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E-mail: ilkhom.soliev@landw.uni-halle.de and isoliev@daad-alumni.de**Keywords:** activism, nudging, framing, benefit sharing, climate action, behaviorSupplementary material for this article is available [online](#)**Abstract**

This study argues that scholars and policy-makers need to understand environmental activists better to bridge the gap between growing activism and policy. Conventional wisdom is that environmental activists generally support stronger climate policies. But there is still little understanding about diversity of views within activist groups when it comes to specific policies, and existing studies indicate that their views are not uniform, which can weaken their impact as a group. Activists might unite to demand change, but not necessarily agree on details of the desired change. Exploring the differences within the group, this paper focuses on how to nudge those who already share favorable attitudes towards policies that mitigate climate change. The motivation has been to see, in presence of general support for stronger environmental policies, whether this support could be channeled into more specific policies. We first take on a methodological challenge to construct an index of environmental predisposition. Then drawing from existing social-behavioral scholarship, we analyze results of an experimental survey with select treatments previously reported as promising. In November and December 2019, we collected responses from 119 participants at the Fridays for Future demonstrations in Germany. The results indicate that there are indeed important differences within the group, and nudging effects exist even in this rather strongly predisposed group, with participants assigned to the experimental group showing higher levels of support for the introduction of a carbon tax that is traditionally seen as a difficult policy to gain widespread public support. We find that those who score neither too high nor too low are more likely to respond to nudging. Yet, the effects vary for general outcomes such as policy support, behavioral intentions, and environmental citizenship. Overall, the findings show the value of understanding the heterogeneity of individual views within environmental movements better and directing interventions in large resource systems such as climate to specific issues and target groups for accelerating transformations towards sustainability.

1. Introduction

Adoption of policies to boost climate action often faces resistance. Even when there is a political will and growing public support it is often difficult to introduce more environmentally stringent policies (e.g. Rinscheid and Wüstenhagen 2019). A significant strand of literature emerged in recent years dedicated to behavioral interventions such as nudging (Sunstein

and Thaler 2003) as an option to generate more socially and environmentally desirable behavior (e.g. Cialdini *et al* 1990, Cialdini 2003). A nudge is generally understood as a change in choice architecture that can predictably alter people's behavior without eliminating or significantly changing any options available to them (Thaler and Sunstein 2009). Nudging can vary from simple framing, for example when information highlights benefits of action or losses

of inaction (Tversky and Kahneman 1981), to creating and emphasizing various social references, for example an energy utility presenting monthly bills showing personal energy use in comparison to the use of neighbors to trigger energy conservation behavior (Allcott 2011). In the climate domain, most of such research is rightly focused on climate sceptics (Bain *et al* 2012, 2016, Lewandowsky *et al* 2013), as facilitating more environmental understanding and support from the broader public is considered one of the key ways to generate an adequate social response to the changing climate (Ostrom 2010, Carattini *et al* 2019a). In contrast, effects from framing in individuals with stronger environmental predispositions remain unexplored, as such individuals are often seen as a homogeneous and already 'converted' group (Landrum and Lull 2017). However, emerging research on heterogeneity of and gaps between attitude and behavior (cognitive dissonance) indicate that the concerns within pro-environmental groups are often not uniform and do not always translate into pro-environmental behavior, hindering their broader impact as a group (McDonald *et al* 2015, Martiskainen *et al* 2020, Schrems and Upham 2020).

As an example of individuals with strong environmental predispositions we investigated members of the Fridays for Future³ international climate movement as new, engaged, activists in support of climate action (e.g. De Moor *et al* 2021, Fisher and Nasrin 2021a, 2021b). Although the movement has considerably expanded both globally and particularly in Germany (Neuber and Gardner 2020) in the last 2–3 years, there is limited research on the Fridays for Future movement. The new generation of environmental activists are not yet very well understood (Fisher *et al* 2019, Von Zabern and Tulloch 2020). Of particular relevance for our research is that the existing studies, although recognize the heterogeneity within the group, largely view the Fridays for Future movement as a group or a phenomenon on its own. For example, Evensen (2019) questions the call of the Fridays for Future to listen to science and appears to discuss the movement rather as a single actor. De Moor *et al* (2021), although analyze the individual composition of the Fridays for Future movement, mainly focus on the movement's particular differences and similarities in relation to the past movements. Fisher and Nasrin (2021a) look into the Fridays for Future as an example of a specific type of an indirect activism that uses strikes and boycotts as a tactic, and in their other study (Fisher and Nasrin 2021b) how the youth-led groups in the US evolved into a coalition led by both youth and adult-led groups. The study by Martiskainen *et al* (2020) is perhaps one of the few exceptions in this regard, as

