

Who Will Provide Effort to Protect the Climate?

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February 28, 2023

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Current collective agreements seem insufficient to prevent the potentially disastrous consequences of climate change. Many NGOs, activists and policy makers are therefore trying to encourage voluntary efforts of individuals for climate protection. But who will provide voluntary effort to prevent climate change? And what motivates such efforts? In a large representative survey of the German population (N=1659), we study the determinants of individual efforts to prevent climate change. In our online survey experiment, all subjects get the chance to generate donations that directly off-set carbon emissions by taking part in a real-effort task. Our first finding is that the motivation for voluntary effort is strongly related to subjects' social and demographic characteristics: women, university students and voters of green and left-wing parties are more likely to volunteer a high effort. We then study why these social groups may differ in their effort levels: effort is systematically related to subjects' economic preferences (altruism, risk and time preferences, positive reciprocity) as well as their beliefs about climate change and the efforts of others. Last, we use an experimental manipulation of the returns to effort to show that increasing the effectiveness of the task does not increase subjects' effort. This suggests that voluntary efforts for climate protection are not motivated by pure altruism. Instead, our data suggest that voluntary efforts for climate protection are a symbolic act providing warm glow shaped by social norms and identity.

JEL Classification: D64, D83, D91, Q51, Z13

1 Introduction

Climate change is a threat to our prosperity and survival on planet Earth. Countries' commitments up to the 2021 United Nations Climate Change Conference (COP26), however, will very likely fail to prevent a global increase in average temperature causing high environmental, economic, and social risk. Making mitigation of climate change faster and more efficient will strongly reduce damages and adaptation costs, more than offsetting the necessary investments. Changes in how individuals use and adopt new infrastructure and end-use technology can play a large part in reducing emissions, but this requires sociocultural and behavioral changes (IPCC, 2022). Large potential economic damages and catastrophic risk from unmitigated climate change therefore require more understanding of engagement in pro-environmental behavior and related factors. Also relevant for policy makers is the question of who has the most potential to increase efforts and how to make interventions more efficient through targeting.

Current proposals for interventions and policies to address individual behavior may have no effect or even be counter-productive because factors relating to individuals' motivation are misunderstood. Behavioral interventions in research and public policy have become very established. Discussions now include also their legitimacy and unintended side- and long-term effects. At the same time, evidence has accumulated that the efficiency of interventions is highly context dependent, and the same intervention will produce different and even conflicting results at different times and places (Strasheim and Beck, 2019; Congiu and Moscati, 2022). Heterogeneous treatment effects on individual's motivation based on their self-image or social identity (Schubert, 2017; Fanghella et al., 2019) as well as perceived efficiency (Dechezleprêtre et al., 2022) may play a role in determining interventions' effects. For studies that look at the willingness to pay for climate protection, the role of collective action, and that of expectation about others' behavior, see Löschel et al. (2013, 2017); Sturm et al. (2019).

Contributing to the literature on this topic, we evaluate individuals' real efforts when given the option to volunteer for a task that directly offsets harmful emissions in an experimental survey with German participants. For another example of using a real-effort task to measure environmental behavior see Gleue et al. (2022). We explore factors such as norms, beliefs and personal characteristics that may be related to pro-environmental behavior. We also introduce a randomized variation in the size of the environmental impact of the task as well as different self-image frames.

Based on findings in the literature, investigate the following points. The effort individuals provide for preventing climate change is related to:

1. social and demographic factors,
2. beliefs about climate change,
3. descriptive social norms about others' effort,
4. economic preferences,

5. the impact of their task, and
6. the frame provided for their environmental self-image.

We find that social and demographic factors, as well as beliefs and preferences regarding climate change, self-image and social norms about expected behavior of others are strongly related to effort in preventing climate change. Women, university students and voters of green and left-wing parties solved significantly more tasks. Opposing climate change skepticism, seeing oneself as environmentally friendly and expecting more effort from others also predicted higher effort. High risk-tolerance, impatience and a preference for reciprocity on the other hand were associated with less tasks solved. Changing the task reward or re-framing participants' environmental self-image did not significantly influence behavior. Over a third of participants solved the maximum of 40 tasks, so more effects can be measured by increasing this upper-bound in future experiments.

Our paper contributes to understanding of motivations behind real effort to prevent climate change by indicating that effort is strongly rooted in slow-changing demographic factors, norms and beliefs, and not so much influenced by effort impact or framing. This provides evidence that climate effort is more about individuals' own background and preferences and less about purely altruistic concerns about the climate. This result is also important for policy discussions about how to incentivize environmentally-friendly behavior and how to target interventions effectively to increase effort in the broader population.

Our study contributes to the survey literature on environmental behavior, providing new data covering the German population. Studies such as Andre et al. (2022) focus on self-reported self-image and use decisions over financial contributions to fight climate change, to understand the role of norms and knowledge about others' behavior. We add to this with a task including real personal effort and two randomized treatments concerning efficiency and self-image. For an example of a representative survey on self-reported environmental behavior, see Stieß et al. (2022), for another survey with real donations, see Diederich and Goeschl (2014).

The paper is structured as follows. First we introduce our study design, describe our pro-environmental task as well as the experimental treatments and how the survey was conducted in section 2. Then we present our stylized results, how effective the treatments were and how the effect differed for different subgroups, especially with regards to beliefs, in section 3. We show how those results relate to behavioral motives such as pure altruism, warm glow, self-image and social norms in section 4. That leaves section 5 to discuss the implications of our results and conclude.

2 Design and data

To understand what influences the decision to volunteer time or effort to counter climate change it is important to collect data that goes beyond individuals' intention or

willingness to act and reflects actual behavior, as well as factors that are truly external and not confounded by other personal characteristics. We address this by using a task requiring real effort with a direct payoff in terms of donations to combat climate change. Additionally, we randomize treatments varying self-image regarding environmental behavior and the efficiency of the task in terms of donations per task. In order for the results to be significant and representative, we collected a large and diverse sample of the German population. In this section, we explain how the survey, the task and the experimental treatments were set up to satisfy these requirements. Our outline follows that of Andre et al. (2022), who investigate how norms, preferences and values relate to the willingness to fight climate change among US survey participants.

2.1 Survey and treatment

The online survey was conducted in 2021 from August 27th to September 2nd via the services of ResponDi AG, a German company that specializes in market research. Users can sign up to their platform to earn rewards for completing surveys. 1659 valid survey entries were submitted. One third of participants was randomly assigned a block with positive, negative or neutral self-image framing concerning their emissions-causing behavior respectively. Half of participants were randomly assigned a wage of 0.10€ donations per complete task ("high"), the other half was assigned a wage of 0.05€ ("low"). At the median time of 7.5 seconds taken per task in our sample, this corresponds to an hourly wage of 24€ (low) or 48€ (high), exceeding the usual reward for a survey on this platform¹. After the survey, an amount of money was donated to Compensators e.V. to retire carbon certificates, corresponding to the amount raised by the participants. This way every completed task had a direct impact on emissions. In total, survey participants compensated around 51 tons of CO₂, about 30kg on average, earning donations worth approx. 3000€, or about 1.8€ per person.

