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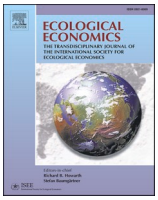

Behavioral barriers impede pro-environmental decision-making: Experimental evidence from incentivized laboratory and vignette studies

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ABSTRACT

Despite increasing concerns about climate change, many people struggle to translate their pro-environmental values into action. Here, we explore the origins of this value-action gap focusing on the role of behavioral barriers that are characteristic for many environmentally relevant decisions. Using incentivized online laboratory and vignette experiments, we find that individuals are less likely to behave in accordance with their environmental values if they are not immediately affected by the consequences of their actions, if the impacts of their actions are uncertain, and if they contribute only marginally to the outcome. The behavioral barriers also exert an indirect effect on environmental behavior by undermining reciprocity and positive peer effects. The value-action gaps are correlated across the different experimental settings with men and younger participants showing a particularly large gap. These insights are important for climate communication and education, highlighting the important role of the perceived relevance and potential consequences of personal behaviors in collective action.

1. Introduction

To mitigate the impacts of anthropogenic climate change on natural and human systems, a rapid reduction of greenhouse gas emissions is urgently needed (IPCC, 2022; Schleussner et al., 2016). In a recent poll by the Pew Research Center (2022), 75% of respondents across 19 countries globally named climate change as a major threat. Apart from engaging in national and international mitigation efforts, personal actions and a shift towards more sustainable behaviors and lifestyles play a vital role in curbing global warming and achieving the ecological transition (Creutzig et al., 2018; Mundaca et al., 2019; Swim et al., 2011).

Although an increasing number of people worldwide are concerned about climate change and share pro-environmental values, sustainable consumption and living patterns are adopted only very slowly (Hedlund-de Witt, 2012). As a result, global emissions continue to grow and have now rebounded to the levels prior to the Covid-19 pandemic (Jackson et al., 2022). The divide between concerns and values on one side and actions on the other, commonly referred to as value-action gap (Kollmuss and Agyeman, 2002; Poortinga et al., 2004), has been documented in several areas, including consumption (Nguyen et al., 2019; Peattie, 2010; Wang, 2017; Young et al., 2010), energy use (Momsen and Stoerk, 2014), dietary choices (Gifford and Chen, 2017; Haider et al., 2019; Vermeir and Verbeke, 2006), transportation (Anable et al., 2006; Haider et al., 2019), and investment decisions (Paetzold and Busch, 2014; Wins and Zwergel, 2016). In addition, value-action gaps have been identified in a wide range of non-environmental behaviors, such as physical activity, gambling, voting, or smoking (Sheeran, 2002).

Here, we examine some of the root causes of the value-action gap by studying behavioral barriers to pro-environmental decision-making using an innovative integration of an online laboratory and vignette experiment. While structural and economic barriers, such as the unavailability of affordable and accessible green alternatives, have been shown to be highly relevant (Diekmann and Preisendörfer, 2003; Farjam et al., 2019; Steg and Vlek, 2009), also psychological and behavioral

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factors related to the decision-making contexts and the processing of information can represent important behavioral constraints. These factors may increase the psychological distance between a person's decisions and their outcomes, making it more challenging for individuals to align their actions with their pro-environmental values (Brügger et al., 2015; McDonald et al., 2015; Schuldt et al., 2018; Spence et al., 2012).

We test for the role of three behavioral barriers in the two experiments, the first one representing a stylized and controlled laboratory setting ($n = 800$) and the second one a realistic setting ($n = 658$). In different treatment conditions, we vary (1) the extent to which participants' actions affect them personally versus others (immediacy treatment), (2) the probability with which these actions can have an impact (uncertainty treatment), and (3) the (perceived) importance of the individual actions for the overall outcome (marginality treatment).

All of these potential barriers are characteristic for many environmentally relevant behaviors and their consequences, which are often not immediately observable and do not have a direct effect on the individual, come with a high level of uncertainty, and depend not only on one person but on the decisions of many (Gifford, 2011). By raising the abstractness and complexity of the social dilemma underlying climate change (Van Lange et al., 2018; Van Lange and Rand, 2022), these barriers can thus provide an explanation for why in certain contexts humans do not act in a way corresponding to their own environmental values (Dawes, 1980; Koletsou and Mancy, 2011; Kollock, 1998; Newell et al., 2014; Weber et al., 2004).

In the laboratory setting, we employ collective-risk social dilemma games (Barrett and Dannenberg, 2012; Dannenberg et al., 2015; Hauser et al., 2014; Milinski et al., 2008; Szekely et al., 2021; Tavoni et al., 2011), which confront participants with a conflict between individual short-term interests and the risk of collective damage due to climatic change. Participants play in groups and can contribute to climate change protection as a collective good. Climate change can only be prevented if contributions exceed a certain climate protection threshold. While passing the threshold is beneficial for all, participants may decide to free ride on the contributions of others and behave in an environmentally unfriendly way (Bicchieri, 2006; Cialdini et al., 1990).

To study the role of the barriers in a realistic vignette experiment, participants were invited to a second follow-up online study after two months. In this experiment, the participants were shown 12 randomly varied descriptions of environmental protection projects (Atzmüller and Steiner, 2010;). They were informed that they could donate a certain amount of a monetary endowment to these projects, knowing that at the end of the experiment one of the presented projects would be randomly selected to receive the individual donation (Wyss et al., 2022).

The behavioral barriers were implemented in different ways in the laboratory and vignette setting. In the laboratory context, the immediacy barrier was varied by having the consequences of not reaching the climate protection threshold either directly affect the participant's group or another group. In the vignette setting, the environmental projects benefited either the participant's country directly or another country. To implement the uncertainty treatment in the laboratory, we experimentally varied the probability (100% vs 70%) with which a participant's contributions were effective in protecting the collective good reflecting the experienced uncertainty of making an impact with one's pro-environmental actions. In the vignette study, the descriptions of the environmental projects were changed to suggest differential chances of success of the environmental projects. Finally, the marginality of one's decisions was varied by changing the size of the groups in the laboratory setting (three vs six players) with the perceived importance of one's decisions being lower in larger groups. In the vignette setting, the descriptions were changed to suggest different marginal impacts of one's contributions on the success of the environmental projects.

To determine the value-action gap, we compare participant's actual behavior with their answers to normative questions of how much one ought to contribute to the collective-risk social dilemma game or how much one ought to donate to an environmental project, respectively (Bicchieri, 2006; Cialdini et al., 1990). Participants were asked to reveal their values in the laboratory and vignette settings prior to the start of the actual experiments using a neutral framing comparable to our baseline treatments. Decisions in both the laboratory and vignette experimental study had real consequences for the participants as well as for other participants in the interactive game or an actual environmental protection organization who received all donations made by the participants.

Our study makes three contributions to the literature. First, we provide experimental evidence on the value-action gap complementing the rich survey-based literature which has largely relied on self-reported behaviors and hypothetical scenarios (Blake, 1999; Kollmuss and Agyeman, 2002; Peattie, 2010). Also, by explicitly measuring and examining the difference between values and actually realized actions, we complement studies that focus primarily on behavioral outcomes (e.g., in form of pro-environmental behaviors or contributions to collective goods). Second, while previous experimental studies have typically considered the role of the different barriers in isolation, e.g. by varying the group size in social dilemma games (Barcelo and Capraro, 2015; Isaac and Walker, 1988), we simultaneously test for the impact of all three barriers and study accumulation effects of increasing barriers on behaviors and the emergence of the value-action gap (Dawes, 1980; Koletsou and Mancy, 2011; Kollock, 1998; Newell et al., 2014; Weber et al., 2004). Moreover, our design allows us to investigate the role of peer influences and reciprocity under conditions with more or less behavioral barriers. Third, we combine laboratory and vignette experimental methods to account for concerns about the external validity of our experimental findings (Levitt and List, 2007). Our integrated approach sheds light on the drivers of environmental behaviors and value-action gaps from two complementary vantage points, ultimately increasing the robustness and validity of our findings.

2. Theoretical framework and previous literature

An individual's environmental behavior is influenced by a number of psychological (internal) and structural (external) determinants (Fig. 1). Internal factors, such as values, preferences and beliefs, and external factors, such as social and cultural influences or the economic conditions, can shape a person's awareness and concerns about environmental issues (Bamberg and Möser, 2007; Inglehart, 1995; Steg et al., 2014).

Normative values are an important factor preceding and affecting pro-environmental behaviors (Hitlin and Piliavin, 2004; Stern, 2000). They can be defined as "*desirable goals that transcend situations and serve as guiding principles in people's lives in general*", shaping perceptions of what is considered good and fair in different contexts (Steg, 2016, p. 279). Whether and to what extent values translate into behavioral intentions and ultimately environmental behaviors depends on the perceived efficacy, costs, and consequences of the behavior (Ajzen, 2002; Kaiser et al., 1999; Miller et al., 2022; Tabernero and Hernández, 2010).

The behavioral barriers examined in this study shape these mediating processes and perceptions by influencing whether a behavior has direct and immediate consequences for a person, how effective the behavior is perceived, and how marginal the individual's contribution to the consequences is. All of these can discourage acting in a pro-environmental way and increase the psychological distance between one's decisions and their potential impacts (Brügger et al., 2015; McDonald et al., 2015; Schuldt et al., 2018; Spence et al., 2012). Despite being environmentally concerned and conscious, many people may therefore not adopt pro-environmental behaviors, constituting a gap between their values and actions (Blake, 1999; Kollmuss and Agyeman, 2002).

