

Feeling guilty, anxious or still hopeful? The role of distinct emotions in climate change mitigation behavior

Myriam Bechtoldt^a, Carina Keller^a, Daniel Schunk^b, Isabell Zipperle^{b,*}

^a EBS University for Business and Law, Rheingaustrasse 1, Oestrich-Winkel, 65375, Germany

^b Johannes Gutenberg University, Jakob-Welder-Weg 4, 55128, Mainz, Germany

ARTICLE INFO

JEL classification:

C91
D91
Q50

Keywords:

Behavioral economics
Decision-making
Environment
Emotions

ABSTRACT

This study examines the role of experienced emotions in economic decision-making in the context of climate change. Using short video treatments in an experimental laboratory setting with 301 students, we successfully induce climate-related hope, anxiety, and guilt —emotions that are commonly addressed by NGOs to raise funds. We investigate the potential of our video treatments to affect one key dimension of climate change mitigation behavior: donations to NGOs engaging in CO₂ emission reduction. In our experimental setting, we find that being in the guilt condition positively impacts donation behavior at the extensive margin, while being in the hope or anxiety condition negatively impacts donation behavior at the intensive margin. Experiencing anxiety, however, leads to a lower probability of donating larger amounts to spatially far away donation beneficiaries. Finally, we find that donating subsequently reduces guilt levels, indicating emotional relief. We argue that this finding aligns with theoretical considerations on the inclusion of emotions in the utility maximization framework.

1. Introduction

Few scientific findings have such fundamental and broad implications as the discovery of human-caused climate change (Lee et al., 2023). Since climate change has adverse consequences for global societies and economies, it is of utmost importance to engage in collective efforts to sharply reduce CO₂ emissions in the atmosphere. Climate change mitigation activities require collective action and thus have global public good character, posing a social dilemma —a situation in which costs or benefits of these activities spill outside the market and are not captured by market prices (Van Lange et al., 2018; Nordhaus, 2019). Engaging in climate change mitigation often entails costs at an individual level, while the benefits are shared by a large global society, yielding minimal marginal per capita returns. Further, perceived geographic and psychological distance from regions and population groups more affected by the consequences of climate change can attenuate engagement for climate change mitigation and maintain barriers that impede collective action (e.g., Grimson et al., 2020; Chapman et al., 2022). Theoretical work in economics and psychology advocates that emotions can serve as a catalyst to overcome such barriers because they influence how individuals make economic decisions (e.g., Folkman and Lazarus, 1985, 1988; Loewenstein, 1996, 2000; Lerner and Keltner, 2000, 2001; Rick and Loewenstein, 2008). Indeed, research in behavioral economics provides empirical evidence that distinct emotions affect behavior in various domains, including complex decision-making on climate change mitigation (e.g., Ibanez et al., 2017; Schwartz and Loewenstein, 2017; Ibanez and Roussel, 2021; Palosaari et al.,

* Corresponding author.

E-mail addresses: myriam.bechtoldt@ebs.edu (M. Bechtoldt), carina.keller@ebs.edu (C. Keller), daniel.schunk@uni-mainz.de (D. Schunk), isabell.zipperle@uni-mainz.de (I. Zipperle).

<https://doi.org/10.1016/j.jeem.2025.103273>

Received 6 December 2024; Received in revised form 11 December 2025; Accepted 13 December 2025

Available online 15 December 2025

0095-0696/© 2025 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

2023). Moreover, emotions appear to direct focus to specific population groups, thus potentially reinforcing locational preferences and impacting beneficiary selection in donation decisions (Caviola et al., 2021); at the same time, however, Diederich and Goeschl (2018) argue that ‘home bias’ in climate change mitigation activities does not impede effective climate change mitigation. Hence, understanding how emotions shape pro-environmental donation decisions and interact with specific donation alternatives is essential for developing strategies that effectively motivate individuals to contribute to collective climate change mitigation efforts.

Our study investigates the potential of short videos that aim at inducing climate-related hope, anxiety, and guilt in supporting collective action, i.e., raising donations to an environmental non-governmental organization (NGO). Many environmental NGOs operate various projects around the world—spatially close to and spatially far away from potential donors—and raise donations and non-financial support at the project level. To do so, they are highly likely to use hope, anxiety, and guilt appeals when addressing potential donors.¹ While hope and anxiety focus on future goals (Baumgartner et al., 2008), guilt concerns past actions yet motivates reparative actions that are directed toward the future to prevent further harm. Each plays a distinct role in social dilemma situations such as climate change mitigation (Smith and Lazarus, 1990), thereby justifying the investigation of their action potential from a theoretical perspective.

We conducted a laboratory experiment with 301 students to investigate the following: First, we analyze whether videos designed to trigger climate-related hope, anxiety, and guilt affect the probability of donating and the donation amounts expended to support climate change mitigation; second, we investigate how the emergence of differential emotions direct donations to different choice alternatives, i.e., spatially close and spatially far away climate change mitigation projects. Lastly, we assess the relationship between experiencing climate-related hope, anxiety, and guilt and donations to climate change mitigation projects in light of the economic utility maximization framework. Specifically, we examine whether donating is associated with changes in discrete emotional experiences, thereby serving as an instrument for emotion regulation and influencing subsequent decision-making processes. The study uses data collected from participants in three experimental treatment groups and one control group in a between-subjects experimental design. We successfully induced our target emotions by showing emotion-inducing videos to the treatment groups and an emotion-neutral video to the control group. Our video treatments mirrored important aspects of the 2023 IPCC report (Lee et al., 2023): Individuals in the hope condition watched a video capturing the potential for successful climate change mitigation, individuals in the anxiety condition watched a video capturing the consequences of climate change, and individuals in the guilt condition watched a video capturing the human causes of climate change. After the treatment, individuals obtained the opportunity to deduct part of their financial endowment and donate it to two distinct projects—either spatially close or far away—of an environmental NGO engaged in afforestation, thereby contributing to CO₂ emission reduction. During our experiment, we measured emotions at four points in time. This enables us to descriptively investigate the repercussions of donating on emotions, hence providing insights into the potential instrumental value of donations in relieving emotional stress.

Our main finding suggests that videos inducing distinct emotions affect donation decisions. Specifically, we find that watching a video designed to induce climate-related guilt prior to facing a donation opportunity increases the probability of donating, i.e., affects donation behavior at the extensive margin, but does not affect the donation amount, i.e., does not affect the donation behavior at the intensive margin. Watching videos that are designed to induce climate-related hope or anxiety decreases donation amounts but does not affect the probability of donating. Further, we find that the experience of anxiety decreases the probability of donating larger amounts to spatially far away beneficiaries compared to spatially close beneficiaries. Finally, our data show that donating to an environmental NGO is followed by a subsequent decrease in guilt levels, suggesting that donations serve the purpose of relieving emotional distress.

Our study adds various new aspects to the behavioral economic literature on the role of emotions for economic decision-making (e.g., Ifcher and Zarghamee, 2011; Gneezy et al., 2014; Stanton et al., 2014; Drouvelis and Grosskopf, 2016; Marini, 2023), and pro-environmental decision-making in particular (Ibanez et al., 2017; Schwartz and Loewenstein, 2017; Ibanez and Roussel, 2021; Palosaari et al., 2023). First, we empirically investigate how inducing climate-related hope, anxiety, and guilt affects pro-environmental donation decisions—a bundle of emotions that has not been covered by the related literature so far, despite its relevance for both theoretical and practical reasons. Beyond suggesting differential *general* effects of these emotions on pro-environmental donation decisions, our study adds insights on the role of beneficiary location in the environmental domain, providing evidence on how hope, anxiety and guilt influence the financial support of spatially close and spatially far away projects of an environmental NGO. This finding adds to a small interdisciplinary literature on how emotions guide focus to particular population groups (Van Leeuwen et al., 2013; Arceneaux, 2017; Richins et al., 2021) and contributes to the question of whether locational preferences matter in climate change mitigation (Diederich and Goeschl, 2018; Löschel et al., 2021). Further, our findings inform research on the role of emotions within the utility maximization framework (Loewenstein, 2000; Rick and Loewenstein, 2008), highlighting that donating might serve as an instrument to relieve emotional distress or sustain emotional comfort.

The remainder of the paper is organized as follows. Section 2 reviews the literature on emotions in decision-making. By incorporating psychological and economic theories on how emotions might translate into behaviors and discussing approaches to integrate experienced emotions, i.e., climate-related hope, anxiety, and guilt, in a classical utility maximization framework, we provide a broad foundation for the interpretation of our findings. In Section 3, we derive the hypotheses that we aim to test using our experimental setup. Section 4 sheds light on our experimental design. Results are presented in Section 5 and discussed in Section 6.

¹ We conducted a systematic machine learning-based analysis of the emotional language applied on German NGOs' web pages. We find that the use of hope, anxiety, and guilt is identified with very high probabilities. A detailed documentation of this analysis is provided in Section Appendix A. Research on NGO advertising, also addressing the use of emotions, has been summarized by Wymer and Gross (2023).

2. Emotions in (economic) decision-making

Emotions modulate and guide cognition, enabling adaptive responses to the environment. They determine how we perceive our world, organize our memory, and make important decisions such as whether to contribute or not to collective climate change mitigation efforts (Brosch et al., 2013; Brosch, 2021). Lazarus and colleagues (e.g., Folkman and Lazarus, 1985; Smith and Lazarus, 1990) proposed that emotions emerge from cognitively appraising a situation relevant to an individual's concern. Hence, whether a positive or a negative emotion emerges depends on how the situation is appraised. More so, depending on the context of the situation, some emotions are more likely to emerge than others. Appraisal is a goal-directed process through which emotions influence decision-making until the emotion-eliciting situation is resolved (Lerner and Keltner, 2000, 2001). This means that decisions taken following the subjective appraisal of a situation might also be influenced by the purpose of instrumentally managing the respective affective state (Folkman and Lazarus, 1988; Smith and Lazarus, 1990).

Climate change mitigation is characterized by a high level of complexity as, e.g., returns to investments are distributed along an extreme time horizon, are highly uncertain and can only be realized when meeting a critical threshold (Blagoev and Schreyögg, 2025). Drawing the conclusion about whether current climate change mitigation efforts have been successful is incumbent on future generations. According to Smith and Lazarus (1990), the emergence of hope, anxiety, and guilt can be categorized into the different appraisal categories. Hope is related to a “strong desire to be in a different situation than at present” (Lazarus, 1999, p.663) and emerges in response to a challenging appraisal. Hence, it can emerge if achieving a future goal of climate change mitigation is perceived as feasible. In contrast, anxiety is related to ambiguity about a potential threat or loss (Smith and Lazarus, 1993; Lerner and Keltner, 2001). It can emerge in response to a threatening appraisal, e.g., when it is perceived rather unlikely to achieve the future goal. Guilt is considered a self-directed emotion that arises from appraisals of having committed a transgression against one's own or socially shared moral standards (Smith and Lazarus, 1993). It typically emerges when an outcome is appraised as wrongdoing, motivating reparative actions to restore relationships and prevent future harm.

The impact of climate-related hope, anxiety, and guilt on pro-environmental donation decisions depends on whether these emotions are immediate or incidental, hence either arising from the decision itself or from dispositional factors unrelated to the decision (Rick and Loewenstein, 2008). Emotions have an effect on the utility associated with a certain choice option and determine the trade-offs individuals make between different choice options (Loewenstein, 2000). E.g., in the case of incidental emotions, they raise the marginal utility of an alternative in a decision situation that promises managing the affective state even when it is not aligned with economic interests (Loewenstein, 2000). Utility then emerges from restoring a psychological equilibrium, i.e., relieving emotional distress or sustaining emotional comfort.² In the context of climate change mitigation, donating to an environmental NGO could serve a similar purpose. As climate change mitigation activities are likely to be interlinked with the emergence of emotions associated with future-directed outcomes such as hope, anxiety, and guilt, a higher utility should be derived from donating to an environmental NGO compared to not donating if the positive emotional payoff, i.e., sustaining hope or relieving anxiety or guilt, exceeds the negative emotional payoff associated with the monetary costs. This means that climate-related hope, anxiety and guilt can be considered as potentially ‘productive’, in the sense that each may trigger climate change mitigation activities, leading individuals to make an intuitive, emotion-based decision to donate (Gilovich et al., 2002; Lerner et al., 2015). However, the decision about the donation amount is more subject to complex processes, including deliberate assessments and value-based considerations (Meritt et al., 2010; Cryder et al., 2013). For instance, anxious individuals may donate less because they perceive collective climate change mitigation as unfeasible, leading to disengagement and withdrawal of individual resources (O'Neill and Nicholson-Cole, 2009). On the other hand, individuals experiencing guilt may donate less, as their decision to donate may already suffice to repair their wrong-doing, hence creating a moral self-licensing effect (Bissing-Olson et al., 2016).