Table 1: Treatment group distribution

self-image frame	wage 0.05€	wage 0.10€	Σ
positive	271	287	558
control	281	276	557
negative	274	270	544
Σ	826	833	1659

2.2 A task for measuring real effort

What matters for the outcome of mitigating climate change is not only if people value protecting the environment or have the intention of participating in mitigating actions.

¹Payment varies for each survey, but online reports of ResponDi surveys taking 5-20 minutes and earning 0.05-5€ on average correspond to around 12€ per hour.

It is also important if those beliefs and intentions lead to actual behavior. Practical and psychological barriers may prevent people from following through on planned behavior. Additionally, people may view donating personal time and effort differently than donating money. To encourage pro-environmental behavior such as sustainable modes of transportation, people will need to put in effort to change behavior on top of possible financial costs. To avoid these distortions, we introduce a very simple task that requires real time and effort, based on the design by Gill and Prowse (2019).

For this task, participants are offered to adjust a slider until it reaches a number drawn from a random distribution, to earn donations for retiring carbon certificates. They can choose between skipping this task altogether and repeating it up to 40 times, without knowing this limit in advance. The advantages of this task are that it is simple to explain and understand and that there is no advantage of prior knowledge or skill besides basic working experience with a computer. The task varies randomly but the difficulty stays the same. The low complexity implies that the learning speed does not decrease effort by much. In our sample, average time spent per task decreased on average by 0.15 seconds for each additional task, with outliers indicating that people also took breaks between several minutes and up to an hour. Each task also requires only a short amount of time, a median of 7.5 seconds in our sample, so the total amount of solved tasks is a more precise estimate of effort than if tasks were longer.

The drawbacks from having a very simple task are that incentives may not shift behavior by much, or that solving it may even be more engaging than tiring. This could be one of the reasons many respondents (about 38%) solved all 40 tasks. The median respondent solved 25 tasks and took around 3 minutes in total for this task out of 12 minutes for the whole survey. So seeing that the task was easy and not very time consuming, our experiment will help to shed light on why around 1000 or 62% of respondents stopped before reaching the maximum. See Araujo et al. (2016) for another experiment using this task, who find a low effect for purely financial incentives, and Charness et al. (2018) for a review of studies on the appropriateness of stated and real-effort tasks in different experimental settings.

External validity of effort

To correctly interpret the effort in the experiment as an indicator of general effort outside the experiment, we check if a higher effort in the experiment corresponds to more self-reported effort outside the experiment. We find that out of those completing all 40 tasks, a higher share report using green energy (+9%), supporting an environmental NGO (+2%), donating to protect the environment (+10%) and having compensated emissions before (e.g. for air travel, +7%), when compared with those solving 25 or less, the median (compare Table 2). This indicates there is a positive external correspondence to the effort in the experiment.

Table 2: Share of participants reporting external environmentally friendly behavior

	completed 40 tasks	25 or less	difference	p-value
uses green energy	49.2%	39.8%	+9.4%	0.00
eNGO* member	8.8%	7.2%	+1.6%	0.13
donated for the environment	40.6%	30.2%	+10.35%	0.00
compensated emissions before	24.8%	18.1%	+6.7%	0.00

sample median is 25 tasks solved, rounded values, *environmental NGO, p-values for one-sided t-test

Comparison to alternative measures

Using a real-effort task rather than observed or self-reported behavior has several advantages. Since our task is quite simple and short there will not be a large difference between how much completing one of them will cost each participants in terms of effort. Willingness to pay or accept compensation is related to personal wealth and disposable income, which participants may be reluctant to disclose, as well as their general spending habits. A disadvantage is that this task is not comparable to many other efforts outside of the experiment, such as taking the train instead of a car, or researching ways to save energy at home. Many observed variables such as energy use, however, may not be directly related to participants' effort and confounded by other factors, such as the type of their accommodation. The real-effort task also avoids problems that arise when choosing between two products (e.g. cars and trains) which have many other characteristics besides emissions that impact customer choice. Given a comparable opportunity cost of time and effort for participants, completing the task should reveal an isolated interest or a motivation to expend effort to protect the environment, and doing so without the impact of social or other outside factors.

2.3 Experimental treatments

Before participants are asked to solve the task and earn donations to protect the environment, we randomly assign them to receive variants of two different treatments. The first treatment presents them with ten questions about their own behavior related to carbon emissions, such as consumption and travel choices. The answer choices are scaled to evoke a negative, neutral or positive frame for their behavior, implying that they are either at the lower end when it comes to acting sustainably (negative), in the middle (neutral, the control group) or at the higher end (positive).² The second treatment is

²For example, one question asks what share of their grocery shopping has an organic, sustainable-fishing or fair-trade label, which is generally assumed to cause less emissions. These are the answer choices that evoke a negative frame: The share of my consumption that has such a label is (1) less than half, (2) around half, (3) about 3/4ths, (4) about 90% or (5) everything. According to BÖLW (2020), the market share of organic foods was around 5.7%, so the average consumer would have had to chose the lowest option. For the positive frame, the answer choices were: (1) never, (2) around 10%, (3) around 1/4th, (4) around 1/3rd or (5) around or more than half. The average is much closer to the middle option (3) in the positive frame, implying that this is "less extreme" or "more common".

Table 3: Overview of variable units, mean/mode and median. For descriptions and comments see Table 8 in the Appendix. *environmental NGO

	unit	mean/mode	median
<i>—Self-image and norms—</i>			
Environmental self-image (ESI)	scale of 0-10	6.1	6
ESI after manipulation	scale of 0-10	6	6
ESI after survey	scale of 0-10	6.1	6
Guess how many tasks were solved on average			
... by all participants	integer 0-10	22.3	20
... by people with low ESI	integer 0-10	16.6	15
... by people with high ESI	integer 0-10	23.3	23
... people with same ESI as their own	integer 0-10	23.3	23
<i>—Environmental attitudes and behavior—</i>			
Is member of or regular donor to an eNGO*	binary (0-1)	0.08	0
Amount donated for the environment last year	8 options	64.5% chose 0€	
Uses green energy at home	binary (0-1)	0.55	1
Has compensated CO ₂ emissions before	binary (0-1)	0.21	0
Others should act first (reciprocity)	4 options	36.6% chose disagree	
Environmental damage is exaggerated (skepticism)	4 options	41.6% chose strongly disagree	
Future generations should act instead (inaction)	4 options	54.4% chose strongly disagree	
Technology will solve problems (tech-solution)	4 options	36.6% chose strongly disagree	
<i>—Economic preferences—</i>			
Patience	scale of 0-10	5.8	6
Risk tolerance	scale of 0-10	3.9	4
Altruism	scale of 0-10	6.2	8
<i>—Demographics—</i>			
Age	integer	43.3	43
Gender	3 options	53.5% chose female, 0.06% "diverse"	
Relationship status	4 options	47.1% chose single	
Income	8 options	22.9% chose 2001-3000€	
Employment status	10 options	48.2% chose full-time	
Religious affiliation	8 options	25.2% chose protestant	
Well-being	scale of 0-10	6.8	7
Parliamentary vote	6 option	19.4% chose green left	
<i>—Outcomes—</i>			
Tasks solved	integer 0-40	24.4	25
Time for all tasks	seconds	221.7	168.7
Average time per task	seconds	9.8	7.5
Total change in ESI after manipulation	[-10,10]	0.02	0
Total change in ESI after survey	[-10,10]	-0.04	0