The immediacy barrier can be conceptually understood in two

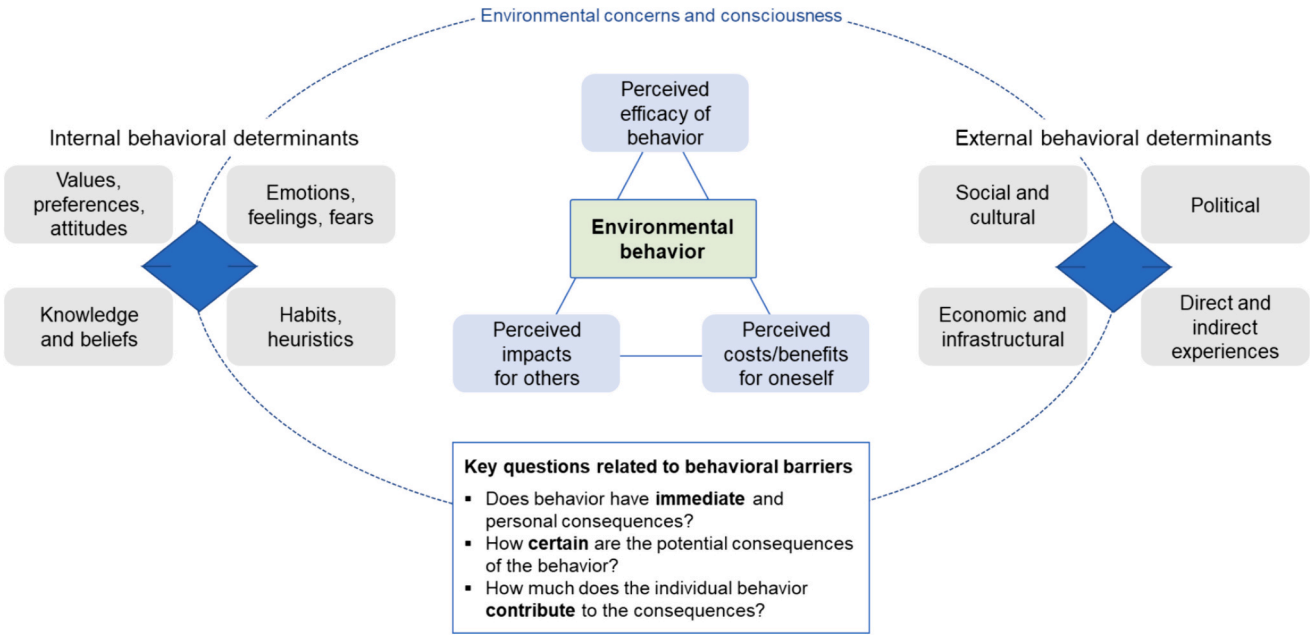

Fig. 1. Conceptual model of the determinants of pro-environmental behaviors and the role of behavioral barriers. Behaviors are determined by internal, psychological (left panel) and external, structural (right panel) determinants, which shape a person's environmental concerns and consciousness (blue ellipse). The center of the graph illustrates mediating processes that are influenced by the different determinants and shape environmental decision-making. Related to these, the textbox at the bottom highlights the relevance of the behavioral barriers examined in this study. The conceptual figure was adapted from Blake (1999), Clayton et al. (2015), and Kollmuss and Agyeman (2002). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

different ways: (i) intra-personal immediacy, which refers to whether consequences of an action impact an individual's well-being immediately in the present or in the future (Jacquet et al., 2013; Tiezzi and Xiao, 2016); and (ii) inter-personal or inter-generational immediacy, which refers to whether consequences affect one's own well-being or that of others, either in the present or in the future (Jacquet et al., 2013; Miller et al., 2022; Van Lange et al., 2018). This study specifically focuses on the latter form of immediacy, investigating whether individuals alter their behavior if they are not personally affected by potential negative consequences of their actions. If a behavior does not result in adverse consequences for a person, but affects spatially distant regions, other social groups, or future generations, then this can represent an incentive to not act in a pro-environmental way and increase the spatial, social, and temporal psychological distance (Jones and Rachlin, 2009; Spence et al., 2012).

Also, the uncertainty surrounding the effectiveness and consequences of one's decisions can widen the perceived gap between behaviors and outcomes (Spence et al., 2012). With regards to climate change, three types of uncertainty can influence people's willingness to take action: (i) Uncertainty about whether and when climate change will lead to damages; (ii) uncertainty about the magnitude of the potential damages; and (iii) uncertainty about the effectiveness of one's actions in mitigating these damages. Studies have shown that the first two forms of uncertainty about the potential occurrence and magnitude of damages can reduce the willingness to take pro-environmental action and be harmful for cooperation (Barrett and Dannenberg, 2012; Milinski et al., 2008). Also, uncertainty regarding critical thresholds and tipping points beyond which damages may occur can result in reduced contributions in collective risk games (Dannenberg et al., 2015). In this study, we focus on the third form of uncertainty related to the efficacy of one's actions in preventing negative consequences, which has received less attention in the previous literature. A recent meta-analysis on household-level climate change adaptation has shown that the perceived outcome efficacy of adaptive behaviors is strongly associated with the adoption of such behaviors (van Valkengoed and Steg, 2019). If people are uncertain about the effectiveness of their actions, then this can lead to an underestimation of potential impacts and discourage taking actions (Nielsen et al., 2021; Wynes and Nicholas, 2017).

Finally, greater marginality can likewise lead to a lower perceived efficacy of behaviors as well as the diffusion of responsibility, and thus counteract environmental behavior. In social dilemmas, specifically the collective-risk social dilemma, the marginal effect of individual contributions decreases with increasing number of participants (Powers et al., 2021). Thus, in larger groups, the (perceived) marginality of each contribution is higher than in smaller groups, which can in turn reduce the belief that pro-environmental behaviors matter (Isaac and Walker, 1988; Van Lange et al., 2018). As individuals perceive their own contribution as less pivotal for the overall outcome, they may react with reduced personal engagement and may fail to do their part in reaching a cooperative outcome (Barcelo and Capraro, 2015; Weimann et al., 2022).

The behavioral barriers related to immediacy, uncertainty, and marginality are characteristic for many environmental behaviors, especially with respect to climate change (Gifford, 2011). The negative consequences of changing climatic conditions are often not experienced directly by those who have contributed the most to them. For many, climate change is an abstract and complex phenomenon that is associated with high levels of uncertainty. Furthermore, grasping the impact of one's actions is challenging, given that they appear marginal when viewed against the global scale of the challenge.

3. Methods

This study combines an online laboratory experiment studying environmental behavior in the collective-risk social dilemma game (n = 800) and a vignette experiment validating measures in a realistic decision scenario (n = 658). While the laboratory experiment identifies the causal effects of the three behavioral barriers under stylized and controlled conditions, the vignette experiment analyzes the effects in a realistic environmental decision context.

3.1. Participants and procedures

Participants for the experiments were recruited using the crowdsourcing platform Prolific.co, which was specifically designed for scientific data collection purposes (Palan and Schitter, 2018). The experiments were programmed using the experimental platform Lioness (Giamattei et al., 2020). The data collection for the laboratory study was organized in 23 sessions from 4th of December 2020 to 28th of February 2021. Only residents of the United Kingdom (UK) or the United States (US), who were above 18 years at the time of the study, were eligible to participate. In total, 800 participants completed the online laboratory study and filled in an attached questionnaire. Although not representative, Prolific provides a more diverse and heterogeneous sample than most laboratory studies with participants coming from a wide array of socioeconomic backgrounds (Supplementary Material Section 1, Supplementary Tables S1, S2, and S3).

Before the start of the laboratory experiments, all eligible participants saw a short introductory text on Prolific informing them about the interactive nature and expected duration of the study. Furthermore, participants learned about the payment structure of the experiments. They received a fixed payment of £2.50 and a bonus payment depending on their own decisions and the decisions of other participants. Those who registered for the study received a link to the experiment with further instructions. In particular, they were informed that their participation was fully anonymous, implying that other participants were not able to link their behavior in the interactive game to their personal identities. At this stage, all participants provided informed consent. To qualify for the study, participants had to answer seven control questions in order to ensure that all participants correctly understood the experimental instructions (Supplementary Material Section 2).

Each participant in the experiment was equipped with an endowment which they could contribute to climate protection efforts and interacted with other participants in groups over ten rounds. At the start, the participants received full information about the size of their group, their endowment, and the climate protection threshold, i.e., the total sum of contributions needed to be reached to prevent dangerous climate change. After each period, the participants were informed about their contribution and whether their contribution was added to the climate account or not (in the high uncertainty treatments), about the total contributions in their group, about the points missing to reach the threshold, and about the points left in their endowment.

All participants were paid for their participation depending on the outcome of the game. In total, the final payments received by the participants ranged from £2.50 to £8.88 with an average payment of £5.26 (SD = £1.38). Participants took on average 33 min to complete the entire interactive study. At the end of the study, participants filled in a questionnaire assessing their sociodemographic characteristics, their environmental attitudes and stated behaviors, as well as their time, risk, and social preferences (Falk et al., 2022).

Two months after completion of the laboratory experiment, participants were invited to participate in the second vignette experiment (Supplementary Material Section 3). Of the 800 initial participants, 658 also took part in the vignette study. Again, respondents were first informed about the nature of the study and gave their informed consent to participate (Supplementary Material Section 4). The average time to complete the second study was 24 min and participants earned on average £2.25.

3.2. Laboratory experiment: the collective-risk social dilemma

The laboratory experiment was characterized by two features: First, the participants interacted directly with other participants, and second, all decisions in the game had real consequences in terms of possible financial gains or losses for both the participants themselves and their fellow participants. While responses in surveys typically remain without real-world consequences for participants, actions in our experiments were associated with actual payoffs.

At the beginning of the interactive laboratory experiment, participants were randomly sorted into groups and endowed with 40 tokens which they could contribute to reaching an exogenously imposed climate protection threshold (Milinski et al., 2008). The tokens had a real monetary value and were translated into £ at the end of the experiment at an exchange rate of 8 tokens for £1. We use tokens instead of real money in the laboratory setting as they allow creating a psychological distance from real-world financial consequences and to abstract from absolute monetary values, while still providing a basis for a clear incentive structure. This can help participants focus on the decisions within the experimental setting rather than external financial implications.

The game was played for ten rounds keeping the groups of participants constant. In each of the ten rounds, participants could decide to contribute either 0, 1, 2, 3, or 4 tokens from their endowment to a climate account. Those tokens that were not invested into climate protection in a round could not be contributed to the climate account at a later stage. With this feature we mimic in a stylized way that insufficient environmental protection today may result in irreversible consequences in the future that cannot be mitigated or reversed, even with substantial efforts or investments.

At the end of the game, the remaining token endowment was paid out to the participants if their total contributions to the climate account exceeded a pre-specified threshold amount, representing the climate protection target. If the group failed to reach the exogenous threshold, the tokens left in the personal endowment of the participants were destroyed with a 90% probability. While contributing to the collective good was socially beneficial, it came at a cost for the participants in the form of foregone earnings, reflecting efforts an individual has to undertake to protect the environment. The climate protection threshold was varied depending on the treatment conditions (Table 1). Importantly, in all treatments, the threshold was adjusted such that if all players on average invested half of their endowment, that is, 2 of 4 tokens per period, the threshold would be reached. The objective difficulty of reaching the threshold was thus kept identical across all treatment conditions.