So far, empirical studies have focused on the donation-evoking potential of distinct emotions per se that promise differential behavioral responses, but do not consider the instrumental value of donating to manage or cope with emotions. Ibanez et al. (2017) and Ibanez and Roussel (2021) induced positive and negative emotions and used donation behavior measured in a modified dictator game set-up as their economic outcome of interest. In their earlier paper, they investigated awe, amusement, fear and sadness, and reported that awe increased donation amounts, while amusement and sadness did not impact the outcome, and fear was not successfully induced. In their later paper, they documented that the two negative emotions they induced, shame and sadness, decreased donations to an environmental NGO compared to controls, while the induced positive emotions, pride and happiness, did not change donation amounts. On the contrary, however, Schwartz and Loewenstein (2017) found that sadness induction evokes larger donation amounts. Palosaari et al. (2023) reinvestigated the effects of induced fear on donations to climate change mitigation but found no significant differences between the treatment and control groups.

To the best of our knowledge, no empirical results regarding our bundle of emotions and pro-environmental donations exist yet.³ To assess whether the theorized action potentials of hope, anxiety, and guilt hold up in prior empirical investigations, we briefly review behavioral science evidence on their effects on pro-environmental behavior more broadly. Climate change mitigation behavior may be considered one such behavior, although distinct. Importantly, the majority of these studies relied on a large range of self-reported

² This is supported by empirical evidence contributed by Gneezy et al. (2014) who have shown that individuals tend to donate higher amounts to an NGO after having engaged in unethical behavior to get rid of a bad conscience.

³ Indeed, Ibanez et al. (2017) and Palosaari et al. (2023) investigated the relationship between fear and environmental donation behavior. While fear is characterized as a reaction to an observable stimulus, anxiety rather relates to a future, anticipated threat (Oehman, 2008). As climate change consequences will materialize even stronger in the future, we refer to anxiety.

behaviors, behavioral intentions, or costless behaviors, rather than on behaviors involving real costs in the environmental domain. Therefore, we consider them to be only a rough and imprecise indication of the effects on donations to an environmental NGO that we address in our study (Kormos and Gifford, 2014).

Hope. Recent meta-analytic evidence confirms that hope may foster pro-environmental behavior when measured as a cognitive concept (Ojala, 2022; Geiger et al., 2023). Yet, when measured as an emotion, evidence is inconclusive on whether hope is positively related to pro-environmental behavior (Smith and Leiserowitz, 2014; Feldman and Hart, 2018; Bury et al., 2020) or whether there is no relation (Hornsey and Fielding, 2016; Van Zomeren et al., 2019; Ettinger et al., 2021). Additionally, Ojala (2022) highlighted the importance of distinguishing between constructive hope and hope based on denial, with positive and negative behavioral implications, respectively.

Anxiety. Evidence on the relationship between anxiety and pro-environmental behavior is also mixed and, to some extent, contradictory. On the one hand, and in line with the idea that individuals choose the decision alternative that helps to avoid potential harm and alleviate anxiety, induced anxiety predicted self-reported environmental action and environmental activism (Ogunbode et al., 2022; Becht et al., 2024). On the other hand, such appeals may have led to ‘flight or freeze’ behavior, impairing engagement with climate change or climate change mitigation behavior (O’Neill and Nicholson-Cole, 2009; Palosaari et al., 2023).

Guilt. A recent meta-analytic study found a significant correlation between anticipated guilt and pro-environmental behavior (Shipley and van Riper, 2022). However, it seems that only collective (Rees et al., 2015), i.e., group-level guilt, appeals were effective to evoke pro-environmental behavior (also see Ferguson and Branscombe, 2010; Harth et al., 2013; Rees and Bamberg, 2014) as compared to individual appeals (see Bissing-Olson et al., 2016).

3. Hypotheses

Building on the theoretical foundations discussed in Section 2 and considering the specific characteristics of climate-related hope, anxiety and guilt, which make them distinct from other related positively or negatively valenced emotions, we aim to test the following hypotheses.⁴

Our first hypothesis is that experiencing climate-related hope increases both the likelihood of donating to an environmental NGO and the donation amount. This serves the collective goal, which is perceived as achievable (Ojala, 2022). We formulate this hypothesis as:

Hypothesis 1a. Short video treatments inducing climate-related hope positively affect participants’ probability of donating to an environmental NGO and donation amounts.

Regarding climate-related anxiety and guilt, we hypothesize differentiated effects between the probability of donating and the donation amounts. In line with the utility-maximizing framework, we expect that individuals aim to relieve distress caused by the unpleasantness of anxiety and guilt, i.e., an increased average probability of donating. At the same time, we hypothesize that donation amounts will be negatively impacted for individuals in the anxiety condition, following perceived inefficacy of collective goal attainment, and for individuals in the guilt condition, following moral self-licensing. We formulate our second hypothesis as:

Hypothesis 1b. Short video treatments inducing climate-related anxiety or guilt positively affect participants’ probability of donating to an environmental NGO but negatively affect participants’ donation amounts.

Further, emotions might influence beneficiary selection. Therefore, our study goes one further step by also investigating to which beneficiary individuals are donating. We investigate exploratively whether climate-related hope, anxiety and guilt also differentially influence donation behavior directed at spatially close and spatially far away beneficiaries and formulate this additional hypothesis as follows:

Hypothesis 2. Video-induced climate-related hope, anxiety, and guilt affect the extent to which participants donate to spatially close vs. spatially far away beneficiaries.

Also in a more exploratory vein, we aim to test whether our experimental data empirically undermine the theoretical considerations on the integration of emotions into the utility maximization framework (Loewenstein, 2000) by providing evidence that pro-environmental donation behavior comes along with relieving anxiety and guilt and sustaining hope. We do so by investigating the changes in the intensity of emotions over time.

4. Experimental design & procedures

We conducted a laboratory experiment in December 2022 and January 2023 at the MABELLA laboratory at Johannes Gutenberg University in Mainz in Germany. We recruited 301 participants via Orsee (Greiner, 2015). Participant characteristics are displayed in Table 1. Prior to the experiment, participants were informed that they would participate in a study “investigating decision-making” to avoid self-selection into the experiment. A maximum of 25 students participated in one session. The experiment comprised a three-stage between-subjects design with overall five emotion-inducing treatment groups and one control group, each defined by the

⁴ We pre-registered our hypotheses and experimental design. Our pre-registration can be accessed using the following link: <https://doi.org/10.17605/OSF.IO/MD3ZJ>.

Table 1
Sample descriptives.

Statistic	N	Mean	St. Dev.	Min	Max	Kruskal Wallis test
Age	301	22.50	3.64	18	53	0.89
Gender	298	0.86	0.41	0	2	0.34
Income	297	2.90	1.01	1	5	0.62
Prior donations env.	290	0.31	0.58	0	3	0.85
Prior donations gen.	293	0.59	0.81	0	4	0.87
NEP score	301	4.62	0.48	2.33	5.67	0.08
SE score	301	4.09	1.09	1	6	0.29
CE score	301	4.33	0.95	1.5	6	0.64

Notes: The table shows sample statistics and Kruskal Wallis test results using p-values. Gender takes values 0 if male, 1 if female and 2 if non-binary. Income takes values 0 if participants have no money after all fixed expenses in a month, 1 if they have less than 100 EUR, 2 if they have 100 to 250 EUR, 3 if they have 250 to 500 EUR and 4 if they have more than 500 EUR. Prior donations to environmental organizations and in general take values 0 if 0 EUR are donated monthly, 1 if 0 to 10 EUR are donated, 2, if 10 to 30 EUR are donated, 3 if 30 to 50 EUR are donated, 4 if 50 to 100 EUR are donated and 5 if more than 100 EUR are donated. New Ecological Paradigm (NEP) scale score takes values 0 to 6 with 0 denoting a low and 6 denoting a high environmental attitude. The perceived self-efficacy (SE) score takes values 0 to 6 with 0 denoting a low and 6 denoting a high belief in self-efficacy in the environmental domain. The perceived collective efficacy (CE) score takes values 0 to 6 with 0 denoting a low and 6 denoting a high belief in collective efficacy in the environmental domain. Missing values are due to optional non-responses.

video treatment participants received. In this study, we focus on three of these treatment groups, i.e., a hope-inducing treatment group, an anxiety-inducing and a guilt-inducing treatment group, and the control group.⁵ In each session, participants were randomized into either one of the treatment groups or the control group to minimize session effects.

At the pre-treatment stage, participants were welcomed to the experiment and informed about the overall setting in a general manner. We applied a neutral framing in our experimental instructions to avoid the risk of experimenter demand biases (Haaland et al., 2023). Participants received a note that they would get an opportunity to donate to an environmental NGO in the experiment and that they will receive a donation receipt after the experiment. After this, participants could select one out of two environmental NGOs as the potential beneficiary of their donation.⁶ Both NGOs carried out comparable afforestation projects in Germany and Central America, i. e., spatially close to and spatially far away from the participants. Participants were given information about the missions and activities of the NGOs to make an informed choice (comp. Figure C.5 in the Appendix). Participants ‘stuck’ to their selected NGO throughout the experiment in the sense that when being asked whether they wanted to donate to different climate change mitigation projects at a later stage, these projects would both be conducted by their selected NGO.⁷ Then, participants could earn their endowment of at most 10 EUR in a real-effort game (Ibanez et al., 2017).⁸ In the real-effort game, participants had to count zeros in a total of ten matrices (Abeler et al., 2011). Participants earned 6 EUR in addition to their show-up fee of 4 EUR if they counted the right amount of zeros in at least five of the ten matrices (without receiving intermediate feedback) (comp. Figure C.6 and Figure C.7 in the Appendix). Only one participant failed to solve at least five matrices correctly and therefore retained an endowment of 4 EUR. The experiment proceeded with the collection of information on environmental attitudes using the German version of the New Ecological Paradigm (NEP) scale (Dunlap et al., 2000; Schleyer-Lindenmann et al., 2018), ecological behaviors using a German version of the General Ecological Behavior (GEB) scale (Kaiser, 2020), economic preferences using the German version of the Global Preference Survey (GPS) module (Falk et al., 2018, 2023) and personality traits using an adjusted German short version of the BIG5 scale (Rammstedt et al., 2013). Beliefs about self-efficacy and collective efficacy in the domain of environmental behavior were measured using a German translation of the efficacy scales developed by Hamann and Reese (2020). Further, empathetic concern was measured based on a scale provided by Davis (1980).⁹ We implemented four concentration checks to be able to control for careful answering. To check for concentration, participants were asked to choose either the lowest or the highest level of the scale. Overall, 97 % of participants in our sample managed to pass all four concentration check items.

During the subsequent treatment stage, participants were randomly assigned to either one of the treatment groups or the control group and were shown the video associated with their respective experimental conditions. Participants in the control group were watching a scientific emotion-neutral video about diffusive sunlight reflection of a body (control condition), whereas participants in the three relevant treatment groups were watching a video inducing hope about climate change mitigation (hope condition), a video

⁵ In this study, we do not test all hypotheses and do not refer to all treatment conditions that we originally pre-registered. All deviations from the pre-registration are discussed in Appendix D.

⁶ In line with Ibanez and Roussel (2021), we let participants choose a beneficiary on their own to give them a notion of self-agency and avoid preference bias.

⁷ Participants were explicitly told that they can donate to their chosen organization, but do not have to donate. Those who declared that they do not plan to donate during the experiment were given the possibility to revise this decision at a later point in time.

⁸ The majority of experimental sessions did not exceed a duration of 45 min. Thus, students were able to earn more than German minimum wage which at the time of our experiment was 12 EUR per hour.

⁹ All scales which were not available in German language were translated by members of the research team and back translated by a native speaker to assure content validity. An overview of all scales used in the reported analyses including their answering formats is provided in Table C.7 in the Appendix.

inducing anxiety about the consequences of climate change (anxiety condition), or a video inducing guilt about the human causes of climate change (guilt condition). We relied on video treatments, i.e., audiovisual stimuli that address two human senses, to increase treatment intensity and control for differences in the chosen materials at the same time. All videos included a slide show of real images, among others, taken from the data bank Climate Visuals (<https://climatevisuals.org/>) and a voice-over the images were attuned to.¹⁰ The voice-over addressed emotional appeals without directly referring to the target emotions. Following the discussion on whether emotions should target the individual or the group level (comp. Section 2), our emotion-inducing video treatments explicitly referred to both the individual and the collective facet of the target emotion. In our guilt condition, e.g., we addressed individual and collective responsibility for climate change. All stimuli were pre-tested in an independent student sample to make sure that they successfully induce target emotions.

At the post-treatment stage, participants made two consecutive and distinct donation decisions in randomized order: They decided how much of their earned endowment (if at all) they wanted to donate to the spatially close project and how much of their endowment they wanted to donate to the spatially far away project of the organization they had initially selected as beneficiary of any donations. We applied the ‘pay one’ method, meaning that participants were told that one of their two decisions would be randomly chosen for pay-off. This procedure ensures that participants make their decisions as if they are pay-off relevant (Charness et al., 2016; Clot et al., 2018). Then, to measure information-seeking behavior, participants were given the chance to seek further information about climate change (i.e., read an article about general news vs. climate change and environment). At the end of the experiment, participants filled out a questionnaire including socio-demographic questions and questions on prior donation behavior as well as questions on behavioral intentions and their donation decisions (Carroll and Kachersky, 2019). We also asked participants to indicate the amount that they think other individuals in the same situation donate and the amount they think that other individuals should donate (Cialdini et al., 1991).