its explicit aim is to uncover the diversity within the group, yet they too continue to refer to different types of individuals within the group with a more general label of *climate* protesters. Somewhat similarly, Wallis and Loy (2021), analyzing the diverse drivers of activism, show that both collective drivers (such as group identity and peer pressure) and personal norms (values and beliefs) can explain why individuals join demonstrations, however, broadly speaking, they also see the group as *active citizens*. We take a step further and analyze the individuals within the Fridays for Future movement along the broader continuum of environmental predisposition, not only in terms of activism or their participation in strikes, but allowing even non-activist individuals or individuals with mixed views to be a part of the movement. Thus, in addition to our interest in understanding nudging effects, our motivation is to better understand the heterogeneity in this movement, conventionally viewed rather as a homogeneous group with a strong environmental predisposition, and for the first time to demonstrate the potential impact of such heterogeneity on policy support in fine quantitative terms.

Using an experimental survey conducted in Germany in 2019, we studied how demonstration participants responded to nudging elements introduced in the survey in relation to stricter environmental policies, and particularly on the introduction of a carbon tax, traditionally seen as a difficult policy to gain public support (Drews and Van Den Bergh 2015, Hagmann *et al* 2019, Carattini *et al* 2019b). In terms of public support, the reasons for insufficient policy response can be seen from two perspectives: first, the current environmental activists still do not constitute an overwhelming majority strong enough to influence policy as desired; and second, diversity within environmental movements might make it difficult to respond to demands of environmental movements with any single policy. To bridge particularly the latter gap, drawing from social-behavioral scholarship on governance of shared resources (see e.g. Janssen 2015 for an overview), we designed a survey with a combination of treatments previously reported as promising. The purpose is to study how we can understand the diversity of individual views within environmental movements better and whether the general support for stronger environmental policies within these movements could be channeled into support for more specific policies.

2. Theory and research design

The common understanding in the literature on nudging for climate action is that individuals' environmental predisposition—prior environmental awareness and beliefs, political orientation, and existing behavioral patterns—is likely to determine to what extent nudging can succeed (see e.g. review by Clayton *et al* 2015). Conceptually, this raises three

³ See <https://fridaysforfuture.org/> for more information about the movement.

questions for our study: (a) how do we understand environmental predisposition? (b) what do we mean by nudging, particularly by one that triggers environmental concern through social references? and (c) how can we operationalize the impact of nudging using a survey instrument? The following explains and conceptualizes our understanding in relation to these questions.

2.1. Conceptualizing environmental predisposition, nudging, and outcomes

Various understandings of environmental predisposition exist in the literature and correspondingly different methodological instruments are discussed to measure such predisposition by various authors. Some typologies for distinguishing environmental attitudes of individuals include broader concepts such as environmental worldviews (O'Neill 2009, Clapp and Dauvergne 2011) and more direct instruments of environmentally significant behavior (Stern *et al* 1999, Vaske and Donnelly 1999, Stern 2000, Maibach *et al* 2011, Bain *et al* 2012, Metag *et al* 2015, Bernauer and McGrath 2016, Füchslin *et al* 2018). Generally, environmental predisposition can be seen as a long-term pretreatment condition (Druckman and Leeper 2012), when events prior to treatment—new information and reference points—contribute to how respondents react to treatment.

A broadly-applied group of such variables in survey research focuses on identifying the degree of prior exposure to the topic by an individual in terms of knowledge and understanding. This includes awareness about the topic, beliefs about the urgency and seriousness of the problem, perceived scientific consensus (Maibach *et al* 2011, Bain *et al* 2012, Metag *et al* 2015, Bernauer and McGrath 2016, Füchslin *et al* 2018). Political orientation is another factor, which plays an important role in how individuals filter—accept or reject—information (Wiest *et al* 2015, Dharshing *et al* 2017, Landrum and Lull 2017). What has received relatively little attention in survey-based climate research is path dependencies from the existing behavior of individuals that might create constraints for them in showing support for a given climate policy or changing their behavior. For example, behavioral patterns of individuals in terms of traveling by air, driving mileage, and using electricity from renewable energy sources at their residence might be a sign of both preferences and limitations individuals do or do not have, which in turn can make them resist change. We will use a combination of these three groups of variables to operationalize environmental predisposition (figure 1).