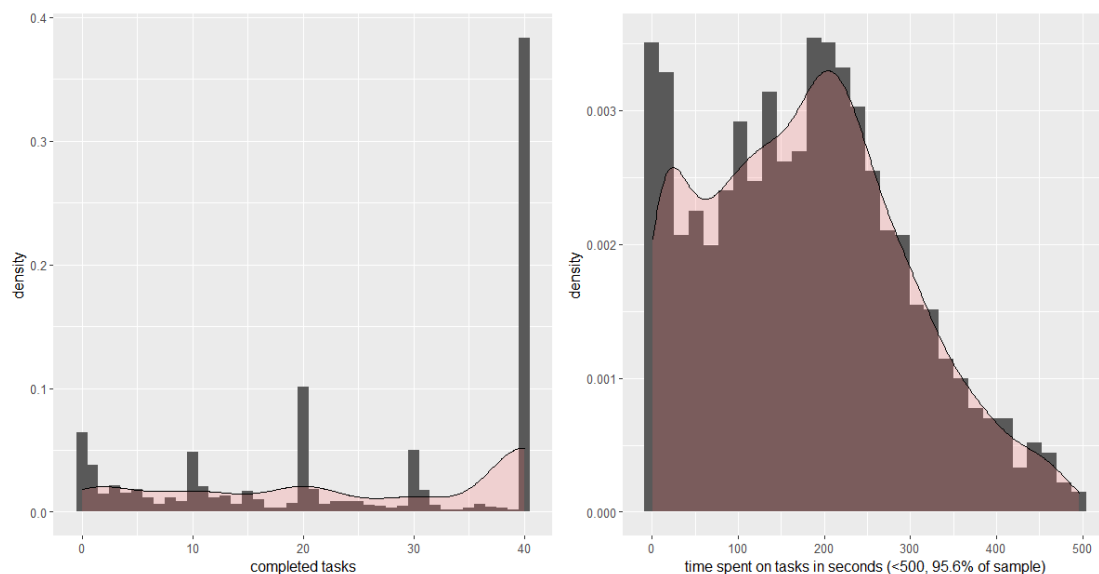


Figure 1: Histogram of completed tasks and time effort

a variation in the amount of money, or "wage", participants could earn with each task. The "low" treatment earns 0.05€ per task, the "high" treatment earns 0.10€ per task, which means they can offset double as much emissions per task.

3 Results: Stylized facts

Surprisingly, many participants did not solve the maximum of 40 tasks, even though the median time taken by those completing 40 tasks was only around 4 minutes. Many completed a round number of 0, 10, 20 or 30 tasks. The preference for round numbers is well-documented in the literature (e.g. Kersten et al. (2018)). The median was 25 tasks, the average was 24.4. Most participants invested between 3-4 minutes in solving tasks (median: 3.11, mean: 3.68). After a total of 5 minutes, the number of participants taking this long or more declines quickly and is most likely driven by participants taking breaks, which can be seen by outliers taking over 30 minutes. There is no clear difference in the distribution of effort (time or tasks solved) over the different treatments for the whole sample. In the following section, we will look at differences in effort and treatment effect for different subgroups.

3.1 Demographic and social factors

When including only demographic and social factors in a linear OLS model, we can observe several stylized facts (compare figures and tables in the Appendix for more de-

From participants' comments at the end of the survey we know that at least some participants noticed and felt influenced by the framing.

tails). Self-reported voters of the far-right or non-voters solve on average fewer tasks, with voters of the green and left parties solving between 6 and 10 tasks more. Employment status only showed a significant difference for university students when compared to people working full-time (+3.6 tasks on average). In line with similar findings for general sustainable behavior (e.g. Stieß et al. (2022)), women show more effort in solving tasks to fight climate change when compared to men (+3 tasks on average). Factors related to income, age, age², number of children, religious affiliation, and relationship status do not show a clear relation to the amount of tasks solved. This leads us to our first result:

Result 1: Social and demographic background is important when explaining pro-environmental effort. In our sample, the median male, non-student, far-right voter solved 30 tasks less than the median female, student green party voter. Gender, employment status and political views are clearly related to effort.

3.2 Climate change beliefs and economic preferences

In this section we show statistical observations relating to participants' self-stated beliefs about climate change and economic preferences. The results for each can be seen in Table 4 with and without social and demographic controls. To better understand participants' beliefs and preferences regarding climate change, we included a block with four questions at the end of the survey. Those questions were: 1. If others don't act for the environment, I won't either. (*Reciprocity*) 2. Environmental harm is usually exaggerated. (*Skepticism*) 3. Future generations should primarily be responsible for environmental problems. (*Inaction*) and 4. Environmental problems will be solved by technological progress anyway. (*Tech-solution*). Answers were recorded on a scale from 1 (strong disagreement) to 4 (strong agreement).

We find that several answers show a connection to how many tasks were solved. As expected, having a preference for positive reciprocity ("I won't act unless others do so as well."), on average reduced tasks solved by 1.9 per step on the 4-point scale. Participants who agreed with the view that environmental harm is usually exaggerated also solved less tasks (-3.5 per step). Answers about future generations' responsibility and technological progress were not clearly related to effort. In another question block at the end of the survey, we asked participants to rate themselves with respect to economic preferences about time, risk and giving for a good cause. Being patient (+0.5 to +0.7 per step on a 10-point scale) and altruistic (+1.4 to +1.7 per point) had positive associations with higher effort. Risk-tolerant respondents were less likely to exhibit higher effort (-0.4 to -0.3). These effects persist when both beliefs and preferences are included, with the exception of risk-tolerance, which is correlated with the belief variables. For details see Table 10 in the Appendix.

Result 2: Our findings show that beliefs about climate change are strongly related to real effort in environmental protection. Especially scepticism about information on

Table 4: Regression results for beliefs concerning climate change and economic preferences. Beliefs are measured on a scale from 1-4, where 4 is most strongly aligned with climate change denialism.

	tasks solved			
(Intercept)	37.03*** (1.00)	36.64*** (6.75)	12.74*** (1.18)	11.29 (6.14)
Reciprocity	-1.90*** (0.47)	-1.67*** (0.48)		
Skepticism	-3.49*** (0.52)	-2.99*** (0.55)		
Inaction	-0.23 (0.59)	-0.25 (0.59)		
Tech-solution	-0.77 (0.56)	-0.69 (0.57)		
Patience			0.50*** (0.15)	0.69*** (0.15)
Risk-tolerance			-0.44** (0.14)	-0.30* (0.15)
Altruism			1.70*** (0.14)	1.39*** (0.15)
Social and demographic controls	no	yes	no	yes
R ²	0.11	0.13	0.10	0.14
Adj. R ²	0.11	0.11	0.10	0.12
Num. obs.	1499	1499	1659	1659

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$, linear OLS, observation at level of individual, standard errors in parentheses.

Social and demographic controls: age, gender, relation, children, income, employment, religion, vote

harm from climate change, and a high preference for reciprocity are tied to less action. Economic preferences for patience, altruism and risk-aversion are connected to higher efforts. Beliefs and preferences both had comparable and relevant effect sizes.