Before the first period of the collective-risk social dilemma, the participants had to indicate how much they think participants should contribute to the climate account every round to measure participants' normative values. Here, we used the baseline condition without barriers (No Uncertainty, High Immediacy, Low Marginality). To measure participants' actual behavior, we calculated their contributions to the climate account in the ten periods. The difference between the two is conceptualized as the value-action gap, with positive values indicating that participants' stated values were above their actual contributions.

Because social norms might prescribe pro-environmental behavior, environmentally harmful forms of action are often perceived as negative. To counteract this effect, decisions in the studies were deliberately presented in a neutral and standardized manner, and behaviors were not given labels with negative or positive connotations. Neither the experimenter nor the participants were informed about the background and personal characteristics of the participants who remained anonymous throughout the interactive game and the vignette study.

While the neutral framing aimed to minimize external biases and influences on decision-making processes, it comes at the expense of a reduced real-world applicability by abstracting away from the social and moral complexities that typically influence behavior. However, the goal of our research is not to explain differences in values and behaviors between different contexts, but to test for the relevance of the three behavioral barriers within each experimental setting in an internally valid way. By combining and comparing insights from different settings, we aim to identify underlying patterns and principles that are consistent across contexts, thereby enhancing the generalizability of our findings and contributing to a broader understanding of how the behavioral barriers operate.

Table 1
Treatment Conditions in the Laboratory (2 × 2 × 3 factorial design).

		Uncertainty					
		No			High		
		Immediacy			Immediacy		
		High Immediacy	Low Immediacy	Dependency	High Immediacy	Low Immediacy	Dependency
Marginality	Low	12 groups TH = 60	12 groups TH = 60	12 groups TH = 60	12 groups TH = 42	12 groups TH = 42	12 groups TH = 42
	High	12 groups TH = 120	12 groups TH = 120	12 groups TH = 120	12 groups TH = 84	12 groups TH = 84	12 groups TH = 84

Note: The value TH indicates the climate protection threshold to be reached by each group to avert climate change. The value was adjusted in order to keep the objective difficulty of reaching the threshold identical over the treatment conditions.

3.3. Treatment conditions in the laboratory experiment

In the laboratory experiment, the three behavioral barriers were varied in a 2 × 2 × 3 factorial design between subjects resulting in 12 treatments (Table 1). The different treatments were implemented in the following way:

(1) Marginality: In the Low Marginality treatment participants played in groups of 3 participants, whereas in the High Marginality treatment they played in groups of 6 participants. Increasing the number of participants reduced the perceived importance of each persons' contribution. As described above, the climate protection threshold was varied to reflect the changes in the group size keeping the objective difficulty of reaching the threshold identical over the treatment conditions.
(2) Uncertainty: In the No Uncertainty treatment, participants' contributions were added to the climate account with certainty (100% probability). In the High Uncertainty treatments, contributions were added to the climate account only with a probability of 70% mirroring a reduced perceived effectiveness of one's actions in reaching a desired outcome. Again, the climate protection threshold was varied to reflect this change in the likelihood of making a meaningful contribution keeping the objective difficulty of reaching the threshold identical over the treatment conditions.
(3) Immediacy: In the Low Immediacy treatment, groups were not directly affected by missing the exogenous threshold. Instead, their failure to reach the climate target affected another randomly selected group, which lost their personal endowments with a probability of 90% (Dependency Treatment). These dependent groups did not only need to reach their own threshold to avoid climate change but were also dependent on the success of the other randomly selected group from the low immediacy treatment. The High Immediacy treatment reflected the baseline condition where groups were independent of other groups and responsible for reaching their own threshold to avert climate change.

3.4. Vignette experiment: donations for charity

In the vignette study, which took place two months after the laboratory experiment, participants were shown vignette descriptions of 12 environmental forest protection and reforestation projects in random order (Atzmüller and Steiner, 2010). For each vignette, they could decide how much of £1 they wanted to invest in the project. The investments determined the likelihood that a donation of £1 was made to the environmental project on behalf of the participant (Becker et al., 1964).

For each additional 10 Pence invested in a project, the probability of a £1 donation increased by 10%. For example, if a participant invested £1 in a project, a donation of £1 was certain to be made (100% probability); if £0.5 were invested, a donation of £1 was made with 50% probability; and if nothing was invested (£0), no donation was made (0% probability). Having participants' investments influence the likelihood that a project is selected for funding is a commonly used, incentive-compatible strategy to assess a person's willingness to pay or donate (Becker et al., 1964; Schmidt and Bijmolt, 2020). It helps abstracting from the actual monetary value of the donation, which is held constant at £1 in our case, and makes participants base their choice solely on the comparable likelihood with which they would like a project to receive a donation which is bound between 0% and 100%.

At the end of the experiment, one of the 12 projects was randomly selected and the participant's investment influenced the probability that the respective project received a donation. Participants received detailed briefings on the project selection process and were shown exemplary test cases to ensure that they understood the employed selection and payout procedures. As final payment, the participants received the amount not invested into the selected project plus a fixed participation fee of £1.5.

Like in the laboratory study, decisions had real financial

Project A

The project plants trees in [your country]. The forestation will benefit people **in your country directly by improving air quality and restoring bio-diversity**.

It is critical for the success of the project to ensure that trees survive and grow. Whether trees survive depends on the geographical location and local conditions of the project site. On this project's site, **nearly all of the planted trees survive.**

Each pound donated allows the project to plant one additional tree. Your donation **directly contributes** to the planting of this tree and you will receive a confirmation of your individual donation to this project at the end of this study.

Fig. 2. Exemplary structure of a vignette. The vignette depicts the baseline treatment condition of an environmental project (High Immediacy, No Uncertainty, Low Marginality). The placeholder [your country] was replaced with the name of the participant's home country (UK or US). Supplementary Material Section 6 shows the complete list of vignettes.

consequences for the participants and individual incentives stood in contrast with the support for the environmental projects. After the data collection, donations of £519 were given to real environmental projects of "One Tree Planted" (https://onetreeplanted.org/), a non-profit organization that supports (re)forestation projects worldwide, including in the UK and in the US, the home countries of the study participants. Participants received a donation confirmation after the data collection was finished.

Also in the vignette setting, participants were asked at the beginning of the experiment in a hypothetical decision situation to indicate how much they thought should be invested in the environmental project, using the baseline treatment without barriers as a reference. Like in the laboratory setting, the value-action gap was determined by taking the difference between the actual decisions and the values elicited in the hypothetical scenario.

3.5. Treatment conditions in the vignette experiment

The behavioral barriers were varied by changing the descriptions of the environmental projects. All descriptions were fictitious and did not contain detailed information about the respective projects (Fig. 2). In the treatments, the project descriptions varied a) one's own benefit or affectedness by the donation to the environmental project (immediacy barrier), b) the likelihood of survival of the trees in the respective location (uncertainty barrier), and c) the relative importance of the individual donation for the environmental project (marginality barrier). The final project description again represented a combination of the individual treatments in form of a $2 \times 2 \times 3$ design (Supplementary Material Section 5).

Even though both the laboratory and vignette experiments considered the effects of barriers on environmental behavior and the value-action gap, the two settings were distinct in their experimental designs. In the laboratory experiment, we employed a between-subject design where participants were exposed to only one combination of the three barriers as treatment. In the vignette experiment, the participants were shown 12 vignettes representing different combinations of barriers in random order following a within-subject design. Importantly, both the between and within treatment allocations were completely random and thus by design uncorrelated between the two settings. Hence, the exposure to specific treatment conditions in the first experiment could have not systematically affected decision-making in the second experiment, for example in the form of priming. Also, since the participation in the laboratory experiment was a requirement for the participation in the vignette study, all participants were exposed to the same prior conditions which could hence not bias the estimation of average treatment effects which is the primary focus of our study.

3.6. Measurement of the value-action gap using survey-items

At the conclusion of the laboratory experiment, participants completed a questionnaire aimed at gathering survey-based data on their personal characteristics, including their general environmental attitudes and tendency to show environmentally friendly behaviors. The questionnaire primarily served two purposes: First, to collect additional information on the participants which we use as control and interaction variables in our analysis; and second, to show the replicability of our experimental findings through survey-based methods. The measurement of the primary behavioral outcomes, the calculation of the value-action gap, and the implementation of the behavioral barriers in the experiments was independent of the survey administration process.

Aside of collecting basic demographic and socioeconomic information about the participants, their environmental values were assessed in the questionnaire by asking for agreement to two statements (Oreg and Katz-Gerro, 2006): "We worry too much about the future of the environment and not enough about prices and jobs today" and "People worry too much about human progress harming the environment" (five-point agreement scale from fully disagree to fully agree).

Participants were also asked about their environmental behaviors across different private and public domains (Babutsidze and Chai, 2018), including efforts to recycle, use less pesticides, drive less, consume less energy, save water, and avoid buying new products or consuming meat (five-point frequency scale from never to regular) as well as signing a petition, donating money, taking part in a protest, or being a member of an environmental organization (yes/no). The items were aggregated into an index and normalized to a scale from 0 to 1.

By subtracting the self-reported environmental value and the actual behaviors, we calculated a survey-based value-action gap. Please note that this value-action gap is different from the ones calculated in the laboratory and vignette experimental settings and serves mainly to compare our experimental results on the role of the three behavioral barriers using survey-based measures. For this, we collected information on the participants' perception of the three barriers in their everyday environmental orientation and behavior. They were asked in the survey if they agree that a) environmental problems have a direct effect on their everyday life (immediacy), b) it is hard to know whether the way they live is helpful or harmful to the environment (uncertainty), and c) personal actions can contribute to prevent climate change (marginality). All items were measured on a five-point agreement scale and recoded to dummy variables. Using these measures, we tested to what extent we find relationships between the barriers and the survey-based value-action gap and whether these relationships are consistent with our experimental findings. The results showcase the usability of survey items to study the relevance of behavioral barriers, including using larger and more representative samples as the one used in our experimental study.

The participation in the laboratory experiment prior to answering the questionnaire may have influenced participants' response behavior. Our decision to administer the experiment before the questionnaire was guided by several considerations. First, we wanted to ensure that the exposure to the survey items could not influence behavior in the game which could have had very detrimental consequences for our experimental design. Second, since the experimental treatments in the laboratory were assigned randomly, we do not anticipate any systematic bias in the measurement of the survey variables. Indeed, additional analyses (results not reported) investigating the impact of the experimental conditions to which participants were exposed on their survey responses revealed no significant relationships. Also, the variables measured in the questionnaire served mainly as control and interaction variables, and to showcase the replicability of our main experimental findings using self-reported survey items.