Nudging in the context of this study is understood as an information-based treatment designed to alter individual's behavior in a predictable way without diminishing or forbidding any choices available to a respondent (Thaler and Sunstein 2009). Various forms of nudging can be distinguished ranging from

simple framing, where a text describes an otherwise largely equivalent content by emphasizing different attributes of it (for example, reading about risks of not taking action versus benefits of taking action before making a choice) (Tversky and Kahneman 1981), to more other-regarding nudging (Janssen 2015), where the order of various attributes can be reorganized to increase the salience of social references (for example, prompting a comparison with or a consideration of others first before making own choices) (Cialdini *et al* 1990). Here nudging is also assumed to affect cognitive dissonance (McDonald *et al* 2015), that is, individuals providing stronger behavioral intentions in relation to their predisposition as a result of treatment. We will use a set of treatments such as exposure to peer-pressure and authority, as well as what we term as constructive benefit sharing. The former two are implemented by letting the respondents consider (evaluate) others (Schuman and Presser 1981), and read information about overwhelming scientific consensus (Doran and Zimmerman 2009, Lewandowsky *et al* 2013). The latter is operationalized by letting respondents express their preferences on revenue-spending options from collected tax before voting on a tax policy, an exercise expected to encourage constructive thinking (Turner and Krauss 1978) and enable participation in decision making, considered particularly relevant for democratic societies (Cardenas *et al* 2000, Vollan *et al* 2017).

To understand impact, building on the theory of environmentally significant behavior (Stern 2000) and existing survey examples from climate policy research (e.g. Bain *et al* 2012, Bernauer and McGrath 2016), we focus on three groups of potential change in individuals' behavioral intentions. First is individual's willingness to support stricter policies—non-activist but improved environmental behavior in public sphere. Second is individuals' intentions to make own behavioral adjustments—private sphere environmentalism. Third is individual's intentions to influence others more directly—environmental activism. Respondents' intentions to engage in these areas after the treatment will serve as outcome measures in our study. Further, since carbon tax is of specific interest in this research, we treat respondents' voting intentions on a carbon tax policy as an additional single outcome measure.

2.2. Constructing an index of environmental predisposition

A particular methodological challenge addressed here is the question how to operationalize and quantify an individual's environmental predisposition. Analysis with a single index will be contrasted to the results of the effects from individual items.

Using the three groups of variables of environmental predisposition, we applied confirmatory factor analysis to construct a single index (e.g. Bernauer and McGrath 2016). The idea of the new

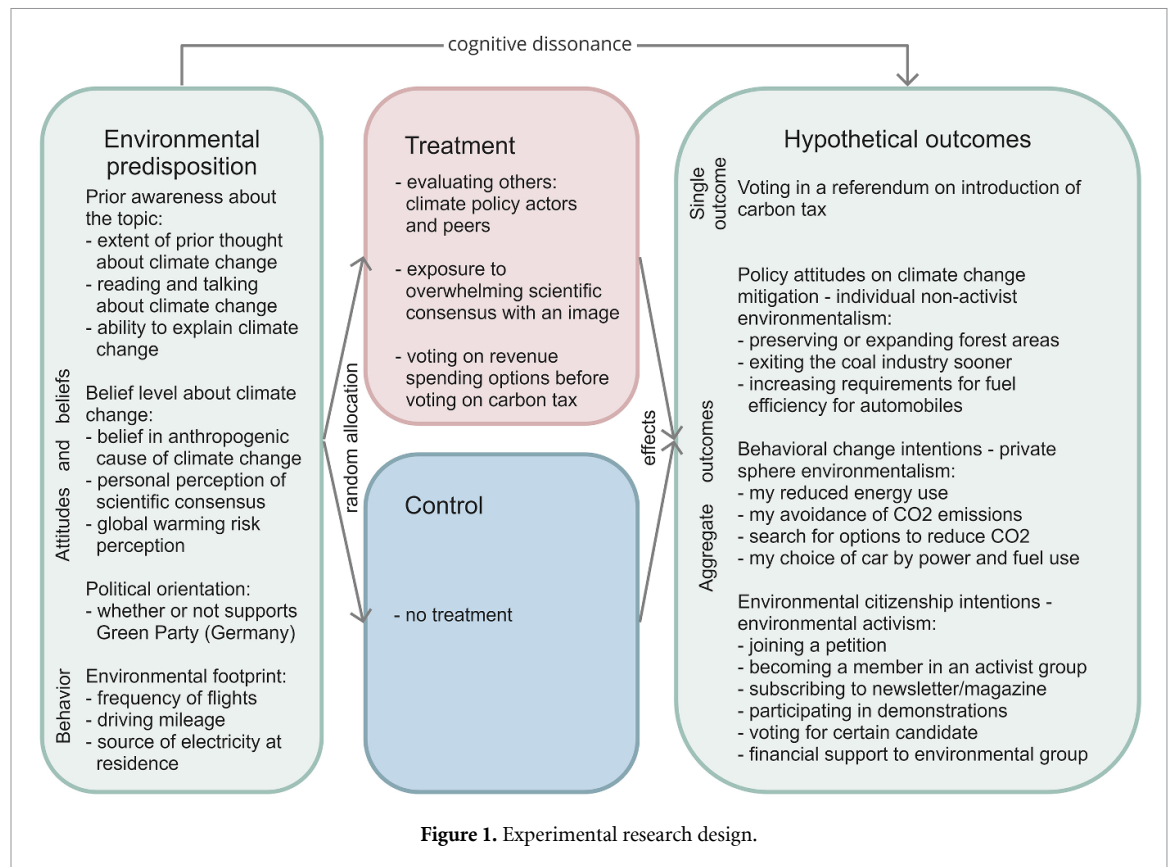


Figure 1. Experimental research design.