Finally, participants were asked whether they wanted a donation receipt confirming the real transfer of their donation to the selected NGO by providing their email address at the end of the experiment. Four weeks after the experiment, we invited participants who had explicitly permitted us to contact them for follow-up data collection purposes to participate in a follow-up survey. Among other purposes, the survey was intended to collect information on levels of distinct emotions over time. Responding to the survey was incentivized through a lottery in which participants could win one of five vouchers for an organic retail store.

Overall, participants reported their current level of twelve subjective emotions, among them hope, anxiety, and guilt, at four points in time: directly before and after the treatment to enable the measurement of successful emotion induction; after the climate engagement tasks, i.e., donation and information seeking task, to detect change in emotions in response to the donation decision; and during the follow-up survey four weeks after the treatment.^{11,12} Measuring a broader set of emotions acknowledges the fact that distinct emotions emerge as part of an emotional canon, also encompassing a variety of other emotions and that they can neither be observed independently of other emotions nor can they be induced without affecting other emotions (Rhodes-Purdy et al., 2021).

5. Results

5.1. Balance of treatment groups

To ensure that potential treatment effects stem from the treatments rather than differences in underlying characteristics influencing donation decisions, we compared participants in the treatment groups and the control group with respect to socio-economic characteristics, prior donations and pro-environmental attitudes as well as perceived self-efficacy and collective efficacy scores. Table 1 reports these characteristics as well as Kruskal Wallis test results using p-values. Based on the p-values, we conclude overall that participants across experimental conditions do not differ significantly in the characteristics considered.¹³

¹⁰ All videos were roughly equal in length and lasted between 3.58 and 4.05 min. Videos can be accessed using the following link: osf.io/k8z7v. In Appendix C.5 we provide respective treatment scripts.

¹¹ The scale we used included the following emotions: activity, anxiety, alertness, shame, attentiveness, determination, guilt, hope, hostility, inspiration, nervousness, anger. The chosen emotions constitute a subset of the German version of the Positive And Negative Affect (PANAS) scale (Watson et al., 1988; Breyer and Bluemke, 2016) to which we added hope. Participants rated each emotion on a 0 to 100 scale. We deviated from a standard Likert scale to allow for a higher degree of granularity.

¹² In addition to the PANAS scale (Watson et al., 1988), emotional states were assessed using the Climate Change Hope Scale (Li and Monroe, 2018), the Climate Change Worry Scale (Stewart, 2021), and the Environmental Guilt Scale (Agoston et al., 2022). Correlations with the post treatment PANAS items were moderate, indicating that these instruments capture conceptually related yet empirically distinct constructs. Given that the primary objective of these measures was to verify the effectiveness of the experimental manipulation, subsequent analyses rely on the PANAS scale, while the climate-specific measures are not considered further. For completeness, descriptive statistics for these additional scales are available upon request.

¹³ Most Kruskal Wallis test results in Table 1 are well above a significance level of 10 %, hence indicating no difference among treatment groups overall. The only exception constitutes the NEP score measuring pro-environmental attitudes where Kruskal Wallis test results yield $p = 0.08$. In this case we additionally conducted pairwise group comparisons using a Dunn test with Bonferroni adjustments. As none of the pairwise group comparisons were statistically significant at a 10 % level after controlling for multiple comparisons, we conclude that participants' environmental attitudes are not significantly different across experimental conditions.

5.2. Emotion induction

With respect to climate-related hope, anxiety, and guilt, we find that our emotion-inducing video treatments successfully induced target emotions in the respective treatment groups compared to the control group. Fig. 1 displays the average changes in our target emotions in each treatment group and in the control group. Exact values of pre- and post-treatment emotion levels by experimental condition and target emotion as well as Kruskal Wallis test results on pre- and post-treatment group differences in emotions are reported in Table B.4 in the Appendix. We conducted Wilcoxon rank sum tests to test whether the change in target emotions in the treatment groups is significantly different from changes in the control group (see Fig. 1). We find that subjectively reported hope significantly increased in the hope condition compared to the control condition, while subjectively reported anxiety significantly increased in the anxiety condition and subjectively reported guilt increased in the guilt condition compared to the control condition, respectively. As distinct emotions emerge as a part of an emotional canon, and emotional experiences are inherently multifaceted and interconnected, we report mean changes in all twelve measured emotions in Figure B.3 in the Appendix. Indeed, we find that other emotions in the emotional canon have changed simultaneously. This needs to be kept in mind when interpreting the results. Given the specific practical and theoretical relevance of climate-related hope, anxiety, and guilt, we nonetheless refer to these distinct emotions.

5.3. Donations to environmental NGOs

5.3.1. Differences between experimental conditions

Table 2 provides the estimated probability of donating a positive amount to at least one of the two climate change mitigation projects (Panel A) and the mean average donation amounts donated to both projects (Panel B) for each experimental condition estimated on the full sample. We further report results of pairwise Wilcoxon rank sum tests. We find that the donation probability as well as the donation amount are highest for individuals in the guilt condition and lowest for individuals in the hope condition. The results of pairwise Wilcoxon rank sum tests show no significant differences in the probability of donating between individuals in the treatment groups and individuals in the control group. Similarly, no significant differences between individuals in the treatment groups and individuals in the control group in donation amount are detected in the full sample. However, we find significant differences between treatment groups. The pairwise comparison of treatment groups yields significant differences in the probability of donating between individuals in the guilt condition and individuals in the hope condition ($p = 0.059$), significant differences in donation amount between individuals in the guilt condition and individuals in the hope condition ($p = 0.006$), and marginally significant differences in donation amounts between individuals in the guilt condition and individuals in the anxiety condition ($p = 0.096$).

Result 1. Individuals in the guilt condition have a higher probability of donating to climate change mitigation projects compared to individuals in the hope condition. Their mean donation amounts are higher than mean donation amounts of individuals in the hope condition and individuals in the anxiety condition.

5.3.2. Extensive and intensive margins

We investigated the effects of our emotion-inducing video treatments on donations to climate change mitigation projects at both the extensive and intensive margins of environmental behavior. We used a linear probability model to estimate treatment effects on probability of donating (extensive margin) and an ordinary least square model to estimate treatment effects on donation amount conditional on donating (intensive margin). In fact, we regressed a dummy indicating whether an individual donated or not to at least one of the two projects on treatment indicator and control variables to investigate effects at the extensive margin. To investigate effects at the intensive margin, we regressed the average amount donated to the two projects on treatment indicator and control variables but used a restricted sample including only individuals who actually decided to donate. In our main specifications, we included demographic information, prior donation amount to environmental NGOs and NGOs in general and economic preferences, as well as descriptive and injunctive social norms, capturing an individual's perception of the amount of money others would donate and the amount of money one should donate.

Column (1) in Table 3 reports extensive margin results: Only the video treatment designed to induce climate-related guilt is associated with a significant change in probability of donating to at least one of the two climate change mitigation projects. We find that being in the guilt condition significantly increased the probability of donating by, *ceteris paribus*, 14 percentage points ($p = 0.065$) as compared to being in the control condition. We do not find any significant effects of being in the hope or anxiety condition on the probability of donating.¹⁴

Result 2. At the extensive margin, we find suggestive evidence that being in the guilt condition positively affects participants' probability of donating to an environmental NGO.

Column (2) in Table 3 reveals results with respect to the intensive margin, i.e., donation amount conditional on donating. We find that being in the hope condition decreased donation amounts *ceteris paribus* by 0.96 EUR ($p = 0.015$) and being in the anxiety condition decreased donation amount by 0.76 EUR ($p = 0.054$) compared to being in the control condition; relative to the mean donation in the control group, this corresponds to a decrease of the donation amount by 39.7 % (31.4 %), or almost 10 % (8 %) of the

¹⁴ Table B.5 in the Appendix documents that our results are robust when including different sets of controls, i.e., when adding psychometric measures such as personality traits or empathy scores and rerunning our main specification using a probit model.

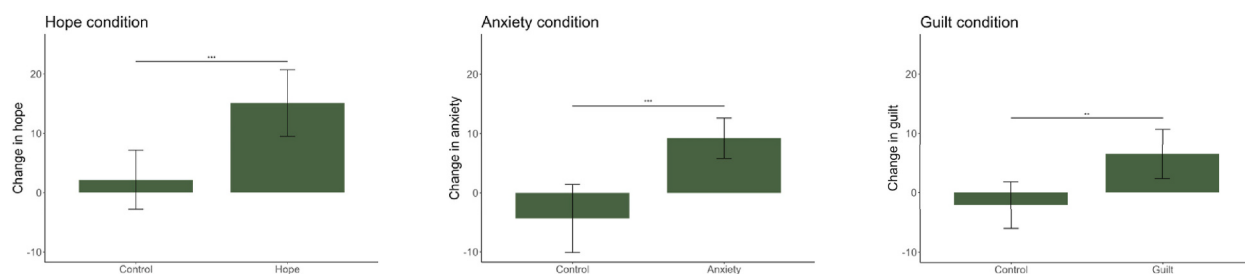


Fig. 1. Change in emotions in the hope (left graph), anxiety (middle graph) and guilt (right graph) condition compared to the control condition. Emotions were measured using a granular 0 to 100 scale. Differences between the treatment conditions and the control condition are measured using Wilcoxon rank sum tests. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 2

Estimated probability of donating and mean donation amounts by experimental condition with Wilcoxon rank sum test p-values.

Panel A				
Condition	Prob. of donating	Wilcoxon rank sum test		
		Control	Hope	Anxiety
Control	0.60 (0.49)	–	–	–
Hope	0.56 (0.50)	0.636	–	–
Anxiety	0.61 (0.50)	0.845	0.500	–
Guilt	0.71 (0.46)	0.155	0.059	0.216

Panel B				
Condition	Donation amount			
		Control	Hope	Anxiety
Control	2.36 (2.85)	–	–	–
Hope	1.68 (2.34)	0.220	–	–
Anxiety	2.02 (2.28)	0.746	0.271	–
Guilt	2.89 (2.97)	0.188	0.006	0.096

Notes: The table shows the estimated probabilities of donating to climate change mitigation projects and mean donation amounts by experimental condition and p-values of pairwise Wilcoxon rank sum tests. Standard deviations are reported in parentheses.

Table 3

Regression of (1) decision whether to donate to climate change mitigation projects, (2) donation amount and (3) decision to donate larger amounts to the spatially far climate change mitigation project conditional on donation on treatment indicator and control variables.

	Prob. of donating (1)	Donation amount (cond.) (2)	Choose spatially far (3)
Hope condition	–0.01 (0.08)	–0.96** (0.39)	–0.04 (0.10)
Anxiety condition	0.04 (0.08)	–0.76* (0.39)	–0.20** (0.09)
Guilt condition	0.14* (0.07)	0.21 (0.37)	–0.04 (0.10)
Constant	0.63*** (0.17)	2.42*** (0.63)	0.36** (0.18)
Observations	286	180	180
R ²	0.18	0.56	0.07
F Statistic	3.57*** (df = 16; 269)	13.12*** (df = 16; 163)	1.11 (df = 11; 168)

Notes: In model (1) and model (2) include demographic controls, information on prior donation, economic preferences, and descriptive and injunctive social norms. Selected controls are omitted from this results table but are displayed in Table B.5 and Table B.6 in the Appendix. In model (3) we include demographic controls and information on prior donation. The reference condition is ‘Control’. Robust standard errors in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

10 EUR endowment. At the intensive margin, we do not find any significant effects of being in the guilt condition on donation amount, keeping in mind that individuals in the guilt condition have an increased probability of donating.¹⁵

Result 3. At the intensive margin, being in the hope condition and being in the anxiety condition negatively affects the amount individuals donate to an environmental NGO.

In Section 1, we discussed the possibility that induced emotions could reinforce ‘home bias’ and thereby impede effective climate change mitigation. We therefore investigated whether watching a video designed to trigger a distinct emotion affected beneficiary selection, i.e., whether conditional on donating an individual either favors the close or far away climate change mitigation project of her chosen environmental NGO. To do so, we used a linear probability model and regressed an indicator for whether an individual

¹⁵ Similar to Table B.5, Table B.6 in the Appendix provides evidence that our results are robust when including different sets of control variables.

chooses to donate strictly larger amounts to the spatially far away climate change mitigation project on treatment indicator and control variables. Column (3) in Table 3 indicates that being in the anxiety condition indeed has an effect on beneficiary selection: Being in the anxiety condition decreased the probability of donating larger amounts to the spatially far away project by, ceteris paribus, 20 percentage points ($p = 0.040$) compared to being in the control condition.

Result 4. Individuals in the anxiety condition are less likely to donate larger amounts to the spatially far project of an environmental NGO.