4. Results

4.1. Values shape pro-environmental behaviors

Fig. 3 shows how environmental values shape individual actions in the laboratory and vignette study. Overall, values and actions are strongly correlated. Participants who considered it morally right to contribute more to climate change protection in the collective-risk social dilemma game also contributed on average more to the common good. Likewise, in the vignette study, participants' views on how much one should donate to an environmental project correlated with their actual

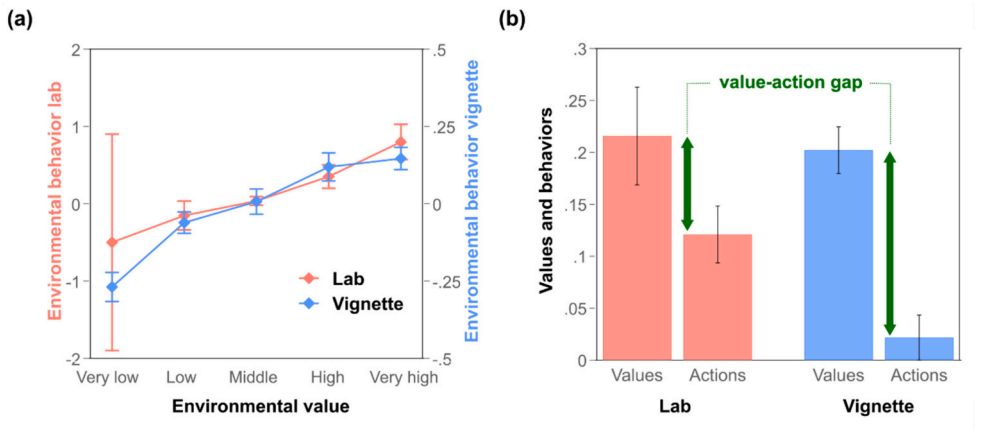

Fig. 3. Environmental values and behaviors in the lab and vignette experiment. Panel (a) shows the association of environmental values and actions in the lab (contributions, left axis) and the vignette study (donations, right axis). Environmental values are classified from very low to very high according to responses in the lab (0; 1; 2; 3; 4) and the vignette experiment (0–0.3; 0.4–0.5; 0.6–0.7; 0.8–0.9; 1). Panel (b) shows the value-action gap calculated at the period-level (lab) and decision-level (vignette). Variables are centered at the focal scale midpoint of 2 (lab) and 0.5 (vignette). 95% CIs are calculated using the standard errors of the mean.

donation behavior (Fig. 3a).

Despite this positive correlation, a considerable gap between values and actions is observable both in the laboratory and vignette setting (Fig. 3b). In the lab, values stated in advance of the interactive game exceeded actions significantly by 0.09 points (95% CI: 0.01, 0.18; scale from 0 to 4). In the vignette study, actual donations were on average 0.18 points (95% CI: 0.15, 0.21; scale from 0 to 1) lower than what participants stated as morally appropriate before the experiment.[1]

4.2. Behavioral barriers drive a wedge between values and actions

The behavioral barriers substantially contributed to widening the gap between values and actions. Both in the laboratory and in the vignette setting, people deviated more strongly from their environmental values the higher the number of barriers they faced. While in the laboratory, the effect of one barrier on the value-action gap was positive but not statistically different from zero, two barriers significantly increased the value-action gap by 0.13 (95% CI: 0.02; 0.23) and three barriers by 0.17 (95% CI: 0.07; 0.28) standard deviations (Fig. 4, Model 1), on average. A similar pattern was discernable in the vignette study, where one barrier increased the gap by 0.22 (95% CI: 0.18; 0.25), two barriers by 0.38 (95% CI: 0.34; 0.43), and three barriers by 0.52 (95% CI: 0.47; 0.57) standard deviations.

Besides the observed cumulative effects, several of the behavioral barriers also affected the value-action gap individually (Fig. 4, Model 2). In the laboratory setting, a high marginality due to a larger group size increased the value-action gap by 0.08 (95% CI: 0.01; 0.15) standard deviations compared to treatments with smaller groups, where the perceived importance of the individual contributions was lower. While we also observe a widening of the gap in the vignette study with a higher marginality, this effect is not statistically significant from zero.

Similarly, uncertainty about the impact of one's actions was an important barrier, leading to an increase in the discrepancy between values and actions by 0.06 (95% CI: 0.01; 0.11) standard deviations in the laboratory and by 0.20 (95% CI: 0.18; 0.23) standard deviations in the vignette experimental setting. If it was uncertain whether environmental actions and donations had a lasting impact for climate protection, people more strongly deviated from their values.

Across settings, the strongest and most consistent effects were observed for changes in the immediacy treatments. In decision contexts in the laboratory where the consequences of the actions did not affect the participants themselves but others, the value-action gap increased by 0.09 (95% CI: 0.01; 0.18) compared to settings with a high immediacy. Likewise, if the environmental projects were not benefiting the country of the participant but another country (Low Immediacy), the value-action gap in the vignette study widened by 0.34 (95% CI: 0.30; 0.39) standard deviations compared to a treatment where the benefits of the pro-environmental action accrued in the direct vicinity of the participants.

In additional treatments, we studied the impact of being dependent on others' contributions for participants' willingness to act in a pro-environmental way (Dependency Treatment). If the success of environmental projects were additionally dependent on the benevolence of others in the vignette setting, the value-action gap grew compared to the High Immediacy treatment by 0.27 (95% CI: 0.23; 0.31) standard deviations. In the laboratory setting, on the other hand, no significant differences were found for groups that were directly affected by the consequences of their actions and those that additionally depended on others. This suggests that the dependency from other groups did not discourage participants from reaching the climate protection threshold.

4.3. Behavioral barriers relevant for survey responses

Using survey items collected in the post-experimental questionnaire, we measure participants' general perceptions of how much they think climate change would affect them directly as opposed to others (immediacy), the expected likelihood of experiencing an impact (uncertainty), and the importance of own behavior for climate action (marginality). Combining this information with participants' environmental values and actual behaviors as measured using a range of standard survey items, we find results in line with our experimental findings (Table 2).

Respondents who were unconvinced that personal actions contribute to preventing climate change had a higher disconnect between environmental values and actions (High Marginality). Those who find it hard to know if their lifestyle is harmful to the environment display greater value-action gaps (High Uncertainty). And if experimental subjects indicated that environmental problems have no direct effect on their personal life, they were less successful in translating their values into

[1] Due to differences in the experimental designs and protocols the estimated size of the value-action gaps cannot be directly compared across the laboratory and vignette settings. For example, while the outcome derived from the laboratory experiment resulted from the interaction between participants, this was not the case in the vignette experiment. The goal of our study is not to compare value-action gaps across settings, but to study the impacts of the behavioral barriers, which were introduced as distinct treatments in experiments, and to explore whether these exert a consistent effect across settings.

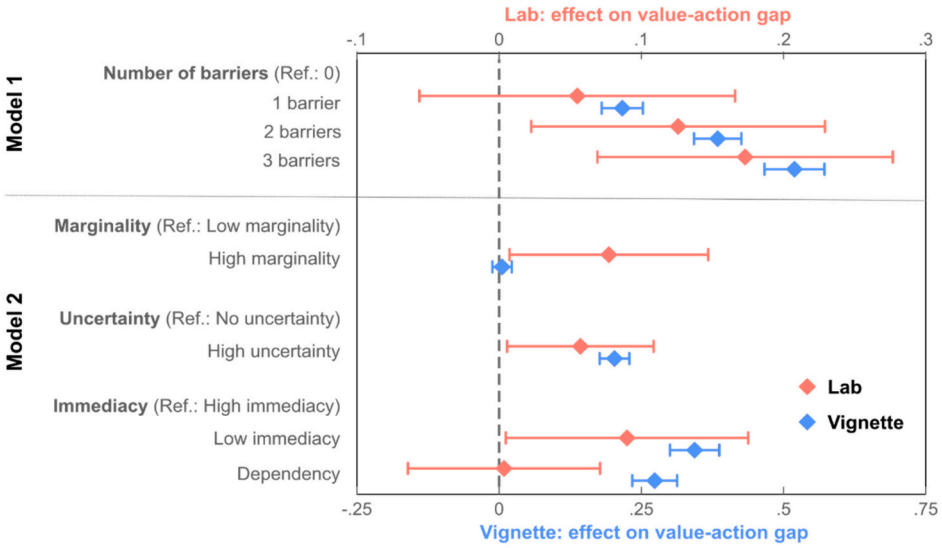

Fig. 4. The effects of the behavioral barriers on the value-action gap. Coefficient plots show the effect of the treatment variables on the standardized value-action gap in the laboratory (red, upper axis) and in the experimental vignette study (blue, lower axis). The coefficients are derived from the models in Supplementary Table S4. Robustness checks are reported in Supplementary Tables S5 and S6. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Table 2
Linear regressions on the importance of the three barriers using survey data.

	Value-action gap (survey)
	(1)
Marginality	
Personal Actions Contribute to Prevent Climate Change	−0.0974***
	(0.0147)
Uncertainty (reversed)	
Hard to know if way of life is harmful or hurtful to environment	0.0215**
	(0.00930)
Immediacy	
Environmental problems have a direct impact on my life	−0.103***
	(0.0170)
Observations	800
R^2	0.614

Note: Regression coefficients with session-clustered standard errors in parentheses. Clustering at session level. Dependent variable: standardized Value-Action Gap in the survey. Not Reported: Constant, Values. 2 Participants were dropped from analysis, as they did not complete the questionnaire. *P*-values: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

environmental actions (Low Immediacy).

Surveys have been extensively used in the empirical literature to explore drivers of pro-environmental actions (Swim et al., 2011). Our findings show the usability of these instruments to complement the experimental evidence on behavioral barriers as presented here. A stronger emphasis on items addressing the perceptions of the immediacy, uncertainty, and marginality of environmental behaviors in large-scale surveys can be beneficial and further enhance our understanding of these barriers for large and representative samples.

4.4. Barriers undermine reciprocity and peer effects

Decisions are often interdependent as people react to the behavior of others. This is also the case for environmental behaviors, where studies have shown that own actions are related to the visible actions undertaken by others (Babutsidze and Chai, 2018). Even though people often underappreciate their own susceptibility to social influence, group norms strongly influence and guide behavior, including in social dilemma games (Simpson and Willer, 2015) and environmental decision-making processes (Culiberg and Elgaaied-Gambier, 2016; Keizer and Schultz, 2018).