4 Results: Behavioral motives

4.1 Pure altruism

With our randomized wage treatment, we can measure how participants react to an external variation of the effect their action has on the environment. The task is still the same, but for one half of participants, the reward is doubled from 0.05€ to 0.10€ per task, leading to double the amount of emissions offset. If participants are purely motivated by the utility of the outcome they generate by fighting climate change in this way, pure altruism predicts that they adapt their behavior to the impact of their actions. If however, they are motivated by the feeling they receive just by acting to protect the environment (also called warm glow), then their utility does not depend on the outcome, so they will solve their optimal number of tasks regardless of the impact. In this section, we show our results with respect to pure altruism, while in the next, we address the issue of warm glow. For an early discussion of warm glow, see Andreoni (1989).

Table 5 shows the OLS results for the model including the wage treatment with social, demographic controls as well as economic preferences and beliefs. The parameter estimate for the wage treatment is negative, implying that the higher wage was related to a small decrease in tasks solved of roundabout 1, and is only slightly significant for a certain set of controls. Overall this is a strong argument against pure altruism in our setting. These results don't change, when participants at the limit of 40 tasks were excluded.

Result 3: Increasing the reward from 0.05€ to 0.10€ per task was not significantly related to the amount of tasks solved by participants, indicating warm-glow is more likely than pure altruism as a motivation.

This result should be put into perspective, however. Since the share of people completing the maximum number of 40 tasks is very high (around 38%), many might have solved more tasks. While we can conclude that for those below 40 tasks, the wage did not matter much, this need not be true for those that would have kept on after 40.

4.2 Warm glow, self-image and social norms

Under warm glow, participants derive utility from the pro-environmental action itself and are not motivated by the impact of their actions. We use the self-image framing treatment to give participants the feeling their behavior is relatively environmentally friendly (positive), neutral, or harmful (negative). A negative self-image might encourage

Table 5: OLS regression including the wage treatment, social and demographic controls, economic preferences and beliefs concerning climate change

	tasks solved		
(Intercept)	25.01*** (0.52)	14.06 (7.43)	21.24** (7.18)
Wage: 0.1€	-1.24 (0.73)	-1.47* (0.71)	-0.74 (0.68)
Social and dem. controls	no	yes	yes
Econ. prefs and beliefs	no	no	yes
R ²	0.00	0.10	0.21
Adj. R ²	0.00	0.08	0.18
Num. obs.	1659	1659	1659

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$, linear OLS, observation at level of individual, s.e. in parentheses.

Economic preferences and beliefs: patience, risk tolerance, altruism, skepticism, inaction, tech-solution

participants to solve more tasks, to make up for it. Conversely, participants may solve more tasks to confirm a positive self-image.

We ask participants to self-report if they view themselves as an environmentally friendly person on a scale of 0 (not at all) to 10 (very strongly). We ask the same question again after the participants received both treatments and found that the negative self-image framing did not have a strong overall effect, while the positive framing increased reported self-image by 0.23 points on average. Note that for the control group there was an average reduction by -0.16 points in self-image at the end of the survey. This may be due to the fact that by completing the survey the increased awareness of the topic of climate change induces doubt about participants self-image. A small sample (N=196) was asked about their self-image directly after the framing section, yielding the same effect signs. There we observe a larger but not significant effect of the positive treatment (+0.44, compare Table 6).

As shown in Table 6, only the positive framing was associated with a small increase in self-reported self-image, while the negative framing did not show any impact. Looking at Table 11, we do not find an effect of this treatment on tasks solved, implying either that the framing was unsuccessful, or the newly-framed self-image did not have a significant effect on participants behavior. Self-image on its own did show a modest but significant relationship to tasks solved (around +0.9 task per 1 point increase in self-image on a 0-10 scale, see Table 9 in the Appendix). The effect disappears when beliefs about climate change and economic preferences are included. Especially these beliefs are correlated with self-image regarding pro-environmental behavior. A high effort in the experiment was associated with a small but significant positive change in self-image of 0.02 per task.

Table 6: Effect of the response scale variation on self-reported self-image at the end of the survey or earlier (*when asked directly after the first treatment)

	Δ self-image	Δ self-image early*
(Intercept)	-0.69*** (0.10)	0.16 (0.22)
Negative frame	0.12 (0.10)	0.06 (0.30)
Positive frame	0.23* (0.10)	0.44 (0.30)
Tasks solved	0.02*** (0.00)	
R ²	0.04	0.01
Adj. R ²	0.04	0.00
Num. obs.	1659	196

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$, standard errors in parentheses

This could indicate that people indeed felt an increase in self-image from solving the tasks, perhaps leading to a feeling warm glow.

Social norms explain a lot of behavior, even in a non-public setting such as this anonymous experiment. For a review of the effects of social norms on pro-environmental behavior see Farrow et al. (2017). While injunctive norms, about "what should be done", are reflected in participants' beliefs about climate change discussed above, we also asked participants about their views on descriptive norms or, "what others are doing" in this experiment. They were incentivized to answer true to their beliefs with a reward of up to 25€ that was paid to 1% of participants, if they guessed close enough to the real behavior of other participants. To understand if these norms are relative to their own or to a certain level of self-image concerning environmental behavior, they were asked to guess the average number of tasks solved by participants with a low environmental self-image (ESI) (0-6 out of 10), with a high ESI (7-10 out of 10), with the same ESI as the participants themselves, and the average number of tasks solved by all participants.

Table 7 shows that these guesses were very strongly related to the number of tasks solved by the participants themselves. Explanation power of models including norms as measured by adjusted R² is almost double those without them. Guessing a high number for persons with average, high or the same ESI was associated with a 0.3-0.5 increase per additional task guessed, while guessing a high number for persons with low ESI seemed to have a "crowding out" association where participants solved around 0.13 tasks less per additional task guessed. These estimates are significant including social and demographic controls as well as economic preferences and beliefs.

Table 7: OLS regression including descriptive social norms on effort, social and demographic controls, economic preferences and beliefs concerning climate change

	tasks solved		
(Intercept)	3.20*** (0.81)	0.89 (6.14)	8.20 (6.10)
Guess avg. number of tasks solved by ...			
... all	0.28*** (0.04)	0.34*** (0.04)	0.34*** (0.04)
... persons with low ESI	-0.15*** (0.04)	-0.14*** (0.04)	-0.11** (0.04)
... persons with high ESI	0.27*** (0.04)	0.23*** (0.04)	0.20*** (0.04)
... persons with the same ESI	0.48*** (0.04)	0.43*** (0.04)	0.37*** (0.04)
Social and dem. controls	no	yes	yes
Econ. prefs and beliefs	no	no	yes
R ²	0.35	0.39	0.44
Adj. R ²	0.34	0.37	0.41
Num. obs.	1659	1659	1659

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$, linear OLS, observation at level of individual, standard errors in parentheses.

Social and demographic controls: age, gender, relation, children, income, employment, religion, vote

Economic preferences and beliefs: patience, risk tolerance, altruism, skepticism, inaction, tech-solution

Result 4: Expecting others with high, average or the same ESI as oneself to solve many tasks is associated with a significant increase in own tasks solved (+0.3 to +0.5 per task). High guesses for others with low ESI seemed to have a "crowding out" association with less own tasks solved (-0.1 to -0.2 per task).