construct is that, we assume each individual has some degree of environmental predisposition that explains their answers related to this group of items to some extent. All items are coded numerically from ‘less’ to ‘more’ environmental predisposition—the more one is environmentally predisposed the more the person is expected to give answers at the higher end. It is reasonable to expect that the most environmentally predisposed person would score high on all of these questions despite the potential personal inconveniences or external limitations related to some of them, but in reality, there are still many environmentally predisposed people who do not or cannot score high on all of the items. For example, they might feel forced to take flights more often than they wish because there are, or they feel there are, no good alternatives, but they still actively continue to believe that making ‘more environmental’ choices is the right direction⁴ (see also McDonald *et al* 2015). Covariance in the answers to the selected ten items gives factor loadings, according to our assumption, how much ‘environmental predisposition’ is contributing to each of the item. Using the obtained factor loadings as coefficients in regression, we predict a single score for each person, which is then rescaled to a continuum of 0–1.

⁴ Cronbach’s alpha—the reliability coefficient of the index—is slightly below 0.4. The recommendation is above 0.6 which is usually for very similar items to ensure items measure the same construct, in our case items are not very similar, but theoretically still relevant.

2.3. Sampling the respondents

We approached participants directly at the demonstration in Halle and Leipzig on 29 November and 6 December 2019 with a group of trained enumerators—graduate students from the class of social science methods at the Martin Luther University in Halle, Germany. Most students and staff of the university live in these two neighboring mid-size cities in central-eastern Germany. To ensure high quality data collection, we discussed the methods in depth—including how to minimize bias that might come from enumerators and ran two rounds of simulation in class with follow-up reflections. One or two enumerators teamed up with a more trained colleague from the department.

We used a convenience sampling and tried to improve its representativeness through approximately dividing the area where the crowd gathered into a number of sections. Investigators entered the crowd according to these sections and approached participants from different age and gender groups (see Fisher *et al* 2019 for various strategies of survey research at the demonstrations and their implications). The starting point of the demonstrations was a public square that allowed this strategy relatively easily. As such, our sample is a purposive convenience sample, appropriate for testing treatment effects with an experimental design, but not for estimating the proportion of citizens in Germany or in any of the demonstrations who support or oppose climate policy, for example. Therefore, while our estimated

treatment effects are internally valid, we should be cautious about external validity. However, research looking at differences between treatment effects from convenience and representative samples in survey research suggests that our treatment effects should be not too different from what traditional survey recruitment would have produced (Mullinix *et al* 2015).

The teams had a regular web-link and a QR code to the online survey (and a phone/tablet if necessary) and asked the demonstration participants to complete the survey. In this regard, we should note that our research combined the elements of an in-person survey with the possibility to complete the survey online. One implication of using such a technique was that it allowed combining the advantages of both methods—respondents could opt for an in-person survey by answering the questions directly on a phone/tablet or take the link and the QR code to the survey and complete it later. Another implication is that the use of a link and a QR code might have limited the respondents to those who felt comfortable specifically with the use of these and could have caused bias in self-selection. We have controlled for such potential bias. Most of the respondents completed the questionnaire right away, few started the survey but said they would complete it later. No participant declined participation in the survey with reference to or while introducing the web-link and the QR code. Further, to understand the effects of completing the survey without the presence of an investigator we have also analyzed the effects from the time taken to complete the survey. We found no effects from the time taken to complete the survey on three outcome measures, but we found effects from those who spent 94 min or more ($n = 11$) on outcome measure environmental citizenship intentions. We conducted the analysis both including and excluding these observations and found no substantial differences in the results. As the differences pointed towards slightly stronger effects from treatment when excluding these respondents and excluding respondents is generally not recommended to avoid losing valuable information, we focus on the more conservative results that do not exclude these respondents (see supplementary information for additional analysis available online at stacks.iop.org/ERL/16/114035/mmedia). As a key element in an experimental research design, the respondents were randomly assigned to one of the two groups by an algorithm built-in in the survey to make sure their membership in the control or treatment group was fully independent of potential investigator or respondent-related bias (figure 1). Statistical tests were performed to understand that the two groups were not significantly different based on a number of pre-treatment characteristics, allowing us to make inferences about the treatment effects.

Further methodological details, including the survey instrument, links to the data and coding

procedures at the repository of Harvard Dataverse (Soliev 2021), and detailed results, are provided in the supplementary information.

