population survey experiment on preferences, beliefs, and motivated reasoning regarding climate policy instruments"

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Motivation

There is empirical evidence in the economics, political science, social psychology, and neuroscience literature that humans tend towards motivated reasoning (Douenne and Fabre, 2022; Eil and Rao, 2011; Gershman, 2019; Kraft et al., 2015; Kuzmanovic et al., 2018; Yao et al., 2021). This implies that they discount new information—or scientific evidence—that runs counter to their prior beliefs and attitudes. This experiment aims at providing causal evidence for the existence and the extent of motivated reasoning in the context of climate action. Specifically, two questions are addressed:

1. How do beliefs on effectiveness of climate policy instruments affect individual preferences?

2. Is there evidence for motivated reasoning?

Choice Task

The study is informed by prior evidence of no indication for motivated reasoning in real but abstract mitigation choices of reducing the number of allowances in the EU Emissions Trading System (ETS) (Jarke-Neuert et al., 2022). Specifically, those subjects that agreed most with the statement that urgent climate action is needed where most willing to switch from the "mitigate now" to the "mitigate later" option after the latter was stated to be more effective in reducing emissions (ibid.).

In this experiment, we compare the same abstract mitigation option, i.e. the reduction of the cap in the EU ETS, with a concrete and intuitive option, i.e.

the reductions of emissions from a coal-fired power plant in Germany, and with a linear combination of the two. The conjecture is that motivated reasoning is more likely for options people are emotionally attached to, or that are part of their identity (Akerlof and Kranton, 2000). Such emotional links are more likely to exist for the coal phase-out than for the EU ETS. There has been substantially more public debate and protests around phasing-out coal (hard coal and lignite) in Germany than about the EU ETS (Liersch and Stegmaier, 2022; Machin, 2019; Markard et al., 2021), albeit both targeting coal-fired power stations in Germany.

The participants in our experiment are free to choose between the following four options:

- A: Reducing the number of allowances in the EU ETS by 10 tons of CO2.
- B: Reducing the emissions from a coal-fired power plant in Germany by 10 tons.
- C: Mixed option with 5 tons each via A and B .
- D: No climate action.

Ten tons of CO2 are roughly equivalent to the carbon footprint of an average German citizen. Participants are informed that decisions are real in that the choices of randomly selected participants will be implemented with the help of the operator of a coal-fired power plant and an NGO that retires EU ETS allowances. Furthermore, we elicit participants' beliefs about the effectiveness of all options in reducing total GHG emission in the EU.

Experimental Conditions

Each subject makes two sequential choices between alternatives A, B, C and D, whereas the informational condition is manipulated within-subjects between first decision ($d = 1$) and the second decision ($d = 2$). The details of this manipulation are changed across four between-subjects conditions.

In the baseline condition BSL (code $z = 0$), subjects choose in $d = 1$ between alternatives A, B, C and D without further information on the true effect of each alternative on total CO2 emissions given, whereas information on the true effect of each alternative on total CO2 emissions *under the current rules* of the EU ETS are given in $d = 2$. In the Regulatory Uncertainty condition RU (code $z = 3$), information on the true effect of each alternative on total CO2 emissions under the current rules of the EU ETS are given in $d = 1$, and information on the true effect of each alternative on total CO2 emissions *under the proposed reform rules* of the EU ETS are given in $d = 2$.

The remaining two conditions are identical to BSL ($z = 0$) except a different framing of the decisions, implemented by an additional sentence in the instructions, respectively. In the Environmental Impact Frame condition FREI (code $z = 1$) the sentence stresses that the EU ETS is an instrument restricting

markets (as opposed to calling it a "market-based" instrument) and provides the government a strong control on total emissions. In the Name and Shame Frame condition FRNS (code $z = 2$) the sentence emphasizes the importance of coal combustion for CO2 emissions and states how emissions from coal-fired power plants have increased in 2021.

The target sample sizes are 600 subjects in BSL ($z = 0$), and 400 subjects in FREI (code $z = 1$), FRNS (code $z = 2$) and RU (code $z = 3$), respectively.

Hypotheses

Main hypotheses

Provision of information on the effectiveness of mitigation options induces participants to adjust their choices in the second decision in line with the information received. Denoting a random individual's choice of alternative $X \in \{A, B, C\}$ in decision $d \in \{1, 2\}$ and experimental condition $z \in \{0, 1, 2, 3\}$ by X_d^z, and the probability of an event Y by $\Pr(Y)$, it is expected that

Hypothesis 1 $\frac{\Pr\left(B_2^0\right)}{\Pr\left(A_2^0+B_2^0+C_2^0\right)} < \frac{\Pr\left(B_1^0\right)}{\Pr\left(A_1^0+B_1^0+C_1^0\right)}$ *and* $\frac{\Pr\left(A_2^0\right)}{\Pr\left(A_2^0+B_2^0+C_2^0\right)} > \frac{\Pr\left(A_1^0\right)}{\Pr\left(A_1^0+B_1^0+C_1^0\right)}$.

In case roughly the same number of participants chooses D in both decisions and there is no relevant drop out between the two decisions, hypothesis 1 simplifies to $\Pr\left(B_2^0\right) < \Pr\left(B_1^0\right)$ and $\Pr\left(A_2^0\right) > \Pr\left(A_1^0\right)$.