Can non-significant treatment effect estimates be interpreted as evidence of no true effect? Based on the observed standard errors and degrees of freedom from the main models reported in Table 3, the minimal detectable effect sizes that our experimental design allowed to detect with high probability (80 % power, two-sided $\alpha = 0.10$) are approximately 18–20 percentage points in the extensive margin specification, 0.93–0.98 EUR in the intensive margin specification, and 23–25 percentage points in the spatial specification. These minimal detectable effect sizes correspond to relatively large changes in the outcomes. At the same time, the confidence intervals around the estimated treatment effects remain wide and in case of the outcomes where we do not find statistically significant treatment effects include both zero and effects that would be quite large in magnitude in the context of our study. Consequently, the non-significant estimates in Table 3 cannot be taken as robust evidence for the absence of a true effect. Rather, they indicate that, in this sample, the data do not provide sufficiently strong evidence to reject the null hypothesis. The findings are therefore statistically inconclusive, and smaller true effects cannot be ruled out.

5.4. Emotional responses to donating

In Section 2, we reviewed the literature proposing that emotions enter the utility function and influence the marginal utility of decision alternatives. Following the theory of Loewenstein (2000), individuals derive utility from decision alternatives that help them manage their affective state.

As we measured participants' emotions at four points in time, we can investigate the relationship between changes in subjectively reported levels of emotions and experimental condition (comp. Schwartz and Loewenstein, 2017). If donating serves the purpose of relieving emotional distress or sustaining emotional comfort, hope levels should increase and anxiety and guilt levels should decrease after donating among individuals who did donate (donators) compared to those who did not donate to an environmental NGO (non-donators). Fig. 2 provides suggestive evidence that donating to climate change mitigation projects is associated with a decreased level of subjectively reported guilt. We conducted Wilcoxon rank sum tests and find that donators reported a significant decrease in guilt levels after donating ($p = 0.040$) as compared to the guilt levels they reported directly after the video treatment (but before the donation), while non-donators did not. We interpret this as a signal for the potential of environmental donations to relieve climate-related guilt. Finally, we

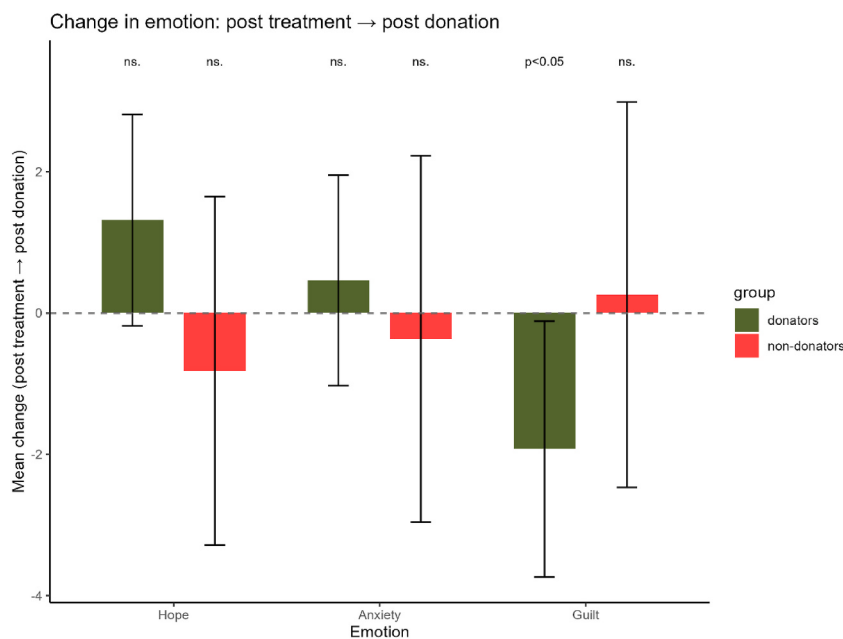


Fig. 2. Change in subjectively reported level of emotions after the climate engagement tasks among donators and non-donators. In this graph, we display the change in levels of emotion between our measurement directly after the treatment and our measurement after the donation decision. Individuals who donated (parts of) their endowment to climate change mitigation projects are classified as 'donators' and individuals who did not donate are classified as 'non-donators'. 'Post treatment' refers to the second measurement of subjectively reported emotions directly after receiving the treatment. 'Post donation' refers to the third measurement directly after the climate engagement tasks. The error bars show 95 % confidence intervals.

compared the difference in average guilt levels directly after the treatment and four weeks after our experiment among donors and non-donors: 34.4 % of donating individuals and only 24.3 % of non-donating individuals answered our follow-up questionnaire, suggesting different levels of self-selection. Focusing on individuals who answered our follow-up questionnaire, the results suggest that those who donated a positive amount during our experiment still experienced a lower subjectively reported level of guilt four weeks later (indicated by a negative change; $p = 0.039$), suggesting more persistent relief (comp. [Figure B.4](#) in the Appendix).

Result 5. Donation to an environmental NGO is related to decreased levels of guilt after donating, indicating emotional relief of guilt.

6. Conclusion

Climate change imposes huge challenges on our societies and economies and addressing these challenges requires collective action. Therefore, we need to better understand ways and develop strategies to motivate individual contributions to collective climate change mitigation behavior. The successful and adequate emotional addressing of individuals might be essential to raise their attention and support for distinct concerns. Different emotions have different, i.e., positive or negative, action potentials in the context of climate change mitigation and it is, thus, important to learn about their distinct action potentials.

In this study, we wanted to learn which emotions are ‘productive’ in fostering individual contributions to collective climate change mitigation efforts and which are not. Specifically, we investigated the potential of climate-related hope, anxiety, and guilt to motivate donations to an environmental NGO. Focusing on a bundle of emotions that has not been covered by the related behavioral economic literature so far, our findings extend the literature examining how emotions—differentiated by valence and arousal—affect collective behavioral responses supporting climate change mitigation ([Ibanez et al., 2017](#); [Schwartz and Loewenstein, 2017](#); [Ibanez and Roussel, 2021](#); [Palosaari et al., 2023](#)). We find that watching a video designed to trigger climate-related guilt affects the decision, whether to donate or not, i.e., the extensive margin of donation behavior: Our guilt-inducing video treatment increased the probability of contributing to climate change mitigation as compared to the video shown to the control group, suggesting that guilt appeals might help to motivate pro-environmental behavior ([Shipley and van Riper, 2022](#)). Additionally, we find that donations to an environmental NGO are related to a decrease in subjectively reported guilt. Our findings support the idea that guilt leads to reactive repairment behavior ([Smith and Lazarus, 1990](#)) and that individuals choose alternative options to relieve guilt ([Loewenstein, 2000](#)). Thus, we conclude that the act of donation might have instrumental value in relieving emotional distress and can be rationalized under the assumption of utility maximizing individuals. Regarding the intensive margin, we find that watching a video designed to trigger climate-related hope reduced donation amounts compared to controls, thus, contradicting the findings of studies that document positive action potential ([Ojala, 2022](#)). A possible explanation could be that positive effects of hope on collective action rely on the co-occurrence of perceived efficacy ([Cohen-Chen and Van Zomeren, 2018](#)) and we do not find efficacy measures to be predictive of donation decision in our sample. Likewise, and in line with our findings, it is documented that, under certain circumstances, hope appeals can be counterproductive, fostering denial and disengagement regarding climate change ([Ojala, 2022](#)); in the context of our study, this could be reflected in withdrawal from individual responsibility. Watching the anxiety-inducing video also led to reduced donation amounts. Intuitively speaking, this means that when an individual experienced climate-related anxiety after concluding that climate change cannot be sufficiently prevented, she reduced her support for climate change mitigation. Hence, in line with [O’Neill and Nicholson-Cole \(2009\)](#), this could indicate distancing or disengagement, possibly as a consequence of resignation or helplessness. In addition, experiencing climate-related anxiety might reinforce ‘home-bias’ ([Löschel et al., 2021](#)): We find suggestive evidence that anxiety-induced individuals were less likely to donate larger amounts to spatially far away climate change mitigation projects, thus confirming earlier arguments that anxiety guides focus on close-by population groups ([Arceneaux, 2017](#); [Richins et al., 2021](#)). These latter findings underline the importance of considering possible interactions with specific donation alternatives when designing emotionally charged addresses.

Overall, our study demonstrates that integrating psychological theories—particularly how distinct emotions are associated with future-directed outcomes—with the economic utility maximization framework provides valuable insights into decision-making related to public goods. Specifically, we showed how short video treatments can elicit emotions that, in turn, influence individuals’ contributions to collective climate change mitigation efforts. At the same time, there are important limitations of our approach: While our study highlights the relevance of emotions induced by a short video treatment, it remains inevitable that our way of inducing emotions might have addressed potential other channels through which the estimated treatment effect could operate. Our experimental design relies on the induction of emotions through the appraisal of different audiovisual stimuli, thereby following a long-standing tradition to induce emotions in the psychological literature ([Siedlecka and Denson, 2019](#)). Nonetheless, it might be that our audiovisual stimuli not only affected donation behavior through the affective state they induced, but also through the information they inherently conveyed. This needs to be kept in mind when interpreting the results. Addressing this concern would have required us to use treatment stimuli unrelated to the outcome ([Drouvelis and Grosskopf, 2016](#)). For the sake of external validity, we decided against doing so to mimic a real-world scenario as closely as possible.

Finally, we aim to highlight some general takeaways of our study. Addressing grand societal challenges requires (motivating) individuals to respond to systemic risks collectively before they become salient, hence negative externalities materialize. This challenge—and our findings—is not confined to the domain of NGOs. Rather, it extends to organizations and all collective entities seeking to foster cooperation around collective future-oriented and pro-social goals. By rendering collective risks personally meaningful and by acting as salient informational and social cues that guide perceptions of responsibility, urgency, significance, and behavioral appropriateness ([Schwarz, 1990](#); [Weiss and Cropanzano, 1996](#); [Van Kleef, 2009](#)), emotions can serve as a catalyst in this regard. Moreover, in a communication landscape characterized by emotionally-charged communication and intense competition for attention—recently introduced as an important resource in the modern economy ([Loewenstein and Wojtowicz, 2025](#))—it is essential to understand how

emotions translate into individual action. Our findings provide one piece of empirical evidence that informs communicators about the potential of inducing distinct emotions. Using a video treatment designed to induce climate-related guilt in our sample motivated non-donators to donate and hence affected individuals who might not have contributed otherwise. Inducing climate-related hope or anxiety in our sample, however, prevented donators —individuals who are generally willing to contribute —from donating higher amounts and might thus be counterproductive. Our findings further advance this understanding by showing asymmetrical effects of emotions in (organizational) communication (e.g., [Lindebaum and Jordan, 2014](#)). While conventional assumptions suggest that positive emotions affect engagement and negative emotions deter it, we find a more nuanced pattern: Under certain conditions, negative emotions like guilt can increase willingness to contribute by amplifying perceived responsibility, whereas positive emotions like hope may dampen motivation when not accompanied by strong efficacy beliefs. These insights point to the need to develop more nuanced and dynamic models of emotional influence on collective action, e.g., by including emotional flows ([Nabi et al., 2018](#)) and ambivalence ([Van Gent et al., 2024](#); [Bechtoldt and Schermelleh-Engel, 2025](#)).

Materials

The manuscript refers to video materials that have been used as treatments in this study. All videos are available via OSF: osf.io/k8z7v.

CRedit authorship contribution statement

Myriam Bechtoldt: Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization. **Carina Keller:** Writing – review & editing, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Daniel Schunk:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization. **Isabell Zipperle:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Ethics approval

The project was conducted in compliance with relevant laws and institutional guidelines and received IRB approval at the joint ethics board of Goethe University Frankfurt and Johannes Gutenberg University Mainz (August 24, 2022). Privacy rights of participants have been observed and informed consent for participation was obtained by participants.

Pre-registration

The authors pre-registered hypotheses and experimental design, The authors pre-registered hypotheses and experimental design. The pre-registration can be accessed using the following link: <https://doi.org/10.17605/OSF.IO/MD3ZJ>.

Data availability

The data underlying this project is available via OSF: osf.io/k8z7v.

Funding source declaration

This research received funding by Deutsche Bundesstiftung Umwelt, the research priority program Interdisciplinary Public Policy (IPP) of Johannes Gutenberg University Mainz, and the Research Fund of the EBS University.

The authors declared conflicts of interest via the Elsevier Declaration of Interests Tool.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Carina Keller reports financial support, equipment, drugs, or supplies, and travel were provided by German Federal Environmental Foundation (DBU). If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

We thank Katharina Hartinger, Timo Heinrich, Maria Kreml, Wladislaw Mill, Erik Sarrazin, Niklas Witzig and participants of the ASFEE 2023 in Montpellier, ESA Europe Meeting 2023 in Exeter, the NHH FAIR/RADY Spring School 2024 in San Diego, the IMEBESS 2024 in Riga and seminar participants of the Economics Research Seminars at the MPI for Collective Goods in Bonn and at the University of Hamburg, the Economics Symposium of the University of Mannheim, and the Behavioral Economics and Management Science Colloquium at the TU Hamburg for valuable comments. We also thank the editor and two anonymous referees for a very constructive revision process and Aaron Zimmer and João Andrade Arce Pais for excellent research support.