Here, we test to what extent participants' behaviors were influenced by the behaviors of other group members in the interactive laboratory experimental setting. We find that participants deviated less from their environmental values in the collective-risk game if others contributed more to environmental protection in the previous round (Supplementary Table S7). Hence, if everyone behaved in a more pro-environmental way, participants acted in a reciprocal way and were more successful in realizing their values.

However, this positive peer effect was attenuated the higher the number of barriers in the game (Fig. 5a). The behavioral barriers hence undermined the reciprocity and positive influence of others making it harder for participants to live up to their own values. This suggests that the considered barriers can have both a direct and an indirect effect on behavior. Directly by influencing individual decision-making processes and the perception of expected outcomes, and indirectly by undermining the otherwise positive peer effects. This can result in a vicious cycle where barriers can lead to a breakdown of cooperation and pro-environmental action in a group, with potentially highly destructive consequences for all.

Indeed, in line with the notion of deteriorating cooperation, we find that the value-action gap inflates over time. Typically, participants behaved more in line with their values at the beginning of the game, but increasingly deviated from them towards the game's end. This effect also holds when controlling for whether or not the groups have already reached the climate protection target in previous rounds, suggesting that it is not driven by groups having succeeded in preventing climate change towards the end of the game (Fig. 5b).

The post-experimental survey provides further evidence of these social and temporal underpinnings of the value-action gap (Franco and Ghisetti, 2022) (Supplementary Table S7). Participants who had an overall stronger altruistic orientation in the survey and were more inclined to reciprocate a favor showed overall a smaller value-action gap in the laboratory experiment, emphasizing the social dimension underlying contributions to environmental protection. Also, larger value-action gaps were observed for those participants with a stronger orientation towards the presence. Those who indicated in the survey that they

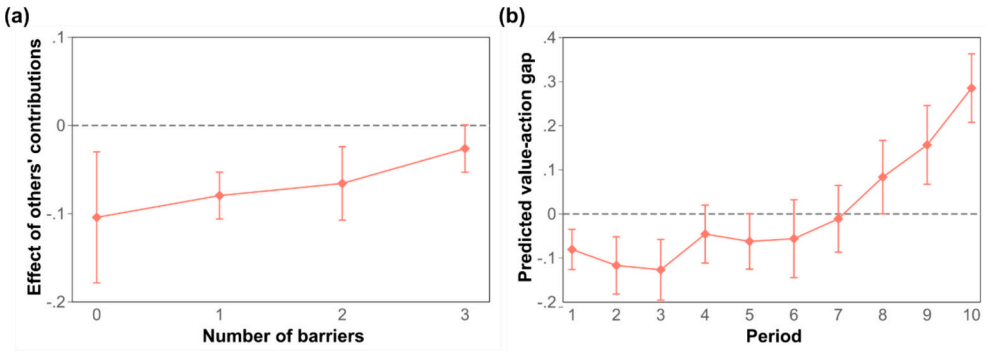

Fig. 5. The social and temporal dimensions of the value-action gap in the laboratory experiment. Panel (a) shows the average marginal effect of others' contributions on the standardized value-action gap for different numbers of barriers. The displayed estimates are calculated holding all other variables constant at the mean (Supplementary Table S7). Increasing contributions have a dampening effect on the value-action gap, but this peer influence is reduced the higher the number of barriers. Panel (b) shows the predicted value-action gap over the course of the experimental game demonstrating increases in the gap over time.

were less willing to give up something today in order to benefit in the future showed larger differences between their values and actions, accentuating the temporal dilemma posed by climate change.

4.5. Value-action gaps are correlated across settings

The value-action gap measures in the laboratory and vignette setting are correlated at the individual level (Fig. 6). The more individuals deviated from their normative response in the laboratory experiments, the more likely they were to also deviate in the vignette study. More precisely, a one-point increase in the value-action gap measured in the interactive laboratory experiment (scale 0–4) resulted in a 0.06 (95% CI: 0.03; 0.09) point increase in the value-action gap in the vignette setting (scale 0–1).

This finding does not only show the high degree of robustness across the different measures used to assess the value-action gap in our study, but it also reveals a tendency for some individuals to more strongly deviate from their personal values than others. This suggests the existence of stable traits leading to increased value-action gaps for some individuals in different experimental settings and across a range of environmental domains (Barr, 2006b; Kollmuss and Agyeman, 2002a). In the next step of our analysis, we explore different underlying drivers of this heterogeneity.

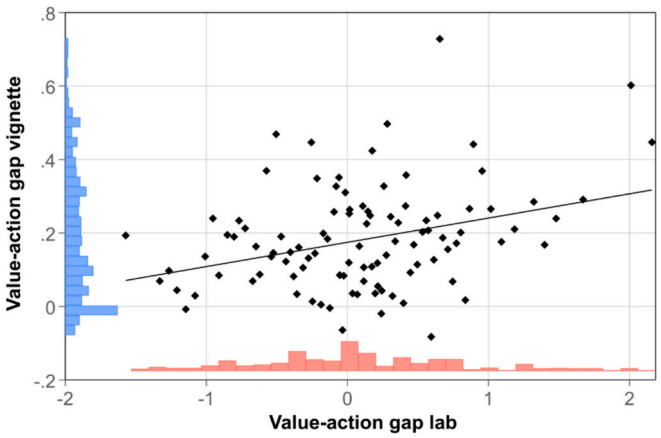

Fig. 6. Scatterplot and histograms for value-action gaps in the laboratory and vignette experiment. The gaps are displayed here in an unstandardized way reflecting differences between participants' behaviors and stated values. Variables are centered at the focal scale midpoint of 2 (lab) and 0.5 (vignette).

4.6. Age and gender explain differences in the value-action gap

Making use of the diverse composition of the participant sample, we explore the heterogeneity in the value-action gap by participants' background characteristics. The goal is to show how variations in demographic and socioeconomic factors influence the discrepancy between stated values and actual behaviors. The analysis carried out here is explorative and cannot be directly generalized to the broader population given the selectiveness of our samples. However, it offers valuable insights into patterns and tendencies that can inform future research and interventions aimed at addressing environmental decision-making processes.

Table 3 shows models that regress the value-action gaps in the laboratory (1) and vignette (2) setting on different demographic and socioeconomic characteristics. Here, we are particularly interested in exploring the effects of participants' gender, age, and socioeconomic status, which we proxy with participants' education and income level. The latter two variables were measured in three categories ranging from low to high education and income levels.

Table 3
Testing for the heterogeneity in value-action gaps in the laboratory and vignette experiment.

	Value-action gap (Lab)	Value-action gap (Vignette)
	(1)	(2)
Gender (Ref.: female)		
Male	0.218***	0.267***
	(0.0655)	(0.0715)
Age (in decades)	−0.135***	−0.121***
	(0.0394)	(0.0346)
Education (Ref.: low)		
Medium	−0.0131	−0.0688
	(0.0836)	(0.0893)
High	0.0323	−0.0644
	(0.0569)	(0.0877)
Income (Ref.: low)		
Medium	0.0452	0.0818
	(0.0570)	(0.0798)
High	0.0469	−0.0226
	(0.0872)	(0.107)
Country (Ref.: UK)		
USA	−0.0355	0.221**
	(0.0782)	(0.109)
Observations	796	654
R^2	0.326	0.326

Notes: Models (1) and (2) show regression coefficients with robust standard errors in parentheses. The dependent variables are standardized. Not Reported: Values, Constant, "Other"/No Response for Education and Income, Treatment (Model (1)), Finished Dummy (Model (1)). *P*-values: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The results are highly consistent across the different settings, suggesting similar drivers of heterogeneity in the observed value-action gaps. In both experiments, men showed a greater value-action gap compared to women, as did younger participants compared to older ones. These findings confirm past work using more representative samples (Babutsidze and Chai, 2018; Barr, 2006; Moser and Kleinhückelkotten, 2017).

Compared to women, men had on average a 0.22 (95% CI: 0.08; 0.35) and 0.27 (95% CI: 0.12; 0.41) standard deviations larger gap in the laboratory and vignette setting, respectively. The gaps decreased by 0.13 (95% CI: 0.04; 0.22) and 0.12 (95% CI: 0.05; 0.19) standard deviations with every 10 years of participant's age, on average. In extended analyses considering age as a continuous measure, we find evidence for non-linearities in the age effects on contributions in the laboratory experiment. According to these estimates, marginal reductions in the value-action gap with age are larger the younger the participants and decrease for older age groups (Supplementary Table S8).

Considering differences by participants' country of residence, we find larger value-action gaps in the vignette study among participants residing in the US compared to residents of the UK. We do not find any significant differences in the value-action gaps for participants with different socioeconomic status suggesting a more important role of the demographic factors in shaping the observed differences.

5. Discussion and conclusion

Despite growing concerns regarding climate change, many individuals do not translate their pro-environmental values into actions. This paper delves into the root causes of this value-action gap, with a particular focus on three behavioral barriers that are relevant for many environmental decisions. By conducting online laboratory and vignette experiments, we show that people are less likely to engage in environmentally-friendly behavior and deviate from their values if they are not immediately and personally affected by the consequences of their actions, if the impacts of the actions are uncertain, or if their contributions to the outcomes are only minimal.

These behavioral barriers affect behaviors not only directly but also indirectly by undermining reciprocity and positive peer influences. Observing others contributing to a public good serves as motivator encouraging higher contributions. At the same time, the absence of contributions and reciprocity in a group can undermine the motivation for individuals to engage in pro-environmental behaviors (Berg et al., 1995; Falk and Fischbacher, 2006). Participants' failure to contribute can adversely influence group dynamics and create a ripple effect threatening the achievement of the common environmental goal (Koletsou and Mancy, 2011).

Our exploratory analyses further demonstrate a persistence in the value-action gap across different settings. Despite variations in the level of the value-action gap stemming from differences in the employed experimental designs and protocols, there exists a clear correlation. This suggests that the success or failure of translating values into actions depends on relatively stable individual characteristics. In particular, men and younger people show larger gaps between their values and actions (Hunter et al., 2004; Vicente-Molina et al., 2018). These findings highlight the importance of looking beyond averages when examining the role of behavioral barriers and value-action gaps, and in the development of policies to effectively target specific groups characterized by larger gaps.