3. Results

3.1. Key descriptive statistics: understanding Fridays for Future participants

The survey participants in the sample ($n = 119$) turned out to be mostly young, female, educated, low-income, and supporters of the Green Party and Left Party. As a whole the group is indeed strongly environmentally predisposed based on their survey answers but there is some noteworthy variation within the group. We are particularly interested in those concerning the three proxies for measuring the environmental predisposition.

First—prior awareness and beliefs about the topic. Looking at the individual questions, the participants in our sample do have overall strong beliefs about the topic with 111 of them (93.28%) considering climate change a very serious problem. While 77.31% ($n = 92$) of respondents considered that anthropogenic CO₂ emissions contributed to the climate change a lot, a share of 20.17% ($n = 24$) thought the CO₂ emissions caused all of the global warming. Yet, there was still some variation within the respondents. For example, 21.01% ($n = 25$) of respondents did not think most scientists agreed that the problem was urgent and enough was known to take action. Similarly, in terms of the climate awareness, a considerably smaller share reported that they had thought about the subject a lot ($n = 85$, 71.3%), read or talked about it often or very often ($n = 97$, 81.51%), and reported to be able to explain the global warming problem ($n = 62$, 52.10%).

Second—political orientation. A somewhat striking finding related to the demographics of the sample is the complete absence of supporters of the largest party—CDU/CSU (Christian Democratic Union and Christian Social Union in Bavaria)—who leads the current governing coalition with Social Democratic Party (SDP). This might place our Fridays for Future participants rather in the opposition to the current government than as simply demanders of change in policy. About half of the respondents indicated ($n = 60$, 50.42%) their political orientation to be closest to that of Green Party. This is consistent with the sharp gains in support of Green Party (22%, +12.8%) and a comparably large losses in support of CDU/CSU (27%, -6%) and SPD (14%, -6.5%) in Germany in the representative opinion polls at the time of this research (ZDF 2019) compared to the results of the latest federal elections in 2017 (Bundeswahlleiter 2017).

($n = 25$) had more than six trips by air in the last 3 years, including 7.56% ($n = 9$) who had more

Table 1. Results of voting on CO₂ tax.

Vote on CO ₂ tax	Control group		Treatment group		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Supports CO ₂ tax	46	74.19	47	82.46	93	78.15
Opposes CO ₂ tax	11	17.74	4	7.02	15	12.61
Does not know	5	8.06	6	10.53	11	9.24
Total	62	100.00	57	100.00	119	100.00

Pearson $\chi^2(2) = 3.1638$, $p = 0.206$ Cramér's $V = 0.1631$

than ten trips. About the same share of respondents (19.33%, $n = 23$) had no travel by air in the last 3 years. According to the national statistical reports, in Germany travel by air had been continuously on the rise until 2020; in 2019 there were an average of two-three trips by plane per person in the country (Statista 2020). Similarly, 17.65% ($n = 21$) of respondents reported that they drove 6001 km or more, including 6.72% ($n = 8$) who drove more than 10 000 km annually. This is much lower than the national average of 57.90% that drove 10 000 km or more in 2019 (Statista 2021). Finally, 26.05% ($n = 31$) of participants reported that they used standard electricity from non-renewable energy sources at their residence and 15.97% ($n = 19$) did not know the source, while 57.98% ($n = 69$) reported they used green electricity. The latter is considerably higher than the national average of only 24.4% of households that used green electricity in 2017 (Storm-Report 2020). Overall, the reported environmental footprint on these selected indicators are indeed rather low, as expected for the participants of Fridays for Future demonstrations, yet the results showing presence of demonstration participants with higher environmental footprint are important, as the data from these participants will serve as natural reference points in developing the single index.

3.2. Understanding the nudging effects

Balance statistics show that there is no statistically significant difference between the two groups on key demographic variables—gender, age group, education, political orientation (party), household income, indicating that our randomization in assigning respondents to one of the groups was successful (see table S15 in supplementary information).

By using a cross-tabulation and correlational tests (table 1), the difference in voting intentions for CO₂ tax policy between the two groups is not obvious and statistically not significant. But excluding those who were uncertain shows noticeable differences for further exploration. At this point, it is of particular interest to investigate further whether those who provided the answer 'do not know' had been more

in support or in opposition of carbon tax prior to the treatment, since both might have been the case but would have opposite implications. If a respondent had been *a priori* in favor of carbon tax policy but answered 'do not know', the treatment might have created resistance for that respondent. Alternatively, if a respondent had been *a priori* not in favor of carbon tax policy but answered 'do not know', it might be an indication that the treatment reduced opposition to carbon tax.

3.2.1. Estimation of treatment effects by individual items

Table 2 provides the estimated effects from the treatment and all hypothesized independent variables. The results show at least four noteworthy observations related to the effects from the treatment. First, the treatment effects for CO₂ tax outcome are positive and statistically significant (at $p < 0.10$ level). Perception of scientific consensus and Green Party-political orientation being the other statistically significant predictors (both at $p < 0.01$ level), both positively related with the outcome.