Appendix A. Text analysis of NGO web pages

We conducted a text analysis of NGO web pages to learn about the use of hope, anxiety, and guilt in NGO communication. We proceeded as follows: First, we generated a data set of text modules from the web pages of all environmental NGOs listed by the *Deutsches Zentralinstitut für soziale Fragen*, a foundation under civil law that advises citizens on their donation decisions. While we were interested in the NGOs' appeals for donations, the donation subpages were generally not very text heavy. We, therefore, used text bodies from the respecting start pages in our analysis; these pages are usually the first encounter a web page visitor has with the NGO's communication. Our emotion analysis required the application of a language model that is trained to predict the probabilities of the emotions hope, anxiety, and guilt to appear in the text body. We therefore applied a large language model capable of detecting our target emotions (for further information see [Liu et al., 2019](#); [Hu et al., 2022](#)). We retrained the model using the ISEAR data set, a data set comprising human descriptions of situations in which individuals have felt a certain emotion ([Scherer and Wallbott, 1994](#); [Troiano et al., 2019](#); [Meque et al., 2023](#)). The ISEAR data set involved descriptions of situations in which people have felt one of the seven emotions joy, anxiety, anger, sadness, disgust, shame or guilt. To generate a larger database to predict anxiety and guilt and to enrich the data set with descriptions of situations that relate to hope, we generated additional data using ChatGPT ([OpenAI, 2024](#)). As we pursued to detect emotions in a very fine-grained manner, we sliced text bodies into single sentences and let our model predict the probability of hope, anxiety, or guilt being transmitted by the sentence.

Our final step was to aggregate the predictions for hope, anxiety, and guilt across NGOs. We found that the average probability that web pages of environmental NGOs in Germany address hope is 91.1 %, while it is 81.7 % for anxiety and 81.1 % for guilt and interpret this as evidence that hope, anxiety, and guilt are emotions that are highly likely in NGO communication.

Appendix B. Results

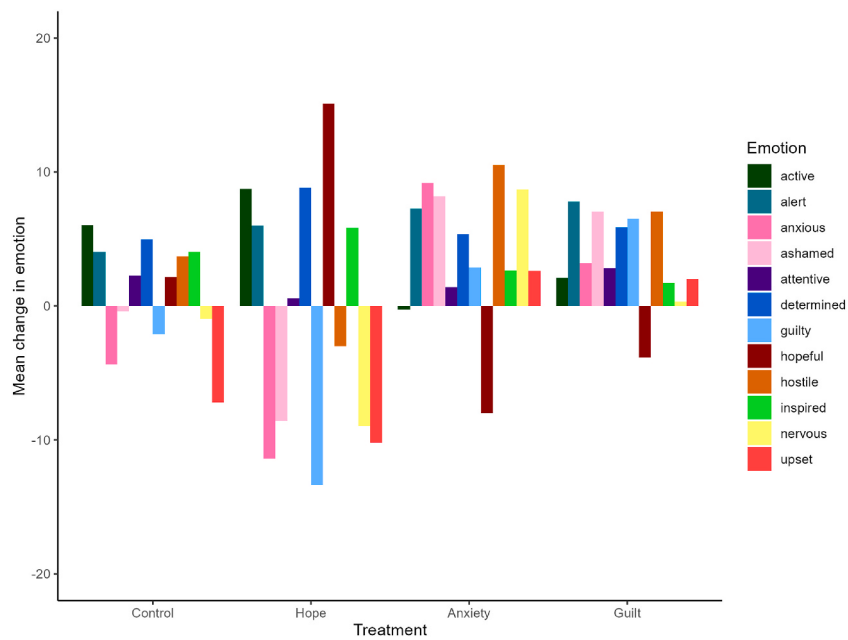


Fig. B.3. Change in all twelve subjectively reported emotions by experimental condition after the treatment.

Table B.4

Changes in subjectively reported levels of emotions by experimental condition

Panel A		
Emotions	Pre-treatment	Post-treatment
Control condition		
Hope	38.6 (29.1)	40.8 (29.4)
Anxiety	60.0 (29.1)	55.7 (28.1)
Guilt	56.0 (24.9)	53.9 (23.0)
Hope condition		
Hope	38.3 (25.2)	53.4 (24.6)
Anxiety	64.1 (26.9)	52.7 (25.9)
Guilt	62.8 (22.3)	49.4 (28.3)
Anxiety condition		
Hope	32.8 (27.4)	24.8 (26.4)
Anxiety	62.7 (30.8)	71.9 (29.0)
Guilt	56.6 (24.7)	59.5 (23.8)
Guilt condition		
Hope	33.1 (21.7)	29.2 (23.3)
Anxiety	63.8 (23.9)	67.1 (25.6)
Guilt	58.0 (22.8)	64.5 (23.0)
Panel B		
Test	Pre-treatment	Post-treatment
Kruskal Wallis test hope	0.46	0.00
Kruskal Wallis test anxiety	0.83	0.00
Kruskal Wallis test guilt	0.42	0.00

Notes: Panel A reports mean changes in subjectively reported target emotions between our pre-treatment and post-treatment measurement of subjective emotions by experimental condition. Emotions were measured using a 1 to 100 scale. Standard deviations are reported in parentheses. Panel B reports p-values of Kruskal Wallis tests indicating differences in emotions prior to and after emotion induction.

Table B.5

Regression of decision whether to donate to climate change mitigation projects on treatment indicator and different sets of control variables (extensive margin)

	Probability of donating				
	OLS				Probit
	(1)	(2)	(3)	(4)	(5)
Hope condition	−0.04 (0.09)	0.00 (0.08)	−0.01 (0.08)	−0.01 (0.07)	−0.02 (0.25)
Anxiety condition	0.01 (0.08)	0.04 (0.08)	0.04 (0.08)	0.04 (0.08)	0.17 (0.24)
Guilt condition	0.10 (0.08)	0.15** (0.08)	0.14* (0.07)	0.13* (0.07)	0.44* (0.23)
Gender	0.01 (0.07)	−0.01 (0.06)	−0.04 (0.07)	−0.08 (0.07)	−0.14 (0.21)
Age	−0.01 (0.01)	−0.01 (0.01)	−0.01 (0.01)	−0.01 (0.01)	−0.03 (0.02)
Income <100 EUR	−0.07 (0.15)	−0.11 (0.14)	−0.09 (0.14)	−0.08 (0.15)	−0.27 (0.41)
Income 100–250 EUR	0.14 (0.14)	0.14 (0.14)	0.13 (0.14)	0.14 (0.15)	0.44 (0.43)
Income 250–500 EUR	−0.03 (0.15)	−0.04 (0.14)	−0.04 (0.15)	−0.00 (0.16)	−0.11 (0.43)
Income >500 EUR	−0.20 (0.18)	−0.19 (0.17)	−0.20 (0.17)	−0.15 (0.18)	−0.59 (0.50)
Prior donations env.	0.01 (0.06)	−0.03 (0.06)	−0.03 (0.06)	−0.04 (0.06)	−0.09 (0.18)
Prior donations gen.	0.01 (0.04)	−0.01 (0.04)	−0.02 (0.04)	−0.01 (0.04)	−0.06 (0.14)
GPS altruism		0.00*** (0.00)	0.00*** (0.00)	0.00** (0.00)	0.00** (0.00)
GPS risk		−0.02 (0.01)	−0.02* (0.01)	−0.02 (0.01)	−0.06* (0.03)
GPS patience		0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.01 (0.01)
NEP score				0.11* (0.06)	
Self-efficacy				0.04 (0.04)	
Collective efficacy				0.00 (0.04)	
Extraversion				−0.03 (0.03)	
Agreeableness				0.04 (0.03)	
Conscientiousness				−0.01 (0.03)	
Neuroticism				−0.00 (0.03)	
Openness				0.01 (0.02)	
Empathy				0.01 (0.04)	
Social norm descriptive			0.02 (0.02)	0.02 (0.02)	0.07 (0.06)
Social norm injunctive			0.03*** (0.01)	0.03** (0.01)	0.10** (0.04)
Constant	0.59*** (0.15)	0.54*** (0.17)	0.63*** (0.17)	0.64*** (0.18)	0.41 (0.52)
Observations	286	286	286	286	286
R ²	0.06	0.13	0.18	0.21	
Adjusted R ²	0.03	0.09	0.13	0.18	
F Statistic	1.71* (df = 11; 274)	2.93** (df = 14; 271)	3.57*** (df = 16; 269)	2.72*** (df = 25; 260)	

Notes: 'Prior donations env.' indicates whether participants have donated to environmental NGOs prior to the experiment. 'Prior donations gen.' indicates whether the participants have generally donated prior to the experiment. The reference condition is 'Control'. Robust standard errors in parentheses. *p < 0.1; **p < 0.05; ***p < 0.01.

Table B.6

Regression of donation amount to climate change mitigation projects on treatment indicator and different sets of control variables (intensive margin)

	Donation amount			
	(1)	(2)	(3)	(4)
Hope condition	−1.16** (0.54)	−0.87* (0.51)	−0.96** (0.39)	−0.99** (0.40)
Anxiety condition	−0.81* (0.49)	−0.71 (0.50)	−0.76* (0.39)	−0.80** (0.40)
Guilt condition	0.10 (0.52)	0.37 (0.50)	0.21 (0.37)	0.15 (0.37)
Gender	−0.18 (0.46)	−0.30 (0.44)	−0.22 (0.32)	−0.26 (0.38)
Age	0.05 (0.06)	0.02 (0.06)	0.04 (0.05)	0.03 (0.05)
Income <100 EUR	1.29 (0.80)	0.76 (0.78)	0.84 (0.56)	0.88* (0.52)
Income 100–250 EUR	1.55** (0.77)	1.26 (0.77)	0.80 (0.59)	0.80 (0.55)
Income 250–500 EUR	2.23*** (0.85)	1.84** (0.84)	1.42** (0.61)	1.52** (0.60)
Income >500 EUR	1.51 (0.98)	1.54 (0.96)	1.59* (0.86)	1.82** (0.85)
Prior donations env.	0.18 (0.45)	−0.11 (0.46)	−0.02 (0.32)	−0.06 (0.32)
Prior donations gen.	0.58* (0.32)	0.35 (0.35)	0.07 (0.23)	0.07 (0.24)
GPS altruism		0.01*** (0.00)	0.01** (0.00)	0.00 (0.00)
GPS risk		0.09 (0.06)	0.06 (0.04)	0.06 (0.04)
GPS patience		−0.00 (0.02)	−0.00 (0.02)	0.00 (0.02)
NEP score				0.51 (0.35)
Self-efficacy				0.06 (0.18)
Collective efficacy				0.14 (0.21)
Extraversion				−0.10 (0.12)
Agreeableness				0.15 (0.18)
Conscientiousness				0.10 (0.15)
Neuroticism				0.02 (0.14)
Openness				−0.08 (0.13)
Empathy				0.03 (0.23)
Social norm descriptive			0.84*** (0.10)	0.87*** (0.11)
Social norm injunctive			0.12* (0.06)	0.08 (0.06)
Constant	2.31*** (0.81)	1.33 (0.89)	2.42*** (0.63)	2.45*** (0.65)
Observations	180	180	180	180
R ²	0.14	0.21	0.56	0.58
Adjusted R ²	0.08	0.14	0.52	0.51
F Statistic	2.44** (df = 11; 168)	3.12** (df = 14; 165)	13.12*** (df = 16; 163)	8.65*** (df = 25; 154)

Notes: 'Prior donations env.' indicates whether participants have donated to environmental NGOs prior to the experiment. 'Prior donations gen.' indicates whether the participants have generally donated prior to the experiment. The reference condition is 'Control'. Robust standard errors in parentheses. *p < 0.1; **p < 0.05; ***p < 0.01.