5 Conclusion

In our paper we measure how much effort people will provide to protect the climate in an incentivized online experiment with a large representative sample of German adults and a real-effort task. We find that individual efforts are strongly related to social and demographic factors, their economic and environmental preferences and what they believe climate change as well as their own and others' pro-environmental behavior. By randomizing two treatments targeting self-image framing and the impact of the pro-environmental task, we look at which factors can influence participants efforts for climate protection.

We find that first, identifying as a woman, being a university student and a voter of green and left parties is each related to an increase in average tasks between +2 and +6. Secondly, believing in the harm of climate change, a propensity for patience, risk-aversion and altruism were also strongly related to a higher number of tasks solved (+4 and +0.5 per step on a scale of 1-4 or 1-10, respectively). Third, doubling the impact of each task or providing different self-image frames did not have a discernible impact. A more positive pro-environmental self-image at the outset of the experiment was strongly connected to more tasks solved (+1 task per one unit of a 0-10 point scale). Descriptive social norms were also strongly related to effort. Participants that guessed a higher number of tasks solved by others, or higher descriptive social norms, also solved more tasks themselves (between 0.11 and 0.48 more per additional task guessed).

This study shows that environmental effort is not easily shifted and strongly related to slow-moving factors such as attitudes towards climate change, social and demographic identity, as well as beliefs about individuals' own and others' pro-environmental behavior. We confirm results found by studies like Andre et al. (2022) with a representative sample from the German population and a real-effort task with real impact. Knowing more about who will provide effort to protect the climate and what motivates these efforts will help designing and targeting interventions and policies to be more efficient and effective to reduce emissions and protect the climate.

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<i>Variable</i>	<i>Comments and description</i>
Environmental self-image (ESI)	self-reported assessment of own sustainable behavior at the beginning
ESI after manipulation	self-image directly after self-image treatment
ESI after survey	env_1 at the end of the survey
Confidence in ESI	self-reported in self-assessment of own sustainable behavior
Guess how many tasks were solved on average	guess average number of tasks solved by all participants
... by people with low ESI	guess average number of tasks solved by people with low assessment of their own sustainable behavior (below 7)
... by people with high ESI	guess average number of tasks solved by people with high assessment of their own sustainable behavior (above 6)
... by people with the same ESI as their own	guess average number of tasks solved by people with the same assessment of their own sustainable behavior as themselves
Is member of or regular donor to an eNGO	1 if they are a member of or have donated to an environmental NGO
Amount donated for the environment last year	amount donated last year to environmental organizations: 0€, less than 25€, 26-50€, 51-100€, 101-150€, 151-200€, 201-250€, above 250€
Uses green energy at home	1 if their household has a green energy contract
Has compensated CO ₂ emissions before	1 if they ever compensated emissions voluntarily, e.g. for airtravel
Reciprocity	asked if they agree that they don't act for the environment unless others do it as well (strongly disagree, disagree, agree, strongly agree, not sure)
Skepticism	asked if they agree that the consequences of climate change are usually exaggerated (strongly disagree, disagree, agree, strongly agree, not sure)
Inaction	asked if they agree that future generations should be the ones to primarily deal with environmental problems (strongly disagree, disagree, agree, strongly agree, not sure)
Tech-solution	asked if they agree that future technology will solve environmental problems anyway (strongly disagree, disagree, agree, strongly agree, not sure)
Patience	self-reported patience
Risk-tolerance	self-reported risk tolerance
Altruism	self-reported willingness to give selflessly
Age	-
Gender	third option was "diverse"
Relationship status	current relationship status, other options were: "divorced", "married" and "widowed"
Income	monthly net disposable income, other options were: "below 500€", "501-1000€", "1001-1500€", "1501-2000€", "2001-3000€", "3001-4000€" and "over 5000€"
Employment status	other choices were: "home maker", "in school", "part-time", "retired", "self-employed", "higher-ed student", "trainee", "unemployed", "other"
Religious affiliation	other choices were: "catholic", "buddhist", "hindu", "judaic", "muslim", "none", "other"
Parliamentary voting intention	choices were parties currently in German parliament: Linke (far left), Grüne (green left), SPD (center-left), FDP (center-right), CDU-CSU (right), AfD (far right).
Well-being	asked how they are currently feeling at the end of the survey
Tasks solved	the number of tasks each participant completed
Time effort spent for all tasks	time participants spent in the task section of the survey
Average time effort per task	average time spent per task
Total change in ESI after manipulation	difference between self-reported self-assessment of sustainable behavior before the survey and after the self-image treatment
Total change in ESI after survey	difference between self-reported self-assessment of sustainable behavior before and after the survey

Table 8: Comments and description of variables

Table 9: OLS Results for demographic factors, not shown: variable children. Reference dummies: for parliamentary vote (far-right), relationship status (divorced), gender (female), employment status (full-time), for details on variable definitions and scaling, see Table 3

	tasks solved	tasks solved
(Intercept)	22.35**	17.82*
	(7.08)	(7.10)
Age: over 63	0.33	0.87
	(2.87)	(2.83)
Age: 41-63	1.07	1.62
	(1.47)	(1.45)
Age: under 22	2.95	2.71
	(2.03)	(2.00)
Age ²	-0.00	-0.00
	(0.00)	(0.00)
Gender: male	-3.23***	-2.49**
	(0.78)	(0.78)
Gender: diverse	17.02	12.84
	(14.84)	(14.63)
Relationship status: married	-1.32	-1.31
	(1.33)	(1.31)
Relationship status: single	0.04	-0.21
	(1.49)	(1.47)
Relationship status: widowed	-4.56	-3.72
	(3.37)	(3.32)
Income: 500 to 1000€	-1.01	-0.97
	(1.72)	(1.70)
Income: 1001 to 1500€	0.79	0.76
	(1.75)	(1.73)
Income: 1501 to 2000€	1.14	1.25
	(1.78)	(1.76)
Income: 2001 to 3000€	0.21	0.04
	(1.74)	(1.73)
Income: 3001 to 4000€	-0.33	-0.52
	(1.98)	(1.97)
Income: 4001 to 5000€	0.35	0.27
	(2.30)	(2.29)
Income: 5001€ or more	-1.48	-1.41
	(2.50)	(2.48)
Employment status: home-maker	3.05	2.85
	(2.08)	(2.06)
Employment status: in	-1.39	-2.72
	(4.43)	(4.38)
Employment status: part time	0.84	0.74
	(1.23)	(1.22)
Employment status: retired	2.31	2.20
	(1.54)	(1.53)
Employment status: self employed	-1.27	-1.91
	(1.84)	(1.82)
Employment status: student	5.27**	3.88*
	(1.71)	(1.70)
Employment status: trainee	-3.49	-3.81
	(3.12)	(3.08)
Employment status: unemployed	0.02	0.07
	(2.35)	(2.32)