To test for motivated reasoning, both heterogeneous treatment effects within BSL ($z = 0$) as well as exogenous variation of salience of policy instruments are considered. Within BSL ($z = 0$), those participants that state to have participated in protests relating to phasing-out coal or extracting coal (prior to making any decision on mitigation options)—denoted by binary indicator $x = 1$ vs. $x = 0$—are expected to respond less to information on the relative ineffectiveness of directly reducing emissions by coal-fired power plants:

Hypothesis 2 $\Pr\left(B_2^0 \mid B_1^0, x = 1\right) > \Pr\left(B_2^0 \mid B_1^0, x = 0\right)$ *and* $\Pr\left(C_2^0 \mid C_1^0, x = 1\right) > \Pr\left(C_2^0 \mid C_1^0, x = 0\right)$.

In treatment FRNS ($z = 2$), provision of information on climate effectiveness is less likely than in BSL ($z = 0$) to induce participants to adjust choices in line with the information provided. Specifically, providing information induces a smaller reduction in FRNS ($z = 2$) than in BSL ($z = 0$) in the probability that the least effective option (B) is chosen relative to all mitigation options (A, B, C). If the frequency of choosing any mitigation option remains approximately constant across first and second choices in BSL ($z = 0$) and FRNS ($z = 2$), this is formally

$$\frac{\Pr\left(B_2^2\right)}{\Pr\left(B_1^2\right)} > \frac{\Pr\left(B_2^0\right)}{\Pr\left(B_1^0\right)}$$

The general version that corrects for changes in the probabilities of choosing any mitigation option is

Hypothesis 3 $\frac{\Pr\left(B_2^2\right)}{\Pr\left(B_1^2\right)} \cdot \frac{\Pr\left(A_1^2+B_1^2+C_1^2\right)}{\Pr\left(A_2^2+B_2^2+C_2^2\right)} > \frac{\Pr\left(B_2^0\right)}{\Pr\left(B_1^0\right)} \cdot \frac{\Pr\left(A_1^0+B_1^0+C_1^0\right)}{\Pr\left(A_2^0+B_2^0+C_2^0\right)}$.

Auxiliary hypotheses

To check whether the channel of transmission runs via participants' beliefs on instruments effectiveness in reducing GHG emissions and other relevant impacts, the following auxiliary hypotheses are tested. Beliefs about the effects of an environmental policy have been found to be crucial determinants of voter support (Drews and van den Bergh, 2016; Millner and Ollivier, 2016; Rinscheid and Wüstenhagen, 2018).

Hypothesis 4 *Ordinal rankings of first-order beliefs about climate effectiveness and co-benefits contribute to explaining first choice in BSL ($z = 0$), FREI ($z = 1$) and FRNS ($z = 2$).*

Hypothesis 5 *In condition FREI ($z = 1$), Retire and (Retire; Coal + Retire) are chosen more frequently in the first choice compared to BSL ($z = 0$).*

Hypothesis 6 *In condition FRNS ($z = 2$), Coal and (Coal; Coal + Retire) are chosen more frequently in the first choice compared to BSL ($z = 0$).*

Hypothesis 7 *In condition RU ($z = 3$), providing information that reduces the expected difference in climate effectiveness between options increases the role of expected co-benefits. In RU ($z = 3$), the correlation between the probability that an alternative is chosen and the alternative's rank re. beliefs about co-benefits is stronger in the second than in the first choice.*

Previous research has pointed towards a preference for command-and-control over market-based environmental policies among voters (Kirchgässner and Schneider, 2003; Stadelmann-Steffen, 2011). Without additional information on the climate effectiveness of options, i.e. in the first choice in treatment BSL ($z = 0$), more than two-thirds of those participants that choose any of the climate actions, choose either the concrete option (coal phase-out) or the "safe" option, i.e. a linear combination of all available options. Formally,

Hypothesis 8 $\frac{\Pr\left(B_1^0+C_1^0\right)}{\Pr\left(A_2^0+B_2^0+C_2^0\right)} > \frac{2}{3}$.

For participants from active as well as recently abandoned coal/lignite-mining regions as well as from the primary trading area of STEAG GmbH—denoted by binary indicator $c = 1$ vs. $c = 0$, the relative ineffectiveness of phasing-out coal is less likely to be news that is counter to their prior attitude (Rinscheid and Wüstenhagen, 2019). Hence, participants from these regions exhibit a lower degree of this particular type of motivated reasoning. Participants from active mining regions as well as those living in the primary trading area of STEAG GmbH could receive direct economic benefits from not reducing the output of coal-fired power stations. For recently abandoned mining areas, the effect would in contrast be based on beliefs and attitudes acquired in the past:

Hypothesis 9 $\frac{\Pr\left(B_2^0|B_1^0,x=1,c=1\right)}{\Pr\left(B_2^0|B_1^0,x=1,c=0\right)} > \frac{\Pr\left(B_2^0|B_1^0,x=0,c=1\right)}{\Pr\left(B_2^0|B_1^0,x=0,c=0\right)}$ *and* $\frac{\Pr\left(C_2^0|C_1^0,x=1,c=1\right)}{\Pr\left(C_2^0|C_1^0,x=1,c=0\right)} > \frac{\Pr\left(C_2^0|C_1^0,x=0,c=1\right)}{\Pr\left(C_2^0|C_1^0,x=0,c=0\right)}$.

Hypothesis 10 *The effect of Hypothesis 3 is smaller (closer to zero) for subjects from coal-mining regions ($c = 1$) compared to the other subjects ($c = 0$).*

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