Second, perception of scientific consensus predicts both outcome variables 'voting on CO₂ tax' and 'policy support', while higher frequency of reading and talking about climate change also predicts higher levels of support for generally stronger climate policies.

Third, only those with very strong predisposition, such as those who think anthropogenic CO₂ causes all global warming, or who read and talk about climate change very often, and those who have low levels of driving mileage annually (up to 3000 km) predict the environmentally significant behavioral intentions ($p < 0.10$, $p < 0.10$, and $p < 0.05$ respectively). The latter is not surprising as one of the items constructing this outcome measure specifically focuses on whether the respondent intends to buy a car with less or more environmental impact or not to buy a car at all.

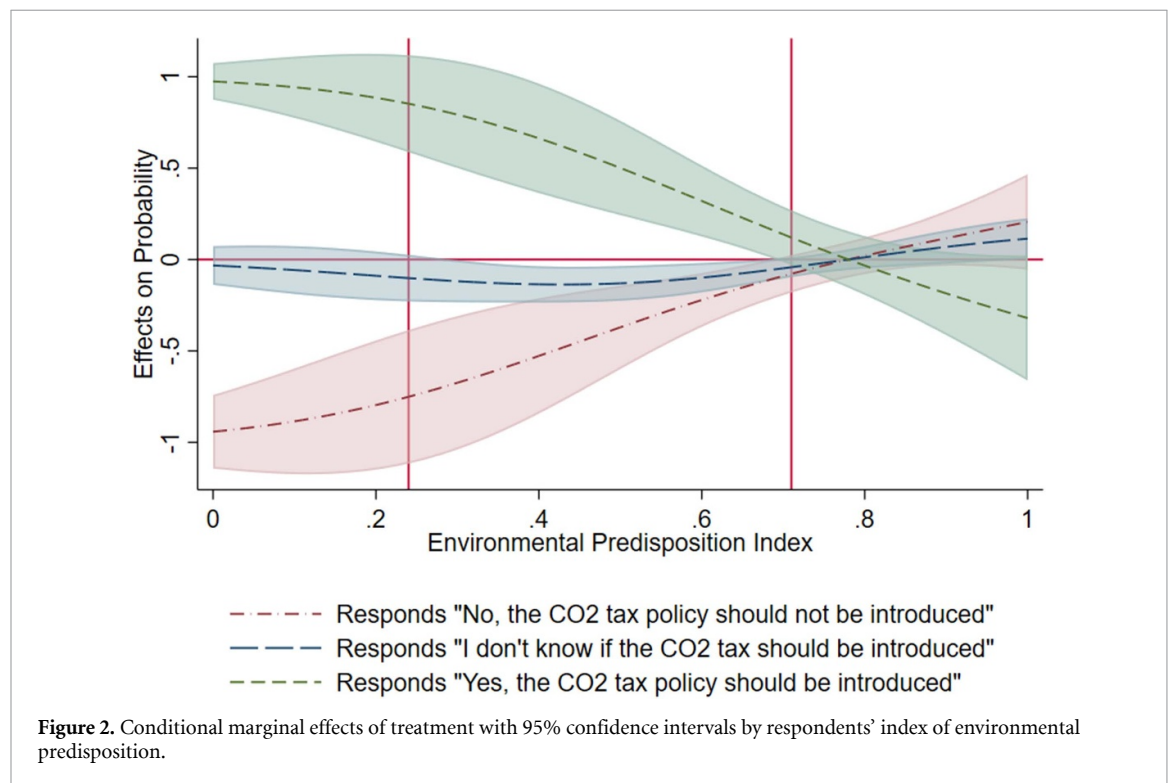
Fourth, the treatment effects were positive and statistically significant (at $p < 0.05$ level) for the outcome variable 'environmental citizenship'. One could

Table 2. Estimations from regressions models (ordinal probit model for CO₂ tax policy, OLS for the three aggregate outcome variables, $N = 119$, *** indicate $p < 0.01$, ** $p < 0.05$, * $p < 0.10$).