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	tasks solved	tasks solved
Religion: catholic	3.47 (6.10)	2.83 (6.02)
Religion: hindu	-0.92 (12.11)	-1.81 (11.95)
Religion: judaic	-0.57 (8.07)	-0.91 (7.96)
Religion: muslim	0.39 (6.76)	-0.40 (6.67)
Religion: none	1.49 (6.08)	0.73 (6.00)
Religion: protestant	2.93 (6.10)	1.77 (6.02)
Vote: right		4.09** (1.58)
Vote: center-right		3.72* (1.71)
Vote: center-left		5.31*** (1.53)
Vote: green left		9.88*** (1.53)
Vote: left		6.91*** (1.83)
Vote: none		2.89 (1.64)
Vote: other		6.80*** (1.78)
R ²	0.05	0.08
Adj. R ²	0.02	0.05
Num. obs.	1659	1659

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$, linear OLS, observation at level of individual, standard errors in parentheses

Table 10: Regression results for both beliefs concerning climate change and economic preferences. Reciprocity, skepticism, inaction and tech-solution measured on 1 (strongly disagree) to 4 (strongly agree), patience, risk-tolerance and altruism measured on a 1-10 scale.

	no controls	with controls
(Intercept)	24.86*** (1.70)	24.89*** (6.72)
Reciprocity	-1.43** (0.46)	-1.20* (0.47)
Skepticism	-2.81*** (0.51)	-2.41*** (0.54)
Inaction	-0.25 (0.57)	-0.25 (0.58)
Tech-solution	-0.60 (0.55)	-0.54 (0.56)
Patience	0.58*** (0.15)	0.72*** (0.15)
Risk-tolerance	-0.08 (0.15)	-0.08 (0.16)
Altruism	1.05*** (0.16)	0.99*** (0.16)
Social and demographic controls	no	yes
R ²	0.18	0.20
Adj. R ²	0.17	0.17
Num. obs.	1659	1659

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$, linear OLS, observation at level of individual, standard errors in parentheses

Social and demographic controls: age, gender, relation, children, income, employment, religion, vote

Table 11: OLS regression including the self-image framing treatment, social and demographic controls, economic preferences and beliefs concerning climate change

	tasks solved	tasks solved	tasks solved
(Intercept)	16.81*** (1.23)	12.99 (7.48)	20.25** (7.23)
ESI treatment: negative	1.07 (0.89)	1.08 (0.88)	1.04 (0.84)
ESI treatment: positive	0.35 (0.88)	0.22 (0.88)	0.51 (0.83)
ESI	1.16*** (0.17)	0.91*** (0.20)	0.09 (0.20)
Social and dem. controls	no	yes	yes
Econ. prefs and beliefs	no	no	yes
R ²	0.03	0.10	0.21
Adj. R ²	0.03	0.07	0.18
Num. obs.	1659	1659	1659

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$, linear OLS, observation at level of individual, standard errors in parentheses.

Social and demographic controls: age, gender, relation, children, income, employment, religion, vote

Economic preferences and beliefs: patience, risk tolerance, altruism, skepticism, inaction, tech-solution

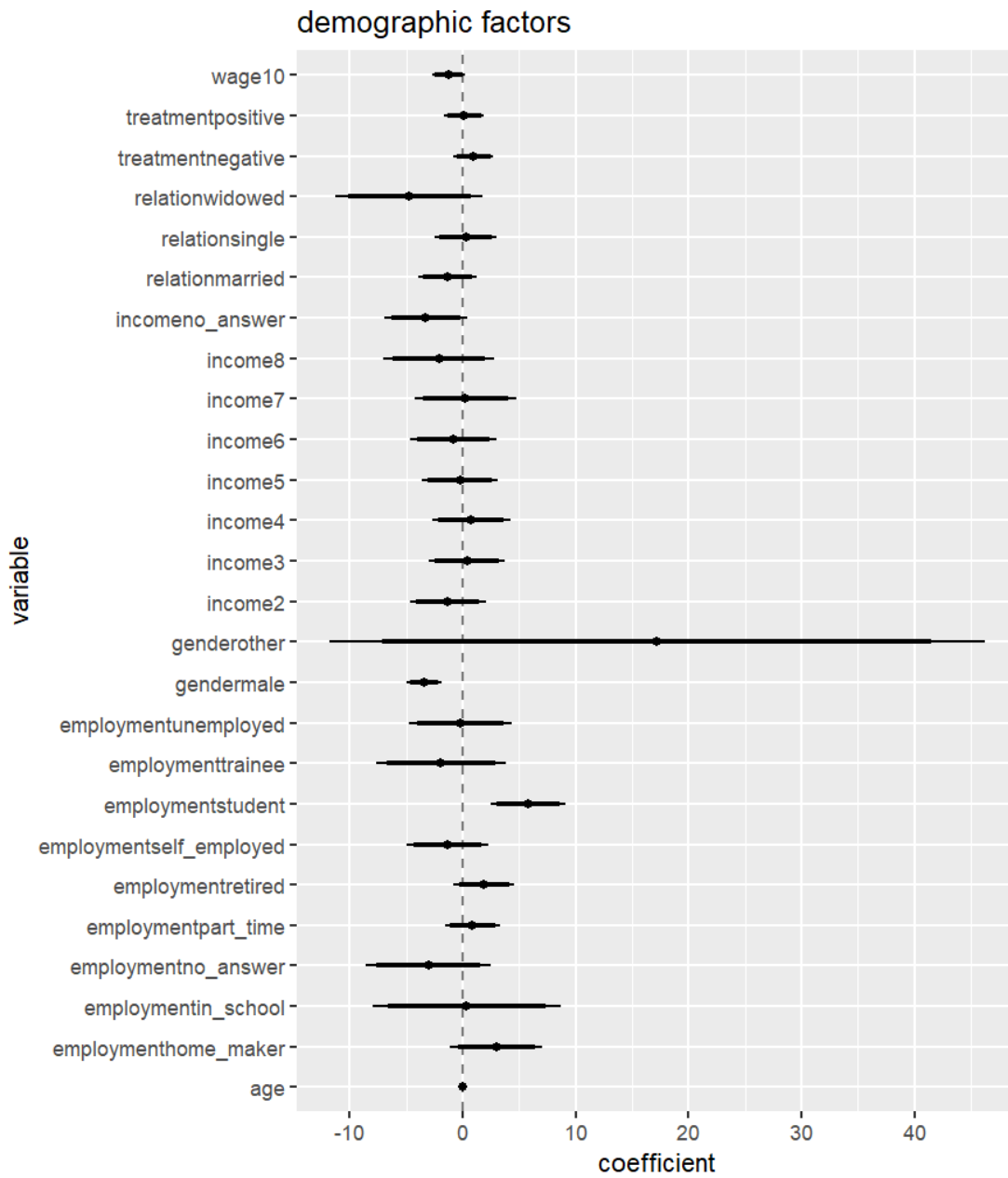


Figure 2: OLS coefficients for demographic variables, regressed on tasks solved .
reference dummies: Relationship status (divorced), gender (female), employment status (full-time), income1 (below 500€). Low significance: Number of children and religious affiliation. Full table in Appendix.