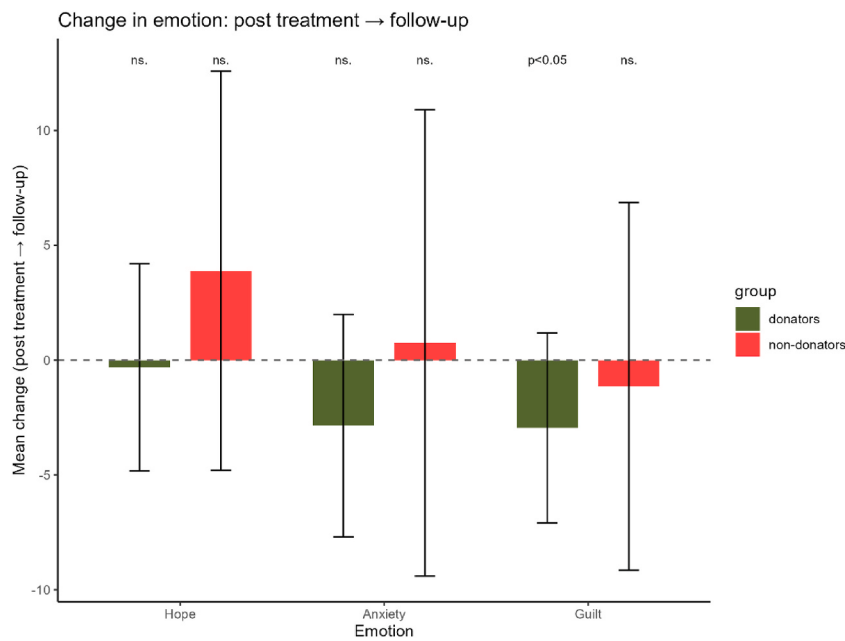


Fig. B.4. Change in subjectively reported level of emotions among donors and non-donators four weeks after the experiment. Individuals who donated (parts of) their endowment to climate change mitigation projects are classified as ‘donators’ and individuals who did not donate are classified as ‘non-donators’. ‘Post-treatment’ refers to the second measurement of subjectively reported emotions directly after receiving the video treatment. ‘Follow-up’ refers to the measurement in the follow-up questionnaire four weeks after the experiment. The error bars show 95 % confidence intervals.

Appendix C. Experimental screens

This section provides example screenshots of the relevant experimental screens. The experiment was programmed with oTree (Chen et al., 2016).

Appendix C.1. Institution selection

To which organisation do you want to donate?

Important: At this point you only choose a potential beneficiary. There is no right or wrong. You can decide late whether at all and how much you donate.

You can choose one of two organisations. Both organisations are non-profit organizations and admit to high transparency standards. For each organisation we have summarized the most important information, that aims to support your choice.

Primaklima e.V.

For 30 years now, Primaklima e.V. has been engaged in reforestation and planting trees that contribute to a reduction of the CO₂ content in the atmosphere and thus have an impact on the global climate. Primaklima e.V. has already successfully implemented numerous forest projects around the globe. Specifically, Primaklima e.V. is currently implementing tree planting projects in Germany and Nicaragua, among other countries. You will be able to donate to these projects later.

[More information on Primaklima e.V.](#)

Naturefund e.V.

Naturefund e.V. buys land to preserve habitat for the diversity of species. In the wake of climate change, Naturefund e.V. is increasingly buying forests and reforesting them. In addition, Naturefund e.V. plants trees to preserve forests and to spread reforestation and cultivation methods with a positive climate balance. Currently Naturefund e.V. is involved in tree planting projects in Germany and Costa Rica. You will be able to donate to these projects later.

[More information on Naturefund e.V.](#)

If you decide to donate later, which NGO shall be the beneficiary of your donation?

Fig. C.5. Screenshot of the institution selection decision page. Individuals were given information about two trustworthy NGOs that engage in climate change mitigation. More information could have been requested to make a more deliberate decision. Individuals could choose one of the two NGOs or declare that they do not plan to donate. All information has been translated to English to secure general understanding in the scientific community.

Appendix C.2. Real effort task

We start!

We'll start now with your first task.

You have the opportunity to earn **6,00 €**. During the experiment, you can either donate (parts of) or take home your participation fee and the amount you earn in this task.

Your task is to **count the amount of zeros**. In each matrix you see, please count all zeros and enter the amount you have counted in the respective field.

You will see **10 matrices** in total and you will have 20 seconds to count the zeros in each matrix.

If you solve **a minimum of 5 matrices** correctly, you will proceed the experiment with a total of 10,00 €.

Fig. C.6. Screenshot of the instructions page of the real effort task. Individuals were instructed on the real effort task and how they could increase their experimental budget. All information has been translated to English to secure general understanding in the scientific community.

Counting zeros

Time left to complete this page: **0:16**

1	1	0	0	0
1	1	0	0	1
0	0	1	0	0
0	1	1	1	0
0	0	1	0	1

How many zeros are you counting?

Fig. C.7. Screenshot of an example page of the real effort task. The selected task is inspired by [Abeler et al. \(2011\)](#). Individuals were instructed on the real effort task and how they could increase their experimental budget. All information has been translated to English to secure general understanding in the scientific community.

Appendix C.3. Donation decisions

Your donation

At the beginning of the study you have chosen the NGO **Primaklima e.V.** as the beneficiary of your donations.

With their afforestation projects **Primaklima e.V.** contributes to climate change mitigation in Germany and worldwide. Now you have the opportunity to donate (parts of) the 10,00 € you earned to support **Primaklima e.V.**

You will now make two independent donation decisions at the favor of **Primaklima e.V.**. In both cases you decide, how much of your earned 10,00 € you want to donate.

We will ask you how much of your 10,00 € you

- want to donate to an afforestation project in **Germany**
- or
- want to donate to an afforestation project in **Nicaragua**

At the end of the study, we will **randomly draw one of the two donation decisions** that we will realize.

That means that we will forward your donation to the corresponding project and disburse the disbursement amount to you at the end of the experiment.

Fig. C.8. Screenshot of the instructions page of the donation task. Individuals were instructed on the two donation decisions they would make in the following. All information has been translated to English to secure general understanding in the scientific community.

Your donation to a project in **Germany**



How much of the 10,00 € you earned, do you want to donate for a afforestation project of Primaklima e.V. in **Germany**?



Reminder: Overall, you will make two independent donation decisions of which only one is payoff relevant.

Fig. C.9. Screenshot of the donation page: spatially close projects. In this example the individual has chosen to donate to Primaklima e.V. at the beginning of the experiment. The maximum donation amount was corresponding to the earned endowment and individuals could decide to donate any amount between zero and the amount of their earned endowment. Donation decisions were displayed in random order and individuals were reminded that they would make two independent decisions. All information has been translated to English to secure general understanding in the scientific community.

Your donation to a project in **Nicaragua**



How much of the 10,00 € you earned, do you want to donate for a afforestation project of Primaklima e.V. in **Nicaragua** spenden?



Reminder: Overall, you will make two independent donation decisions of which only one is payoff relevant.

Fig. C.10. Screenshot of the donation page: spatially far projects. In this example the individual has chosen to donate to Primaklima e.V. at the beginning of the experiment. The maximum donation amount was corresponding to the earned endowment and individuals could decide to donate any amount between zero and the amount of their earned endowment. Donation decisions were displayed in random order and individuals were reminded that they would make two independent decisions. All information has been translated to English to secure general understanding in the scientific community.

Appendix C.4. Information seeking

What will you choose?

Now imagine that you are on a news page.

You have the opportunity to read an article from two different resorts. Which article do you choose?

Click here to read an article from the resort Climate & Environment	Click here to read an article from the resort News
---	--

Fig. C.11. Screenshot of the information seeking page. Decision page: individuals decided on whether they aim to seek climate-change related information or not. All information has been translated to English to secure general understanding in the scientific community. The two buttons were displayed in random order.

Appendix C.5. Treatment scripts

All video treatments consisted of a series of images with a voice layover. Treatment scripts were designed to stimulate target emotions without directly referring to the emotion. Chosen images were adjusted to respective passages of the text. Originally, treatment scripts were presented in German language but translated to English to secure general understanding in the scientific community. German versions are available upon request.

Control condition. “The albedo effect. The albedo effect is based on the Latin word *albus*, white. The albedo describes the ability of a surface to reflect solar energy and depends on its brightness. In other words, it describes the reflectivity of a non-reflective surface. Fresh snow is almost white and thus reflects the most solar energy on earth. This contrasts with asphalt, which absorbs the most energy. Generally, the ratio of reflected to absorbed radiation is given. The brighter a surface is, the higher its reflectivity. The albedo is given in values from 0 to 1, where 1 means that the surface reflects 100 % of the solar radiation, i.e., it is white, and 0 means that it reflects 0 %, i.e., it absorbs 100 % and is black. The absorbed heat then heats the surface. A surface with a value of 0.9 such as high fog reflects 90 % of the radiation and absorbs only 10 % of it. A white snow cover has an albedo of about 0.95, which means it absorbs almost no radiation. A black surface, on the other hand, absorbs all the radiation and therefore has an albedo of 0. Satellite measurements show that the planet Earth has an annual average albedo of about 0.3. This includes cloud cover and the effect of the atmosphere. If you wear a black T-shirt in the sun, you will get warm quickly because the fabric absorbs more heat than if you wear a white T-shirt. Albedo of roof surfaces. Compared to natural surfaces, roof materials such as tiles, gravel or concrete, which are typical in urban building construction, have a lower reflectivity for solar radiation. In summer, these surfaces can reach a surface temperature several degrees higher than, for example, green areas. For buildings, this means increased heat transfer from the building surface both into the building and into the ambient air. The use of materials and paints with a high albedo are therefore possible measures to reduce the air temperature in a city. Albedo of wall surfaces. Compared to natural surfaces, typical building exterior wall materials such as stone, clinker or concrete have a lower reflectivity for solar radiation. For buildings, this means increased heat transfer from the building surface both into the building and into the ambient air. The use of materials and paints with a high albedo are therefore possible measures to reduce the air temperature around a building. Building height. The effects of building height on the air temperature near the ground must be taken into account especially when planning urban living space through new city districts

or through redensification (“city of short distances”). Here, both the influence of the building height on the air flow and the shadow cast, as well as on the heat storage (day) and release (night) by the buildings play an important role. Due to these influences, the dependence of air temperature on building height is not linear and differs significantly between day and night.”

Hope condition. “How can we mitigate climate change? With your commitment and the energy transition on-site. To stop climate change, the world must cut greenhouse gas emissions by half every decade, starting now. If we gradually change our way of life and decarbonize our economy by 2050, we can prevent a climate catastrophe and live on a planet worth living on. Germany also wants to be climate-neutral by 2045. According to experts, we can achieve this goal together, because not only companies, but everyone can do something for the climate and make a big difference. There are many ways to save CO₂. The good news is that many of them are quite simple and require hardly any changes in everyday life. For example, you can consume less animal products and more organic food from the region and season. You can also plan your holiday in such a way that you travel in a climate-friendly way and do not fly, for example. You can also travel to university or work by bike, bus or train. You yourself can make sure that you consume more consciously and dispose of waste correctly, but you can also convince your flatmates and friends to do the same. Of course, it is crucial that climate protection is also heard at the political level—to demand this, you can go to demonstrations or sign petitions, for example. You can also advocate for better climate protection at your university or work and propose to take part in a “clean-up” event together or set incentives to save resources: switching off the lights, turning down the heating when airing and similar things can really be done by everyone. But can we also achieve complex challenges like the energy transition? Yes, together, at your doorstep! The inhabitants of Neuerkirch, a district in Rhineland-Palatinate between Trier, Koblenz and Mainz, show how this can work: with heart and soul and with many good ideas, they are driving climate protection and the energy transition forward locally. Here, wind turbines and photovoltaic systems generate three times more electricity than businesses and households in the district consume. The first steps towards climate protection were taken as early as 1999, when an energy controlling system was set up for public buildings. A seemingly small step that had a big impact: after 14 years, the district's representative took stock: the district has saved two million euros in energy costs and almost 10,000 tons of CO₂. So, climate protection is quite straightforward!”

Anxiety condition. “Climate crisis: Disasters become the ‘new normal’. Ylenia today, the Ahr valley yesterday: floods, storms, droughts and forest fires are becoming more and more frequent. The climate crisis has long had us in its grip—the forecasts are apocalyptic. In the summer of 2021, there were also warnings from the German Weather Service, but hardly anyone had seen this gigantic scale coming. For two days it rained incessantly in western Germany, streams and rivers had burst their banks, the soils could no longer absorb the water. Within hours, the masses of water flooded the country. Villages and towns were devastated, livelihoods destroyed, more than 180 people died. A catastrophe that went down in German history. What happened in 2021 in the night of 15 July in the middle of Germany is a Western European climate flood. This catastrophe was predictable and no longer a once-in-a-century event. We will experience these dramatic changes more and more frequently with rapid global warming: The year 2022 shows this very clearly—in Germany we were plagued by a long-lasting heat wave, the Rhine level was lower than ever before. Pakistan has been hit by the worst floods in decades. Over 1160 people have already died, over 1 million houses have been destroyed. In Belgium and the Netherlands, storms and floods brought heavy rain, violent storms and hailstones the size of tennis balls. In Canada and the USA, tornadoes left a trail of devastation. Canada and California suffered brutal heat waves and drought, with temperatures climbing to nearly 50°. China and Turkey battled floods. Brazil and Iran have been in drought for months. In Russia and the Mediterranean, forest fires are spreading at breakneck speed. Until today. According to experts, by 2050 there will be a disaster like the one in the Ahr valley

every five years. And how does the climate crisis affect your life? What might your life feel like in 2050? The air is hot and polluted. You have to cough. Before you can open the window, you always have to check the air quality. When you go outside, your eyes water and you have to wear a mask —on bad days even an expensive high-tech mask, if you can afford it. Depending on where you live, it can get up to 50° for more than a month a year. You have to pay to use water in public toilets. One person in your family has already died from an emerging tropical disease such as the dangerous Chikungunya virus."