Variables		Voting on CO ₂ tax	Policy support	Behavioral intentions	Environmental citizenship
Treatment		0.5524*	−0.0250	−0.0436	0.0844**
Belief level about climate change	Believes anthropogenic CO ₂ (a) contributes to global warming not at all or a little or not sure				
	(b) contributes to global warming a lot	1.2737	−0.0327	0.1472	0.1160*
	(c) causes all global warming	1.0310	−0.0079	0.1697*	0.0889
	Believes that there is (a) mixed or no scientific consensus about climate change or not sure				
	(b) scientific consensus about climate change	1.3684***	0.2026***	0.1019	0.0678
	Believes climate change is (a) somewhat serious or not too serious or not a problem or not sure				
Climate awareness	(b) very serious problem	0.4257	0.0056	−0.0624	−0.0253
	Thought about climate change (a) not at all or a little or some				
	(b) a lot	0.0038	0.0055	0.0496	0.1198***
	Reads and talks about climate change (a) never or rarely or sometimes				
	(b) often	−0.2625	0.1323**	0.0621	0.1299***
	(c) very often	−0.4063	0.1330*	0.1241*	0.1353***
Party	Can explain climate change (a) believes cannot or only to some extent				
	(b) believes able to explain	−0.4818	−0.0120	0.0016	0.0713*
	'Green Party'-political orientation (a) supports not Green Party				
Reported footprint	(b) supports Green Party	0.9171***	−0.0268	0.0170	0.0193
	Frequency of flights in the last 3 years (a) more than 10 trips				
	(b) 7–10 trips	1.0030	0.0112	0.0534	−0.0562
	(c) 3–6 trips	0.5921	0.0460	0.0394	0.0037
	(d) 1 or 2 trips	0.8519	0.0322	0.0976	−0.0188
	(e) no trips	0.9097	0.0455	0.1258	0.0900
	Annual mileage driven by car on average (a) 10 000 km or more				
	(b) up to 10 000 km	−0.8761	−0.0832	0.1225	−0.1240
	(c) up to 6000 km	0.0373	0.0587	0.0959	−0.1062
	(d) up to 3000 km	0.4777	0.0685	0.1880**	0.0031
(e) up to 1000 km	−0.2906	0.0164	0.2819***	−0.2344	
	(f) up to 500 km	0.0141	0.0481	0.1631**	0.0314
	(g) 0 km	−0.0259	0.0659	0.2052**	0.1098
	Source of electricity used at residence (a) non-renewable energy				
(b) does not know whether renewable	0.3116	0.0030	0.0274	0.0907*	
(c) renewable energy	0.0713	0.0688	0.0856	0.1207***	
Wald $\chi^2(11)$ (Prob > χ^2)		35.4500**			
AIC		174.2775			
BIC		240.9765			
Constant			0.4727**	0.0585	0.0882
R ²			0.2519*	0.2637**	0.5178***

Table 3. Estimation results using an index of environmental predisposition ($N = 119$, *** indicate $p < 0.01$, ** $p < 0.05$, * $p < 0.10$).

Variables	Voting on CO ₂ tax	Policy support	Behavioral intentions	Environmental citizenship
Treatment	4.7993***	-0.1424	-0.1114	0.3505
Predisposition	3.6926***	0.2275	0.2948*	0.7024***
Interaction of treatment and predisposition	-6.1530***	0.1707	0.1241	-0.3814
Wald $\chi^2(3)$ (Prob > χ^2)	12.5200***			
AIC	156.0798			
BIC	169.9754			
Constant		0.6430***	0.4155***	0.0496
R ²		0.0065	0.0760	0.1914



argue that the nature of the treatments was consistent with citizenship—evaluating others, raising awareness about scientific consensus, and exercising voting rights before adopting a policy, and therefore not surprising they could increase the sense of citizenship. It is however interesting that these effects can be observed in a group that already exercises environmental citizenship by joining a climate demonstration. In addition, those who had thought about climate change a lot ($p < 0.01$), who read and talk about climate change often or very often (both $p < 0.01$), believe they can explain climate change ($p < 0.10$), and those who already use electricity from renewable energy sources at their residence ($p < 0.01$) predicted the stronger intentions for environmental citizenship, too. Stronger awareness about the issue and already action taken on their end—consciously using electricity from renewable energy sources at their residence—seem to be indicative of stronger citizenship.

3.2.2. Treatment effects by a single index of predisposition

The results from the estimation of the treatment effects by the index of environmental predisposition are presented in table 3⁵.

The treatment effects can be observed only for the vote on CO₂ tax. Further, the predicted conditional marginal effects of the treatment were simulated for environmental predisposition from 0 to 1 at a 0.01 step (figure 2).

In the estimations, the interval of the predisposition index between 0.31 and 0.67 stands out (figure 2). The treatment effect is statistically significant for all three responses only for this interval

⁵ Questions on political orientation and environmental footprint were asked after the treatment, and therefore were first tested for possible treatment effects. As no treatment effects were revealed, we assume respondents answered these questions unaffected by the order of the survey questions.

($n = 39$). According to the given model specifications and these results, respondents are more likely to support the carbon tax policy *and* less likely to oppose *or* give an uncertain answer as a result of being exposed to the package of treatments in this specific interval of environmental predisposition.