Our findings add to a growing body of literature highlighting the important role of behavioral barriers in influencing decision-making processes Kollmuss and Agyeman, 2002; Van Lange et al., 2018). In particular, expanding beyond previous research, we show how the accumulation of barriers can hinder pro-environmental behaviors and increase the value-action gap. The behavioral barriers identified as relevant can interact with structural barriers that are outside of an individual's control, such as factors and infrastructures shaping available response options (Gifford, 2011; Nguyen et al., 2019). Further research is needed to fully understand how structural and behavioral barriers jointly contribute to the emergence of the value-action gap in individuals' decisions in everyday life.

The experimental approaches and methods used in this study have different limitations that are important for the interpretation of the results. For our laboratory and vignette experiments, we created an artificial decision situation that masks out contextual influences. While this allows us to investigate the causal effects of the three behavioral barriers in controlled settings, it comes at the expense of a loss of external validity and a reduced transferability of our findings to other environmental decision contexts (Reindl et al., 2019; Sturm and Weimann, 2006). In our approach, we follow established procedures (Atzmüller and Steiner, 2010; Jacquet et al., 2013; Milinski et al., 2008) to complement other experimental and non-experimental research and to provide novel theoretical and empirical insights into the underlying determinants of value-action gaps.

Combining insights from a highly stylized laboratory experiment, a realistic vignette study, and a general questionnaire, we increase the external validity of our findings and demonstrate the relevance of behavioral barriers across diverse settings and measurement approaches. In this context, Levitt and List (2007) point out that both laboratory and non-laboratory data have strengths and weaknesses that, when combined, can enhance each other to derive a more comprehensive understanding. The measures of the value-action gaps observed across the different settings (laboratory, vignette, survey) are inherently different due to differences in the structure and research design employed in each setting, but they allow for a comprehensive analysis of the influence of the three barriers on decision-making processes and the importance of individual characteristics in shaping value-action gaps in different decision situations.

Our study focuses on a selected set of behavioral barriers related to the immediacy, uncertainty, and marginality of environmental decisions. There are aspects related to these barriers as well as other types of barriers which were not considered. For example, our design focuses on the uncertainty in the effectiveness of one's actions and not on the uncertainty related to the occurrence and extent of the consequences of actions or critical thresholds, which have been previously investigated (Barrett and Dannenberg, 2012; Dannenberg et al., 2015; Milinski et al., 2008). Also, we primarily focus on the effects of interpersonal immediacy rather than intrapersonal immediacy, with the latter referring to consequences of actions that affect a person with a delay. Through its focus on a diverse set of barriers, our study provides insights into how different types of barriers operate and how these jointly influence the emergence of value-action gaps.

The data collection was carried out online among a sample of participants from the UK and US who were recruited via Prolific (Henrich et al., 2010; Palan and Schitter, 2018; Peer et al., 2017). Collecting data online meant we had limited control over the data collection process and the circumstances under which participants responded. To address this issue, we implemented monitoring steps and included a number of test questions to ensure a high level of engagement of the participants. Only if the control questions were correctly answered, participants were allowed to participate in the study. Prolific furthermore implements a number of quality standards to ensure high commitment and engagement of participants in the research activities.

While the online data collection allowed us to obtain information from highly diverse respondents, our sample is not representative and results can therefore not be generalized (Supplementary Material Section 7). Compared to the general population in the countries, our sample has on average a lower age, lower income, higher education, and is mostly female. Despite this, the experimental design employed ensures that the results on the role of the barriers are valid, and the major diversity in participants' key characteristics allows us to explore heterogeneity in value-action gaps across the experimental settings. Despite

the sample comprising participants from just two countries, our findings on the factors influencing environmental behaviors and value-action gaps hold relevance beyond these specific country contexts. They also complement previous studies on the value-action gap, which have employed cross-national perspectives based on surveys and hypothetical settings, or laboratory studies utilizing more restrictive samples, such as student samples.

Our findings have important policy implications for the design of effective climate communication and education interventions aimed at closing value-action gaps and promoting pro-environmental behavior. In line with other studies (Weber, 2016), our results show that knowledge and environmental concerns are often not sufficient to induce behavioral changes, but that it is important to also address underlying psychological and behavioral mechanisms and constraints. While our research shows that all barriers have a relevant influence on behavior, the immediacy barrier exerts the most consistent effects. If people are not directly affected by the consequences of an action or perceive to not be affected, they are less likely to act in accordance with their values.

Furthermore, our results indicate that increased marginality in the laboratory experiment adversely affects behavior. Although our experimental setup does not mirror real-world conditions with thousands of contributors, it underscores the significance of marginality. If an increase from 3 to 6 participants reduces the likelihood of achieving climate targets, larger groups may face even more considerable difficulties and an even larger experienced marginality of individual decisions (Milinski et al., 2008). Thus, we consider it likely that incorporating larger groups would have amplified the observed treatment effect, suggesting that our results represent a conservative estimate of the impact of marginality. Previous research has also confirmed that qualitatively participants' behaviors and collective outcomes are very similar in public good social dilemma situations even if these involve larger groups of up to 1000 participants (Pereda et al., 2019; Weimann et al., 2022).

This is particularly relevant in the context of climate change, which is a global phenomenon that requires global action. For many people it may be difficult to grasp the relevance of their individual contributions which can impose an uncertainty barrier (Marx et al., 2007). Highlighting the direct, inter-personal consequences of climate change for oneself and the community, and the relevance of individual actions is hence critical in achieving behavioral change. Indeed, increasing evidence shows that (direct and indirect) experiences with climate change can be a strong driver of changes in perceptions and the adaption of more sustainable behavior (Broomell et al., 2015; Herrnstadt and Muehlegger, 2014; Hoffmann et al., 2022).

At the same time, studies have emphasized that highlighting proximal impacts of climate change might not be sufficient to increase individuals' willingness to behave more sustainably and to support climate mitigation and adaptation policies (Brügger, 2020; Brügger et al., 2015; McDonald et al., 2015). To effectively overcome barriers and promote climate action, there is a need for holistic approaches that involve integrated and comprehensive measures targeting not only individuals, but also their communities and civil society, the private and public sector, as well as structural barriers. Only through the use of integrated measures can we effectively induce change and bridge value-action gaps in a sustainable manner, thereby promoting the ecological transition.

Ethics oversight and compliance

We have complied with all relevant ethical regulations and good scientific practices in the collection and analysis of the data. Participation in the study was voluntary. The participants, who were recruited through the crowdsourcing platform Prolific.co, could drop out at any time. Informed consent was taken prior to the collection of data. The study was carried out as part of a collaborative effort involving the International Institute for Applied Systems Analysis, the Austrian Academy of Sciences, the Vienna University of Economics and Business, and the University of Vienna. The study protocol and procedures were presented and discussed with senior representatives from all institutions who gave their approval. Further oversight was provided by the StartClim 2020 initiative initiated by the Austrian Ministry of Climate Action and Energy, the Ministry of Education, Science and Research, the Climate and Energy Fund, and the State of Upper Austria, which provided funding and guidance to the project. Several designated consultations were held to inform partners and responsible supervisors of the data collection strategy, study protocols, and progress. The data collection was furthermore supported and accompanied by team members of the Prolific.co platform who also provided guidance and oversight.

Code availability

The data analysis was carried out in Stata. The scripts that generate and visualize the results reported in this study are fully available at the Harvard Dataverse repository at: https://dataverse.harvard.edu/privateurl.xhtml?token=3881c3b6-396e-4cf3-83d5-c2368fe15721.

CRediT authorship contribution statement

Roman Hoffmann: Writing – review & editing, Writing – original draft, Supervision, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Georg Kanitsar:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Marcel Seifert:** Writing – review & editing, Writing – original draft, Visualization, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Roman Hoffmann reports financial support was provided by StartClim 2020 initiative, which was funded by the Austrian Ministry of Climate Action and Energy, the Ministry of Education, Science and Research, the Climate and Energy Fund, and the State of Upper Austria. 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.

Data availability

The anonymized experimental data generated and analyzed in the current study are fully available at the Harvard Dataverse repository at: https://dataverse.harvard.edu/privateurl.xhtml?token=3881c3b6-396e-4cf3-83d5-c2368fe15721.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ecolecon.2024.108347.

References

Ajzen, I., 2002. Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior. J. Appl. Soc. Psychol. 32 (4), 665–683. https://doi.org/10.1111/j.1559-1816.2002.tb00236.x.

Anable, J., Lane, B., Kelay, T., 2006. An evidence base review of public attitudes to climate change and transport behaviour. The Department for Transport.

Atzmüller, C., Steiner, P.M., 2010. Experimental vignette studies in survey research. Methodology 6 (3), 128–138. https://doi.org/10.1027/1614-2241/a000014.

Babutsidze, Z., Chai, A., 2018. Look at me saving the planet! The imitation of visible green behavior and its impact on the climate value-action gap. Ecol. Econ. 146, 290–303. https://doi.org/10.1016/j.ecolecon.2017.10.017.

Bamberg, S., Möser, G., 2007. Twenty years after Hines, Hungerford, and Tomera: a new meta-analysis of psycho-social determinants of pro-environmental behaviour. J. Environ. Psychol. 27 (1), 14–25.

Barcelo, H., Capraro, V., 2015. Group size effect on cooperation in one-shot social dilemmas. Sci. Rep. 5 (1), 7937. https://doi.org/10.1038/srep07937.

Barr, S., 2006. Environmental action in the home: investigating the 'value-action' gap. Geography 91 (1), 43–54.

Barrett, S., Dannenberg, A., 2012. Climate negotiations under scientific uncertainty. Proc. Natl. Acad. Sci. USA 109 (43), 17372–17376. https://doi.org/10.1073/PNAS.1208417109/SUPPL_FILE/PNAS.201208417SI.PDF.

Becker, G.M., Degroot, M.H., Marschak, J., 1964. Measuring utility by a single-response sequential method. Behav. Sci. 9 (3), 226–232. https://doi.org/10.1002/bs.3830090304.

Berg, J., Dickhaut, J., McCabe, K., 1995. Trust, reciprocity, and social history. In: Games and Economic Behavior, vol. 10, Issue 1, pp. 122–142. https://doi.org/10.1006/game.1995.1027.

Bicchieri, C., 2006. The Grammar of Society. The Nature and Dynamics of Social Norms. Cambridge University Press.

Blake, J., 1999. Overcoming the 'value-action gap' in environmental policy: tensions between national policy and local experience. Local Environ. 4 (3), 257–278. https://doi.org/10.1080/13549839908725599.