Guilt condition. "Climate crisis: How each of us is failing to save the climate. Reports of global climate catastrophes with devastating consequences for humans and nature are pouring in — floods, droughts, species extinction have long been part of our everyday lives worldwide. Experts agree that only man-made emissions of greenhouse gases, for example from the burning of fossil fuels, can explain the climate crisis. We humans are therefore to blame for the climate crisis. Our way of life — and your way of life too — is responsible for the fact that the earth is warming up at an unprecedented rate. And yet we persist with habits and behaviors that are increasingly destroying our natural environment, poisoning the air and water. In Germany, we are particularly responsible for climate change. Instead of actively mitigating climate change and consuming less, we are consuming more and more. Since the first climate conference in Rio in 1992, private consumer spending in Germany has increased by more than 80 %. The number of passenger cars on German roads has also risen by almost six million to more than 47 million vehicles in the past ten years. Air traffic regularly reports new records: in 2018 there were more than 3.3 million commercial flights in German airspace. Last but not least, the German agricultural and food sector is responsible for about a quarter of all greenhouse gas emissions, with more than half of the grain grown in Germany being fed to animals. That is why Germany needs millions more hectares of agricultural raw materials from other parts of the world for food, as animal feed or for the production of e.g. textiles or bioenergy. Two million hectares alone are due to cultivation for soy in South America. We are thus making a significant contribution to the destruction of unique habitats, which are considered hot spots of biodiversity and CO₂ reservoirs worldwide. Some consumers in Germany, like perhaps you, want to change this, but they get lost in the minutiae. Of course it makes sense to give up strawberries out of season or the plastic straw when drinking. But these are behavioral changes that will not significantly improve your personal climate balance. The big, but uncomfortable levers are the topics of housing, mobility and nutrition. What have you bought in the last few months, how and where were all your products produced, what have you eaten, where have you traveled, and where does your electricity come from? You can certainly think of a lot especially a lot of CO₂ that fills your ecological footprint. More specifically, your personal emissions are around 8.5 tons of CO₂ per year, which is miles away from the necessary value of less than one ton per person per year. Your heating and food alone emit about 1.75 tons of CO₂ equivalents per year. Your current CO₂ emissions are about 60 % higher than the world average and more than four times the value of a person in India. So you are not only destroying your own livelihood but above all that of innocent people in the global south. Drought, flood, hunger — these are already part of everyday life for many people in the global south, which you are promoting through your lifestyle."

Appendix C.6. Overview of surveys

Table C.7

Overview of scales

Measure	Scale	Reference
Risk preferences	GPS risk pref. modules	Falk et al. (2018)
Time preferences	GPS time pref. modules	Falk et al. (2018)
Social preferences	GPS social pref. modules	Falk et al. (2018)
Personality traits	(adopted) Likert scale (1–6)	Rammstedt et al. (2013)*
Empathetic concern	(adopted) Likert scale (1–6)	Davis (1980)*
Environmental attitudes	(adopted) Likert scale (1–6)	Schleyer-Lindenmann et al. (2018)*
Self-efficacy	(adopted) Likert scale (1–6)	Hamann and Reese (2020)
Collective efficacy	(adopted) Likert scale (1–6)	Hamann and Reese (2020)
Social norms	Free choice	Cialdini et al. (1991)
Emotions	Slider (1–100)	Breyer and Bluemke (2016)*

Notes: The table provides an overview of the scales providing key control variables in the reported analyses. The star indicates the implementation of an adjusted/shortened version of the scale.

Appendix D. Deviation from pre-registration

Hypotheses and experimental design:

In our pre-registration, we outlined six hypotheses, five treatment conditions (hope, anxiety, guilt, and two emotional flow conditions) and one control condition. In the present paper, we focus on H1a, H1b, and an exploratory analysis of spatiality in donation decisions, only referring to data collected from participants in the control, hope, anxiety, and guilt conditions. These conditions are described in Section 4. Participants in the emotional flow treatment groups—the remaining treatment conditions—were exposed to video treatments that aimed to induce combined emotions, i.e., the sequential experience of either hope and anxiety or anxiety and hope. (Most of) the remaining hypotheses (including the hypotheses that cover the emotional flow conditions) are examined in separate papers. This approach leverages synergies in data collection while allowing each paper to provide a focused examination of a distinct theoretical framework. In the following we refer to the remaining hypotheses and justify why they are excluded from the present paper:

H2: Building on theoretical frameworks on how emotions influence risk-related information seeking and information avoidance (Griffin et al., 1999; Golman et al., 2017), this hypothesis explores how distinct climate-related emotions shape individuals' motivation to engage with or withdraw from climate change information. These frameworks suggest that emotions affect both the perceived need for information and the willingness to confront potentially threatening or uncomfortable content, leading to different patterns of information consumption and avoidance. Because information processing represents a cognitive outcome distinct from actual climate change mitigation behavior, we will analyze this pathway in a separate paper.

H3/H4: We initially aimed to investigate the potential fade-out effect of distinct emotions on pro-environmental behavior over time. However, we encountered an insufficient response rate in our follow-up survey, which precluded the quantitative analysis of text data. Consequently, no results derived from the follow-up survey's text data are reported in this manuscript. Further, we aimed to investigate the role of perceived efficacy more extensively, a factor commonly discussed in related psychological literature (Cohen-Chen and Van Zomeren, 2018). As neither perceived self-efficacy nor perceived collective efficacy showed significant relationships with our outcome variables in our regression models (see Tables B.5 and B.6 in the Appendix), and subsequent interaction analyses with treatment conditions and higher efficacy levels also yielded no significant effects, a detailed discussion of perceived efficacy is omitted from this paper.

H5/H6a/H6b: These hypotheses draw on emerging research in emotional flow (Nabi, 2015), which theorizes that persuasive effects unfold following a progression of multiple emotions (Nabi et al., 2018) stimulating distinct message processing depth and action tendencies. Importantly, this approach is also grounded in Excitation Transfer Theory (Zillmann, 1983), which posits that residual physiological arousal from one emotional experience can intensify the subsequent emotional response if the arousal is not fully dissipated. In this context, initial anxiety may amplify subsequent hope, making emotional sequencing a potentially powerful mechanism for persuasion. Moreover, this work conceptually aligns with an 'emotions-as-frames' perspective, which positions discrete emotions as interpretive lenses that shape message meaning and influence downstream cognitive and behavioral responses (Kühne and Schemer, 2015; Lecheler et al., 2015). These emotional flow conditions, therefore, will be analyzed in a separate research paper that engages directly with these psychological theories to preserve conceptual clarity.

Sample size:

The sample sizes of the different experiments deviate from what has been specified in the pre-registration. While the pre-registration aimed at 80 per treatment group, each treatment group includes a few participants less (control: $n = 74$, hope: $n = 72$, anxiety: $n = 77$, guilt: $n = 78$). This shortfall is attributable to participant no-shows during the laboratory sessions.

References

- Abeler, J., Falk, A., Goette, L., Huffman, D., 2011. Reference points and effort provision. *Am. Econ. Rev.* 101, 470–492.
- Ágoston, C., Urbán, R., Nagy, B., Csaba, B., Kóváry, Z., Kovács, K., Varga, A., Dull, A., Monus, F., Shaw, C., Demetrovics, Z., 2022. The psychological consequences of the ecological crisis: three new questionnaires to assess eco-anxiety, eco-guilt, and ecological grief. *Clim. Risk Manag.* 37, 100441.
- Arceneaux, K., 2017. Anxiety reduces empathy toward outgroup members but not ingroup members. *Journal of Experimental Political Science* 4, 68–80.
- Baumgartner, H., Pieters, R., Bagozzi, R., 2008. Future-oriented emotions: conceptualization and behavioral effects. *Eur. J. Soc. Psychol.* 38, 685–696.
- Becht, A., Spitzer, J., Grapsas, S., van de Wetering, J., Poorthuis, A., Smeekes, A., Thomaes, S., 2024. Feeling anxious and being engaged in a warming world: climate anxiety and adolescents' pro-environmental behavior. *JCPP (J. Child Psychol. Psychiatry)* 65, 1270–1282.
- Bechtoldt, M., Schermelleh-Engel, K., 2025. Worry's clout: concern, not positive affectivity, drives climate activism. *J. Environ. Psychol.* 101, 102517.
- Bissing-Olsen, M., Fielding, K., Iyer, A., 2016. Experiences of pride, not guilt, predict pro-environmental behavior when pro-environmental descriptive norms are more positive. *J. Environ. Psychol.* 45, 145–153.
- Blagoev, B., Schreyögg, G., 2025. Eigenzeit: a new lens on temporal complexity. *Acad. Manag. Rev.* 50, 93–113.
- Breyer, B., Bluemke, M., 2016. Deutsche Version der Positive And Negative Affect Scale PANAS (GESIS Panel). Zusammenstellung Sozialwissenschaftlicher Items und Skalen. <https://doi.org/10.6102/zis242>.
- Brosch, T., 2021. Affect and emotions as drivers of climate change perception and action: a review. *Curr. Opin. Behav. Sci.* 42, 15–21.
- Brosch, T., Scherer, K., Grandjean, D., Sander, D., 2013. The impact of emotion on perception, attention, memory, and decision-making. *Swiss Med. Wkly.* 143 w13786–w13786.
- Bury, S., Wenzel, M., Woodyatt, L., 2020. Against the odds: hope as an antecedent of support for climate change action. *Br. J. Soc. Psychol.* 59, 289–310.
- Carroll, R., Kachersky, L., 2019. Service fundraising and the role of perceived donation efficacy in individual charitable giving. *J. Bus. Res.* 99, 254–263.
- Caviola, L., Schubert, S., Greene, J., 2021. The psychology of (in) effective altruism. *Trends Cognit. Sci.* 25, 596–607.
- Chapman, C., Louis, W., Masser, B., Thomas, E., 2022. Charitable triad theory: how donors, beneficiaries, and fundraisers influence charitable giving. *Psychol. Market.* 39, 1826–1848.
- Charness, G., Gneezy, U., Halladay, B., 2016. Experimental methods: pay one or pay all. *J. Econ. Behav. Organ.* 131, 141–150.
- Chen, D., Schonger, M., Wickens, C., 2016. Otree—An open-source platform for laboratory, online, and field experiments. *Journal of Behavioral and Experimental Finance* 9, 88–97.
- Cialdini, R., Kallgren, C., Reno, R., 1991. A focus theory of normative conduct: a theoretical refinement and reevaluation of the role of norms in human behavior. In: Zanna, M. (Ed.), *Advances in Experimental Social Psychology*, vol. 24. Academic Press, pp. 201–234.
- Clot, S., Grolleau, G., Ibanez, L., 2018. Shall we pay all? An experimental test of random incentivized systems. *J. Behav. Exp. Econ.* 73, 93–98.
- Cohen-Chen, S., Van Zomeren, M., 2018. Yes we can? Group efficacy beliefs predict collective action, but only when hope is high. *J. Exp. Soc. Psychol.* 77, 50–59.
- Cryder, C., Loewenstein, G., Seltman, H., 2013. Goal gradient in helping behavior. *J. Exp. Soc. Psychol.* 49 (6), 1078–1083.
- Davis, M., 1980. A Multidimensional Approach to Individual Differences in Empathy. *JSAS Catalog of Selected Documents in. Psychology* 10, 85.
- Diederich, J., Goeschl, T., 2018. Voluntary action for climate change mitigation does not exhibit locational preferences. *J. Environ. Econ. Manag.* 90, 175–180.
- Drouvelis, M., Grosskopf, B., 2016. The effects of induced emotions on pro-social behaviour. *J. Publ. Econ.* 134, 1–8.
- Dunlap, R., Van Liere, K., Mertig, A., Jones, R., 2000. New trends in measuring environmental attitudes: measuring endorsement of the new ecological paradigm: a revised NEP scale. *J. Soc. Issues* 56, 425–442.
- Ettinger, J., Walton, P., Painter, J., DiBlasi, T., 2021. Climate of hope or doom and gloom? Testing the climate change hope vs. fear communications debate through online videos. *Clim. Change* 164, 19.
- Falk, A., Becker, A., Dohmen, T., Enke, B., Huffman, D., Sunde, U., 2018. Global evidence on economic preferences. *Q. J. Econ.* 133, 1645–1692.
- Falk, A., Becker, A., Dohmen, T., Huffman, D., Sunde, U., 2023. The preference survey module: a validated instrument for measuring risk, time, and social preferences. *Manag. Sci.* 69, 1935–1950.
- Feldman, L., Hart, P., 2018. Is there any hope? How climate change news imagery and text influence audience emotions and support for climate mitigation policies. *Risk Anal.* 38, 585–602.
- Ferguson, M., Branscombe, N., 2010. Collective guilt mediates the effect of beliefs about global warming on willingness to engage in mitigation behavior. *J. Environ. Psychol.* 30, 135–142.
- Folkman, S., Lazarus, R., 1985. If it changes it must be a process: study of emotion and coping during three stages of a college examination. *J. Personality Soc. Psychol.* 48, 150–170.
- Folkman, S., Lazarus, R., 1988. Coping as a mediator of emotion. *J. Personality Soc. Psychol.* 54, 466–475.
- Geiger, N., Dwyer, T., Swim, J., 2023. Hopium or empowering hope? A meta analysis of hope and climate engagement. *Front. Psychol.* 14, 1139427.
- Gilovich, T., Griffin, D., Kahneman, D. (Eds.), 2002. *Heuristics and Biases: the Psychology of Intuitive Judgment*. Cambridge University Press.
- Gneezy, U., Imas, A., Madarász, K., 2014. Conscience accounting: emotion dynamics and social behavior. *Manag. Sci.* 60, 2645–2658.
- Golman, R., Hagmann, D., Loewenstein, G., 2017. Information avoidance. *J. Econ. Lit.* 55 (1), 96–135.
- Greiner, B., 2015. Subject pool recruitment procedures: organizing experiments with Orsee. *Journal of the Economic Science Association* 1, 114–125.
- Griffin, R., Dunwoody, S., Neuwirth, K., 1999. Proposed model of the relationship of risk information seeking and processing to the development of preventive behaviors. *Environ. Res.* 80 (2), S230–S245.
- Grimson, D., Knowles, S., Stahlmann-Brown, P., 2020. How close to home does charity begin? *Appl. Econ.* 52, 3700–3708.
- Haaland, I., Roth, C., Wohlfart, J., 2023. Designing information provision experiments. *J. Econ. Lit.* 61, 3–40.
- Hamann, K., Reese, G., 2020. My influence on the world (of others): goal efficacy beliefs and efficacy affect predict private, public, and activist pro-environmental behavior. *J. Soc. Issues* 76, 35–53.
- Harth, N., Leach, C., Kessler, T., 2013. Guilt, anger, and pride about in-group environmental behaviour: different emotions predict distinct intentions. *J. Environ. Psychol.* 34, 18–26.
- Hornsey, M., Fielding, K., 2016. A cautionary note about messages of hope: focusing on progress in reducing carbon emissions weakens mitigation motivation. *Glob. Environ. Change* 39, 26–34.
- Ibanez, L., Roussel, S., 2021. The effects of induced emotions on environmental preferences and behavior: an experimental study. *PLoS One* 16, e0258045.
- Hu, E., Shen, Y., Wallis, P., Allen-Zhu, Z., Li, Y., Wang, S., Wang, L., Chen, W., 2022. Lora: Low-rank adaptation of large language models. *ICLR* 1 (2), 3.
- Ibanez, L., Moureau, N., Roussel, S., 2017. How do incidental emotions impact pro-environmental behavior? Evidence from the dictator game. *J. Behav. Exp. Econ.* 66, 150–155.
- Ifcher, J., Zarghamee, H., 2011. Happiness and time preference: the effect of positive affect in a random-assignment experiment. *Am. Econ. Rev.* 101, 3109–3129.
- Kaiser, F., 2020. GEB-50. General Ecological Behavior Scale [Verfahrensdokumentation, Fragebogen deutsch und englisch]. In: Open Test Archive.
- Kormos, C., Gifford, R., 2014. The validity of self-report measures of pro-environmental behavior: a meta-analytic review. *J. Environ. Psychol.* 40, 359–371.
- Kühne, R., Schemer, C., 2015. The emotional effects of news frames on information processing and opinion formation. *Commun. Res.* 42 (3), 387–407.
- Lazarus, R., 1999. Hope: an emotion and a vital coping resource against despair. *Soc. Res.* 66, 653–678.
- Lecheler, S., Bos, L., Vliegenthart, R., 2015. The mediating role of emotions: news framing effects on opinions about immigration. *Journal. Mass Commun. Q.* 92 (4), 812–838.
- Lee, H., Calvin, K., Dasgupta, D., Krinner, G., Mukherji, A., Thorne, P., Trisos, C., Romero, J., Aldunce, P., Barrett, K., et al., 2023. Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. The Australian National University.
- Lerner, J., Keltner, D., 2000. Beyond valence: toward a model of emotion-specific influences on judgement and choice. *Cognit. Emot.* 14, 473–493.
- Lerner, J., Keltner, D., 2001. Fear, anger, and risk. *J. Personality Soc. Psychol.* 81, 146–159.