4. Discussion and conclusions

Despite the growing environmental movements such as Fridays for Future and sharply increasing support for Green Party in Germany, it is still difficult to introduce more stringent climate policies. Framing of climate policies has recently attracted some attention in scholarly (e.g. Andor *et al* 2018, Leipprand and Flachsland 2018, Dehler-Holland *et al* 2021) and public debate (e.g. Appun *et al* 2019) but the focus largely remains on energy industry (coal, renewables) and general public or opposing groups. Until now there has been no direct evidence for channeling the environmentalism into tangible policies to inform the ongoing debates, emerging studies with media analysis stressing the need to understand such groups better (Von Zabern and Tulloch 2020). In addition, the current debates on climate policy framing in Germany focus more on identifying framings in discourse and less on their potential for generating necessary mind-shifts for desired social-environmental outcomes (Göpel 2016). The research reported here aimed at filling this gap.

The results of the survey from 119 participants of Fridays for Future demonstrations in Germany related to the voting intentions on carbon tax indicate that the nudging on aggregate as designed in this study appears to be effective even in individuals with a strong predisposition, expected from participants of Fridays for Future demonstrations. However, the results also indicate that it might be more effective if nudging focuses on a specific issue and not as a blanket measure to boost more general environmentally significant behavior, keeping in mind the hypothetical bias from survey research as what we measure is behavioral intentions and not actual behavior. Results indicate that the effects from nudging are variable when analyzed with aggregate outcome measures such as (general) policy support, individual behavioral intentions, and environmental citizenship (Stern 2000). As climate action is a very broad concept, it seems reasonable that nudging should be tailored to specific issues such as a carbon tax, while not disregarding the importance of more general framing in scholarly, political, and media discourse for shaping the societal debate (e.g. Evensen 2019, Bergquist *et al* 2020).

A further important contribution of this research is the operationalization of a single index of environmental predisposition. It is illuminating that there is a specific level of environmental predisposition

where treatment is likely to nudge respondents to vote more in support of the tax policy *and* less against it. This is in line with the literature that highlights the importance of those who are less polarized (e.g. Arcuri *et al* 2008) or those who score neither too high nor too low in their confidence levels towards various issues, as they are the ones likely to respond to treatments as theorized. These estimations should obviously be treated as an orientation and for exploratory purposes rather than as exact thresholds. Studies with larger and probabilistic samples are necessary to test robustness of these findings. While arranging a simple (probabilistic) randomization is unlikely in demonstrations, a systematic randomization should be considered for improving representativeness of the samples in the future (Fisher *et al* 2019). Our survey still showed a good level of within-group variation and the findings of the experiment could be compared to undecided or so-called swing voters in elections, who tend to make decisions less affected by their predisposition. These findings are a substantial advantage of using a single index compared to the one with individual analysis of multiple items (table 2). The use of this single index reveals heterogeneity within target audiences in fine margins. This way the analysis contributes to studies on audience segmentation (e.g. Maibach *et al* 2011) and typology of protesters (Martiskainen *et al* 2020) and demonstrates how those who score neither too high nor too low on the continuum of environmental predisposition are more likely to respond to treatment. This brings forward the power of undecided who might be more open to being convinced as the potentially decisive segment of audience for climate policies, even in groups with general support for climate action.

These findings are in line with the recent call for studies in behavioral science that can capture heterogeneity of context and populations (Bryan *et al* 2021). As discussed earlier, while a number of studies have helped to put the Fridays for Future movement in the broader political and social movements context (e.g. Evensen 2019, De Moor *et al* 2021, Martiskainen *et al* 2020, Fisher and Nasrin 2021a, 2021b, Wallis and Loy 2021), our study helps to understand further how heterogeneity within a segment of such a group can be studied and how heterogeneity can interact with potential interventions aimed at boosting support for specific policies. Our research presents the first experimental evidence with the participants of the Fridays for Future demonstrations showing an example of how to take such heterogeneity seriously. First, the results show in what specific ways intervention effects can be context and population dependent. Second, they show how the design of interventions, in this case, of the survey instrument, plays an important role that can influence the outcomes.

Overall, the study demonstrates that scholars and policy-makers need to understand those with

stronger environmental predisposition compared to the general public better and not simply treat them as a converted group or even assume that supporting the activists would suffice (Hagedorn et al 2019). Findings from such studies also uncover broader issues related to the link between environmentalism, general public, and policy. With well-tailored nudging the growing environmental movements can accelerate transformations towards sustainability.

Data availability statement

The survey instrument, as well as additional analysis and methodological details are available in the supplementary information.

The data that support the findings of this study are openly available at the following URL/DOI: <https://doi.org/10.7910/DVN/YIO1SL>.

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Ethical statement

The research followed the European Union's General Data Protection Regulation 2016/679 from

25.05.2018 and the ethical guidelines of the German Society for Psychology on data protection and obtaining informed consent within the framework of research from 06.09.2018. Informed consent was obtained from survey participants before proceeding with the survey questions.

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