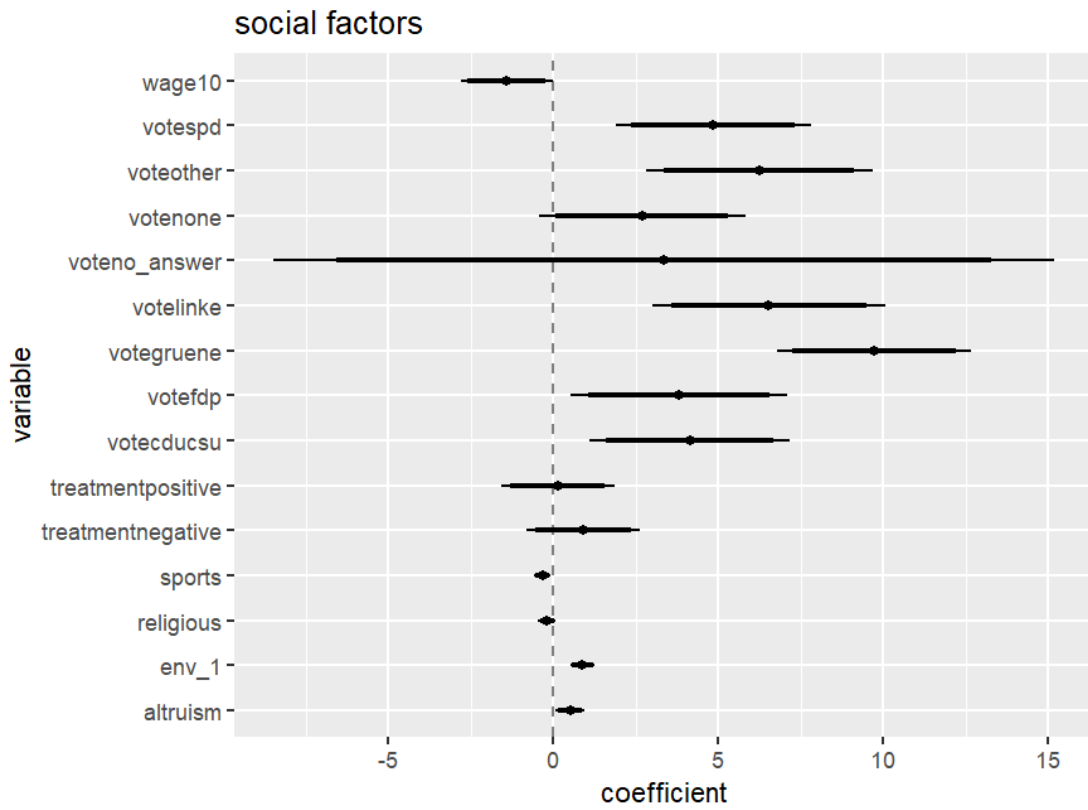


Figure 3: OLS coefficients for social variables, regressed on tasks solved. reference dummies: Wage (low), parliamentary vote (far-right), treatment (control). Identity with respect to sports, religiousness, environmental self-image (env_1) and altruism measured on a 1-10 scale. Low significance: Number of children and religious affiliation. Full table in Appendix.