- Lerner, J., Li, Y., Valdesolo, P., Kassam, K., 2015. Emotion and decision making. *Annu. Rev. Psychol.* 66, 799–823.
- Li, C., Monroe, M., 2018. Development and validation of the climate change hope scale for high school students. *Environ. Behav.* 50 (4), 454–479.
- Lindebaum, D., Jordan, P., 2014. When it can be good to feel bad and bad to feel good: exploring asymmetries in workplace emotional outcomes. *Hum. Relat.* 67 (9), 1037–1050.
- Liu, Y., Ott, M., Goyal, N., Du, J., Joshi, M., Chen, D., Levy, O., Lewis, M., Zettlemoyer, L., Stoyanov, V., 2019. Roberta: a robustly optimized bert pretraining approach. *arXiv preprint arXiv:1907.11692*.
- Loewenstein, G., 1996. Out of control: visceral influences on behavior. *Organ. Behav. Hum. Decis. Process.* 65, 272–292.
- Loewenstein, G., 2000. Emotions in economic theory and economic behavior. *Am. Econ. Rev.* 90, 426–432.
- Loewenstein, G., Wojtowicz, Z., 2025. The economics of attention. *J. Econ. Lit.* 63 (3), 1038–1089.
- Löschel, A., Pei, J., Wang, R., Sturm, B., Buchholz, W., Zhao, Z., 2021. The demand for global and local environmental protection: experimental evidence from climate change mitigation in Beijing. *Land Econ.* 97, 137–154.
- Marini, M., 2023. Emotions and financial risk-taking in the lab: a meta-analysis. *J. Behav. Decis. Making* 36, e2342.
- Meque, A., Hussain, N., Sidorov, G., Gelbukh, A., 2023. Machine learning-based guilt detection in text. *Sci. Rep.* 13, 11441.
- Meritt, A., Effron, D., Monin, B., 2010. Moral self-licensing: when being good frees us to be bad. *Soc. Personal. Psychol. Compass* 4 (5), 344–357.
- Nabi, R., 2015. Emotional flow in persuasive health messages. *Health Commun.* 30 (2), 114–124.
- Nabi, R., Gustafson, A., Jensen, R., 2018. Framing climate change: exploring the role of emotion in generating advocacy behavior. *Sci. Commun.* 40 (4), 442–468.
- Nordhaus, W., 2019. Climate change: the ultimate challenge for economics. *Am. Econ. Rev.* 109, 1991–2014.
- Oehman, A., 2008. Fear and anxiety. In: Lewis, M., Haviland-Jones, J., Barrett, L. (Eds.), *Handbook of Emotions*, pp. 709–729.
- Ogunbode, C., Doran, R., Hanss, D., Ojala, M., Salmela-Aro, K., van den Broek, K., Bhullar, N., Aquino, S., Marot, T., Schermer, J., et al., 2022. Climate anxiety, pro-environmental action and wellbeing: antecedents and outcomes of negative emotional responses to climate change in 28 countries. *J. Environ. Psychol.* 84, 101887.
- Ojala, M., 2022. Hope and climate-change engagement from a psychological perspective. *Curr. Opin. Psychol.* 49, 101514.
- OpenAI, 2024. ChatGPT. URL: <https://www.openai.com/>. (Accessed 28 June 2024).
- O'Neill, S., Nicholson-Cole, S., 2009. 'Fear won't do it': promoting positive engagement with climate change through visual and iconic representations. *Sci. Commun.* 30, 355–379.
- Palosaari, E., Herne, K., Lappalainen, O., Hietanen, J., 2023. Effects of fear on donations to climate change mitigation. *J. Exp. Soc. Psychol.* 104, 104422.
- Rammstedt, B., Kemper, C., Klein, M., Beierlein, C., Kovaleva, A., 2013. A short scale for assessing the big five dimensions of personality: 10 item big five inventory (BFI-10). *Methods, Data, Analyses* 7, 233–249.
- Rees, J., Bamberg, S., 2014. Climate protection needs societal change: determinants of intention to participate in collective climate action. *Eur. J. Soc. Psychol.* 44, 466–473.
- Rees, J., Klug, S., Bamberg, S., 2015. Guilty conscience: motivating pro-environmental behavior by inducing negative moral emotions. *Clim. Change* 130, 439–452.
- Rhodes-Purdy, M., Navarre, R., Utych, S., 2021. Measuring simultaneous emotions: existing problems and a new way forward. *Journal of Experimental Political Science* 8, 1–14.
- Richins, M., Barreto, M., Karl, A., Lawrence, N., 2021. Incidental fear reduces empathy for an out-group's pain. *Emotion* 21, 536–544.
- Rick, S., Loewenstein, G., 2008. The role of emotion in economic behavior. *Handbook of Emotions* 3, 138–158.
- Scherer, K., Wallbott, H., 1994. Evidence for universality and cultural variation of differential emotion response patterning. *J. Personality Soc. Psychol.* 66, 310–328.
- Schleyer-Lindemann, A., Ittner, H., Dauvier, B., Piolat, M., 2018. Die NEP-Skala – hinter den (deutschen) Kulissen des Umweltbewusstseins. *Diagnostica* 64, 156–167.
- Schwartz, D., Loewenstein, G., 2017. The chill of the moment: emotions and pro-environmental behavior. *J. Publ. Pol. Market.* 36, 255–268.
- Schwarz, N., 1990. Feelings as information: informational and motivational functions of affective states. In: Higgins, E., Sorrentino, R. (Eds.), *Handbook of Motivation and Cognition: Foundations of Social Behavior*, vol. 2. The Guilford Press, pp. 527–561.
- Shipley, N., van Riper, C., 2022. Pride and guilt predict pro-environmental behavior: a meta-analysis of correlational and experimental evidence. *J. Environ. Psychol.* 79, 101753.
- Siedlecka, E., Denson, T., 2019. Experimental methods for inducing basic emotions: a qualitative review. *Emotion Review* 11, 87–97.
- Smith, C., Lazarus, R., 1990. Emotion and adaptation. In: Parvin, L. (Ed.), *Handbook of Personality: Theory and Research*. Guilford Press, New York, NY, pp. 609–637.
- Smith, C., Lazarus, R., 1993. Appraisal components, core relational themes, and the emotions. *Cognit. Emot.* 7, 233–269.
- Smith, N., Leiserowitz, A., 2014. The role of emotion in global warming policy support and opposition. *Risk Anal.* 34, 937–948.
- Stanton, S., Reeck, C., Huettel, S., LaBar, K., 2014. Effects of induced moods on economic choices. *Judgm. Decis. Mak.* 9, 167–175.
- Stewart, A., 2021. Psychometric properties of the climate change worry scale. *Int. J. Environ. Res. Publ. Health* 18 (2), 494.
- Troiano, E., Padó, S., Klinger, R., 2019. Crowdsourcing and validating event-focused emotion corpora for German and English. *arXiv preprint arXiv:1905.13618*.
- Van Gent, M., Onwezen, M., Renes, R., Handgraaf, M., 2024. Betwixt and between: a systematic review on the role of ambivalence in environmental behaviours. *J. Environ. Psychol.* 97, 102311.
- Van Kleef, G.A., 2009. How emotions regulate social life: the emotions as social information (EASI) model. *Curr. Dir. Psychol. Sci.* 18 (3), 184–188.
- Van Lange, P., Joireman, J., Milinski, M., 2018. Climate change: what psychology can offer in terms of insights and solutions. *Curr. Dir. Psychol. Sci.* 27, 269–274.
- Van Leeuwen, E., van Dijk, W., Kaynak, Ü., 2013. Of saints and sinners: how appeals to collective pride and guilt affect outgroup helping. *Group Process. Intergr. Relat.* 16, 781–796.
- Van Zomeren, M., Pauls, I., Cohen-Chen, S., 2019. Is hope good for motivating collective action in the context of climate change? Differentiating hope's emotion and problem-focused coping functions. *Glob. Environ. Change* 58, 101915.
- Watson, D., Clark, L., Tellegen, A., 1988. Development and validation of brief measures of positive and negative affect: the PANAS scales. *J. Personality Soc. Psychol.* 54 (6), 1063–1070.
- Weiss, H., Cropanzano, R., 1996. Affective events theory: a theoretical discussion of the structure, causes and consequences of affective experiences at work. In: Staw, B., Cummings, L. (Eds.), *Research in Organizational Behavior: an Annual Series of Analytical Essays and Critical Reviews*, vol. 18. Elsevier Science/JAI Press, pp. 1–74.
- Wymer, W., Gross, H., 2023. Charity advertising: a literature review and research agenda. *Journal of Philanthropy and Marketing* 28, e1723.
- Zillmann, D., 1983. Transfer of excitation in emotional behavior. In: Cacioppo, J., Petty, R. (Eds.), *Basic Social Psychophysiological Research*. Guilford Press, New York, NY, pp. 215–240.