Broomell, S.B., Budescu, D.V., Por, H.H., 2015. Personal experience with climate change predicts intentions to act. Glob. Environ. Chang. 32, 67–73. https://doi.org/10.1016/j.gloenvcha.2015.03.001.

Brügger, A., 2020. Understanding the psychological distance of climate change: the limitations of construal level theory and suggestions for alternative theoretical perspectives. Glob. Environ. Chang. 60, 102023 https://doi.org/10.1016/J.GLOENVCHA.2019.102023.

Brügger, A., Dessai, S., Devine-Wright, P., Morton, T.A., Pidgeon, N.F., 2015. Psychological responses to the proximity of climate change. Nat. Clim. Chang. 5 (12), 1031–1037. https://doi.org/10.1038/nclimate2760.

Cialdini, R.B., Reno, R.R., Kallgren, C.A., 1990. A focus theory of normative conduct: recycling the concept of norms to reduce littering in public places. J. Pers. Soc. Psychol. 58 (6), 1015–1026.

Clayton, S., Devine-Wright, P., Stern, P.C., Whitmarsh, L., Carrico, A., Steg, L., Swim, J., Bonnes, M., 2015. Psychological research and global climate change. Nat. Clim. Chang. https://doi.org/10.1038/nclimate2622.

Creutzig, F., Roy, J., Lamb, W.F., Azevedo, I.M.L., Bruine De Bruin, W., Dalkmann, H., Edelenbosch, O.Y., Geels, F.W., Grubler, A., Hepburn, C., Hertwich, E.G., Khosla, R., Mattauch, L., Minx, J.C., Ramakrishnan, A., Rao, N.D., Steinberger, J.K., Tavoni, M., Ürge-Vorsatz, D., Weber, E.U., 2018. Towards demand-side solutions for mitigating climate change. Nat. Clim. Chang. 8 (4), 268–271. https://doi.org/10.1038/s41558-018-0121-1.

Culiberg, B., Elgaaied-Gambier, L., 2016. Going green to fit in – understanding the impact of social norms on pro-environmental behaviour, a cross-cultural approach. Int. J. Consum. Stud. 40 (2), 179–185. https://doi.org/10.1111/IJCS.12241.

Dannenberg, A., Löschel, A., Paolacci, G., Reif, C., Tavoni, A., 2015. On the provision of public goods with probabilistic and ambiguous thresholds. Environ. Resour. Econ. https://doi.org/10.1007/s10640-014-9796-6.

Dawes, R.M., 1980. Social Dilemmas. Annu. Rev. Psychol. 31 (1), 169–193. https://doi.org/10.1146/ANNUREV.PS.31.020180.001125.

Diekmann, A., Preisendörfer, P., 2003. Green and greenback: the behavioral effects of environmental attitudes in low-cost and high-cost situations. Ration. Soc. 15 (4), 441–472.

Falk, A., Fischbacher, U., 2006. A theory of reciprocity. Games Econ. Behav. 54 (2), 293–315. https://doi.org/10.1016/j.geb.2005.03.001.

Falk, A., Becker, A., Dohmen, T., Huffman, D., Sunde, U., 2022. The preference survey module: a validated instrument for measuring risk, time, and social preferences, 69 (4), 1935–1950. https://doi.org/10.1287/MNSC.2022.4455.

Farjam, M., Nikolaychuk, O., Bravo, G., 2019. Experimental evidence of an environmental attitude-behavior gap in high-cost situations. Ecol. Econ. 166, 106434 https://doi.org/10.1016/j.ecolecon.2019.106434.

Franco, C., Ghisetti, C., 2022. What shapes the "value-action" gap? The role of time perception reconsidered. Econ. Politica 39 (3), 1023–1053. https://doi.org/10.1007/S40888-022-00282-8/TABLES/7.

Giamattei, M., Yahosseini, K.S., Gächter, S., Molleman, L., 2020. LIONESS lab: a free web-based platform for conducting interactive experiments online. J. Econ. Sci. Assoc. https://doi.org/10.1007/s40881-020-00087-0.

Gifford, R., 2011. The dragons of inaction: psychological barriers that limit climate change mitigation and adaptation. Am. Psychol. 66, 290–302. https://doi.org/10.1037/a0023566.

Gifford, R.D., Chen, A.K.S., 2017. Why aren't we taking action? Psychological barriers to climate-positive food choices. Clim. Chang. 140 (2), 165–178. https://doi.org/10.1007/s10584-016-1830-y.

Haider, S.W., Zhuang, G., Ali, S., 2019. Identifying and bridging the attitude-behavior gap in sustainable transportation adoption. J. Ambient. Intell. Humaniz. Comput. 10 (9), 3723–3738. https://doi.org/10.1007/s12652-019-01405-z.

Hauser, O.P., Rand, D.G., Peysakhovich, A., Nowak, M.A., 2014. Cooperating with the future. Nature 511 (7508), 220–223. https://doi.org/10.1038/nature13530.

Hedlund-de Witt, A., 2012. Exploring worldviews and their relationships to sustainable lifestyles: towards a new conceptual and methodological approach. Ecol. Econ. 84, 74–83. https://doi.org/10.1016/j.ecolecon.2012.09.009.

Henrich, J., Heine, S.J., Norenzayan, A., 2010. The weirdest people in the world? Behav. Brain Sci. 33 (2–3), 61–83. https://doi.org/10.1017/S0140525X0999152X.

Herrnstadt, E., Muehlegger, E., 2014. Weather, salience of climate change and congressional voting. J. Environ. Econ. Manag. 68 (3), 435–448. https://doi.org/10.1016/j.jeem.2014.08.002.

Hitlin, S., Piliavin, J.A., 2004. Values: reviving a dormant concept, 30, 359–393. https://doi.org/10.1146/ANNUREV.SOC.30.012703.110640.

Hoffmann, R., Muttarak, R., Peisker, J., Stanig, P., 2022. Climate change experiences raise environmental concerns and promote green voting. Nat. Clim. Chang. 12 (2), 148–155. https://doi.org/10.1038/s41558-021-01263-8.

Hunter, L.M., Hatch, A., Johnson, A., 2004. Cross-national gender variation in environmental behaviors. Soc. Sci. Q. 85 (3), 677–694. https://doi.org/10.1111/J.0038-4941.2004.00239.X.

Inglehart, R., 1995. Public support for environmental protection: objective problems and subjective values in 43 societies. PS: Polit. Sci. Polit. 28 (01), 57–72. https://doi.org/10.2307/420583.

IPCC, 2022. In: Pörtner, H.-O., Roberts, D.C., Tignor, M., Poloczanska, E.S., Mintenbeck, K., Alegría, A., Craig, M., Langsdorf, S., Löschke, S., Möller, V., Okem, A., Rama, B. (Eds.), Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

Isaac, R.M., Walker, J.M., 1988. Group size effects in public goods provision: the voluntary contributions mechanism. Q. J. Econ. 103 (1), 179–199. https://doi.org/10.2307/1882648.

Jackson, R.B., Friedlingstein, P., Le Quéré, C., Abernethy, S., Andrew, R.M., Canadell, J. G., Ciais, P., Davis, S.J., Deng, Z., Liu, Z., Korsbakken, J.I., Peters, G.P., 2022. Global fossil carbon emissions rebound near pre-COVID-19 levels. Environ. Res. Lett. 17 (3), 031001 https://doi.org/10.1088/1748-9326/AC55B6.

Jacquet, J., Hagel, K., Hauert, C., Marotzke, J., Röhl, T., Milinski, M., 2013. Intra- and intergenerational discounting in the climate game. Nat. Clim. Chang. 3 (12), 1025–1028. https://doi.org/10.1038/nclimate2024.

Jones, B.A., Rachlin, H., 2009. Delay, probability, and social discounting in a public goods game. J. Exp. Anal. Behav. 91 (1), 61. https://doi.org/10.1901/JEAB.2009.91-61.

Kaiser, F.G., Wölfing, S., Fuhrer, U., 1999. Environmental attitude and ecological behaviour. J. Environ. Psychol. https://doi.org/10.1006/jevp.1998.0107.

Keizer, K., Schultz, P.W., 2018. Social norms and pro-environmental behaviour. In: Environmental Psychology: An Introduction, 179–188. https://doi.org/10.1002/9781119241072.CH18.

Koletsou, A., Mancy, R., 2011. Which efficacy constructs for large-scale social dilemma problems individual and collective forms of efficacy and outcome expectancies in the context of climate change mitigation. Risk Manage. 13 (4), 184–208. https://doi.org/10.1057/RM.2011.12/TABLES/2.

Kollmuss, A., Agyeman, J., 2002. Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior? Environ. Educ. Res. 8 (3), 239–260. https://doi.org/10.1080/13504620220145401.

Kollock, P., 1998. Social dilemmas: the anatomy of cooperation. Annu. Rev. Sociol. 24, 182–214. https://doi.org/10.1146/ANNUREV.SOC.24.1.183.

Levitt, S.D., List, J.A., 2007. On the generalizability of lab behaviour to the field. Canadian Journal of Economics/Revue Canadienne d'économique 40 (2), 347–370.

Marx, S.M., Weber, E.U., Orlove, B.S., Leiserowitz, A., Krantz, D.H., Roncoli, C., Phillips, J., 2007. Communication and mental processes: experiential and analytic processing of uncertain climate information. Glob. Environ. Chang. 17 (1), 47–58. https://doi.org/10.1016/J.GLOENVCHA.2006.10.004.

McDonald, R.I., Chai, H.Y., Newell, B.R., 2015. Personal experience and the 'psychological distance' of climate change: an integrative review. J. Environ. Psychol. 44, 109–118. https://doi.org/10.1016/j.jenvp.2015.10.003.

Milinski, M., Sommerfeld, R.D., Krambeck, H.-J., Reed, F.A., Marotzke, J., 2008. The collective-risk social dilemma and the prevention of simulated dangerous climate change. Proc. Natl. Acad. Sci. https://doi.org/10.1073/pnas.0709546105.

Miller, L.B., Rice, R.E., Gustafson, A., Goldberg, M.H., 2022. Relationships among environmental attitudes, environmental efficacy, and pro-environmental behaviors across and within 11 countries. Environ. Behav. 54 (7–8), 1063–1096. https://doi.org/10.1177/00139165221131002/ASSET/IMAGES/LARGE/10.1177_00139165221131002-FIG 1.JPEG.

Momsen, K., Stoerk, T., 2014. From intention to action: can nudges help consumers to choose renewable energy? Energy Policy 74 (C), 376–382. https://doi.org/10.1016/j.enpol.2014.07.008.