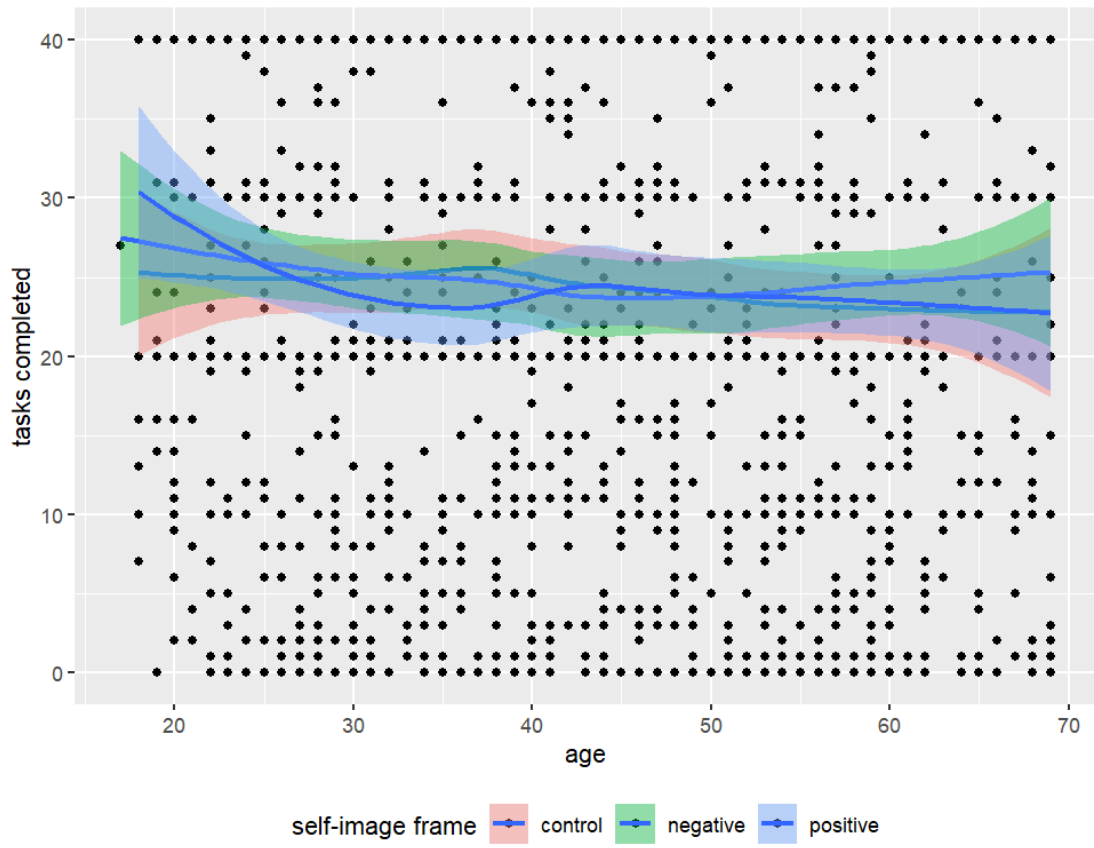


Figure 4: Average tasks completed by age

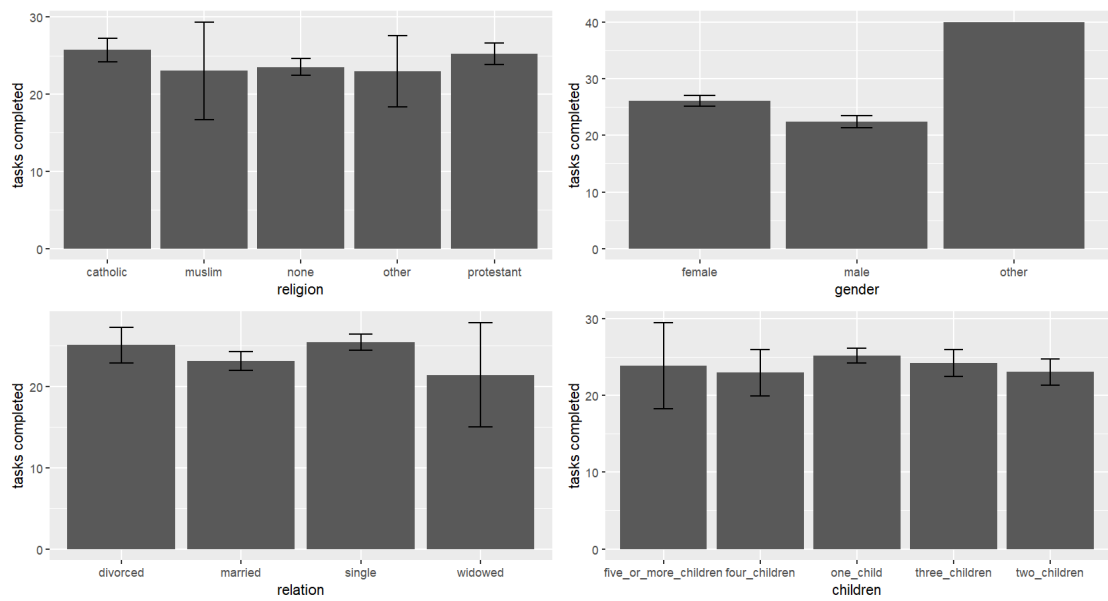


Figure 5: Average tasks completed by gender, number of children, religious affiliation and relationship status

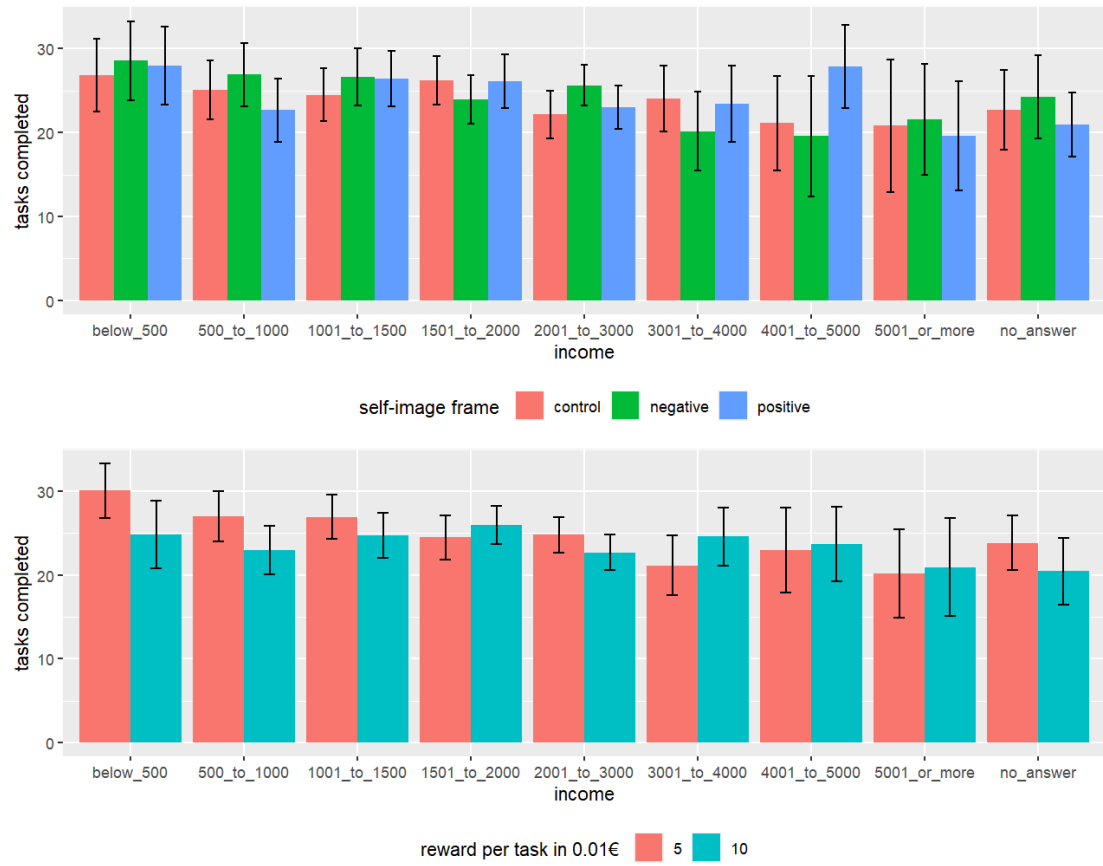


Figure 6: Average tasks completed by income group

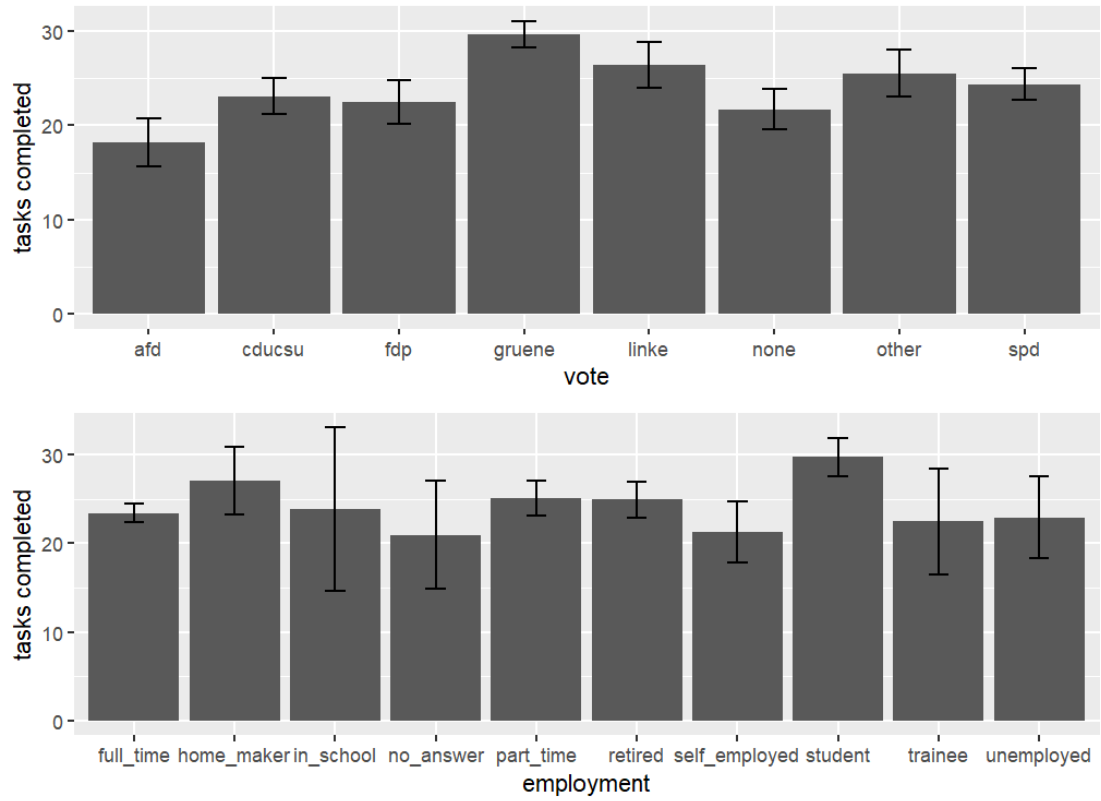


Figure 7: Average tasks completed by parliamentary vote and employment status