Moser, S., Kleinhückelkotten, S., 2017. Good intents, but low impacts: diverging importance of motivational and socioeconomic determinants explaining pro-environmental behavior, energy use, and carbon footprint. Environ. Behav. 50 (6), 626–656. https://doi.org/10.1177/0013916517710685.
Mundaca, L., Ürge-Vorsatz, D., Wilson, C., 2019. Demand-side approaches for limiting global warming to 1.5 °C. Energ. Effic. 12 (2), 343–362. https://doi.org/10.1007/S12053-018-9722-9/TABLES/1.
Newell, B.R., McDonald, R.I., Brewer, M., Hayes, B.K., 2014. The psychology of environmental decisions. Annu. Rev. Environ. Resour. 39, 443–467. https://doi.org/10.1146/ANNUREV-ENVIRON-010713-094623.
Nguyen, H.V., Nguyen, C.H., Hoang, T.T.B., 2019. Green consumption: closing the intention-behavior gap. Sustain. Dev. 27 (1), 118–129. https://doi.org/10.1002/sd.1875.
Nielsen, K.S., Clayton, S., Stern, P.C., Dietz, T., Capstick, S., Whitmarsh, L., 2021. How psychology can help limit climate change. Am. Psychol. 76 (1), 130.
Oreg, S., Katz-Gerro, T., 2006. Predicting Proenvironmental behavior cross-nationally: values, the theory of planned behavior, and value-belief-norm theory. Environ. Behav. 38 (4), 462–483. https://doi.org/10.1177/0013916505286012.
Paetzold, F., Busch, T., 2014. Unleashing the powerful few: sustainable investing behaviour of wealthy private investors. Organization & Environment 27 (4), 347–367. https://doi.org/10.1177/1086026614555991.
Palan, S., Schitter, C., 2018. Prolific.ac—A subject pool for online experiments. J. Behav. Exp. Financ. 17, 22–27.
Peattie, K., 2010. Green consumption: behavior and norms. Annu. Rev. Environ. Resour. 35 (1), 195–228. https://doi.org/10.1146/annurev-environ-032609-094328.
Peer, E., Brandimarte, L., Samat, S., Acquisti, A., 2017. Beyond the turk: alternative platforms for crowdsourcing behavioral research. J. Exp. Soc. Psychol. 70, 153–163.
Pereda, M., Tamarit, I., Antonioni, A., Cuesta, J.A., Hernández, P., Sánchez, A., 2019. Large scale and information effects on cooperation in public good games. Sci. Rep. 9 (1) https://doi.org/10.1038/S41598-019-50964-W.
Pew Research Center, 2022. Climate Change Remains Top Global Threat Across 19-Country Survey. https://www.pewresearch.org/global/2022/08/31/climate-change-remains-top-global-threat-across-19-country-survey/.
Poortinga, W., Steg, L., Vlek, C., 2004. Values, environmental concern, and environmental behavior: a study into household energy use. Environ. Behav. 36 (1), 70–93. https://doi.org/10.1177/0013916503251466.
Powers, S.T., van Schaik, C.P., Lehmann, L., 2021. Cooperation in large-scale human societies—what, if anything, makes it unique, and how did it evolve? Evol. Anthropol. 30 (4), 280–293. https://doi.org/10.1002/evan.21909.
Reindl, I., Hoffmann, R., Kittel, B., 2019. Let the others do the job: comparing public good contribution behavior in the lab and in the field. J. Behav. Exp. Econ. 81, 73–83. https://doi.org/10.1016/j.socec.2019.05.006.
Schleussner, C.F., Lissner, T.K., Fischer, E.M., Wohland, J., Perrette, M., Golly, A., Rogelj, J., Childers, K., Schewe, J., Frieler, K., Mengel, M., Hare, W., Schaeffer, M., 2016. Differential climate impacts for policy-relevant limits to global warming: the case of 1.5 °C and 2 °C. Earth Syst. Dyn. 7 (2), 327–351. https://doi.org/10.5194/esd-7-327-2016.
Schmidt, J., Bijmolt, T.H.A., 2020. Accurately measuring willingness to pay for consumer goods: a meta-analysis of the hypothetical bias. J. Acad. Mark. Sci. 48 (3), 499–518. https://doi.org/10.1007/s11747-019-00666-6.
Schuldt, J.P., Rickard, L.N., Yang, Z.J., 2018. Does reduced psychological distance increase climate engagement? On the limits of localizing climate change. J. Environ. Psychol. 55, 147–153. https://doi.org/10.1016/j.jenvp.2018.02.001.
Sheeran, P., 2002. Intention—behavior relations: a conceptual and empirical review. Eur. Rev. Soc. Psychol. 12 (1), 1–36. https://doi.org/10.1080/14792772143000003.
Simpson, B., Willer, R., 2015. Beyond altruism: sociological foundations of cooperation and prosocial behavior. Annu. Rev. Sociol. 41 (1), 43–63. https://doi.org/10.1146/annurev-soc-073014-112242.
Spence, A., Poortinga, W., Pidgeon, N., 2012. The psychological distance of climate change. Risk Anal. 32 (6), 957–972. https://doi.org/10.1111/j.1539-6924.2011.01695.x.
Steg, L., 2016. Values, norms, and intrinsic motivation to act proenvironmentally. Annu. Rev. Environ. Resour. 41, 277–292. https://doi.org/10.1146/annurev-environ-110615-085947.
Steg, L., Vlek, C., 2009. Encouraging pro-environmental behaviour : an integrative review and research agenda. J. Environ. Psychol. 29 (3), 309–317. https://doi.org/10.1016/j.jenvp.2008.10.004.
Steg, L., Bolderdijk, J.W., Keizer, K., Perlaviciute, G., 2014. An integrated framework for encouraging pro-environmental behaviour: the role of values, situational factors and goals. J. Environ. Psychol. 38, 104–115. https://doi.org/10.1016/J.JENVP.2014.01.002.
Stern, P.C., 2000. New environmental theories: toward a coherent theory of environmentally significant behavior. J. Soc. Issues 56 (3), 407–424.
Sturm, B., Weimann, J., 2006. Experiments in environmental economics and some close relatives. J. Econ. Surv. 20 (3), 419–457.
Swim, J.K., Clayton, S., Howard, G.S., 2011. Human behavioral contributions to climate change: psychological and contextual drivers. Am. Psychol. 66 (4), 251–264. https://doi.org/10.1037/A0023472.
Szekely, A., Lipari, F., Antonioni, A., Paolucci, M., Sánchez, A., Tummolini, L., Andrighetto, G., 2021. Evidence from a long-term experiment that collective risks change social norms and promote cooperation. Nat. Commun. 12 (1), 5452. https://doi.org/10.1038/s41467-021-25734-w.
Tabernero, C., Hernández, B., 2010. Self-efficacy and intrinsic motivation guiding environmental behavior. Environ. Behav. 43 (5), 658–675. https://doi.org/10.1177/0013916510379759.
Tavoni, A., Dannenberg, A., Kallis, G., Löschel, A., 2011. Inequality, communication, and the avoidance of disastrous climate change in a public goods game. Proc. Natl. Acad. Sci. USA 108 (29), 11825–11829. https://doi.org/10.1073/PNAS.1102493108/SUPPL_FILE/PNAS.201102493SI.PDF.
Tiezzi, S., Xiao, E., 2016. Time delay, complexity and support for taxation. J. Environ. Econ. Manag. 77, 117–141. https://doi.org/10.1016/J.JEEM.2016.03.002.
Van Lange, P.A.M., Rand, D.G., 2022. Human cooperation and the crises of climate change, COVID-19, and misinformation. Annu. Rev. Psychol. 73 (1), 379–402. https://doi.org/10.1146/annurev-psych-020821-110044.
Van Lange, P.A.M., Joireman, J., Milinski, M., 2018. Climate change: what psychology can offer in terms of insights and solutions. Curr. Dir. Psychol. Sci. https://doi.org/10.1177/0963721417753945.
van Valkengoed, A.M., Steg, L., 2019. Meta-analyses of factors motivating climate change adaptation behaviour. Nat. Clim. Chang. 9 (2), 158–163. https://doi.org/10.1038/s41558-018-0371-y.
Vermeir, I., Verbeke, W., 2006. Sustainable food consumption: exploring the consumer "attitude – behavioral intention" gap. J. Agric. Environ. Ethics 19 (2), 169–194. https://doi.org/10.1007/s10806-005-5485-3.
Vicente-Molina, M.A., Fernández-Sainz, A., Izagirre-Olaizola, J., 2018. Does gender make a difference in pro-environmental behavior? The case of the Basque Country university students. J. Clean. Prod. 176, 89–98. https://doi.org/10.1016/J.JCLEPRO.2017.12.079.
Wang, Y., 2017. Promoting sustainable consumption behaviors: the impacts of environmental attitudes and governance in a cross-national context. Environ. Behav. 49 (10), 1128–1155. https://doi.org/10.1177/0013916516680264.
Weber, E.U., 2016. What shapes perceptions of climate change? New research since 2010. Wiley Interdiscip. Rev. Clim. Chang. 7 (1), 125–134. https://doi.org/10.1002/wcc.377.
Weber, J.M., Kopelman, S., Messick, D.M., 2004. A conceptual review of decision making in social dilemmas: applying a logic of appropriateness. Personal. Soc. Psyxchol. Rev. 8 (3), 281–307. https://doi.org/10.1207/S15327957PSPR0803_4.
Weimann, J., Brosig-Koch, J., Heinrich, T., Hennig-Schmidt, H., Keser, C., 2022. CO2 emission reduction – real public good provision by large groups in the laboratory. J. Econ. Behav. Organ. 200, 1076–1089. https://doi.org/10.1016/J.JEBO.2022.06.027.
Wins, A., Zwergel, B., 2016. Comparing those who do, might and will not invest in sustainable funds: a survey among German retail fund investors. Bus. Res. 9 (1), 51–99. https://doi.org/10.1007/S40685-016-0031-X/TABLES/20.
Wynes, S., Nicholas, K.A., 2017. The climate mitigation gap: education and government recommendations miss the most effective individual actions. Environ. Res. Lett. 12 (7), 74024.
Wyss, A.M., Knoch, D., Berger, S., 2022. When and how pro-environmental attitudes turn into behavior: the role of costs, benefits, and self-control. J. Environ. Psychol. 79, 101748 https://doi.org/10.1016/J.JENVP.2021.101748.
Young, W., Hwang, K., McDonald, S., Oates, C.J., 2010. Sustainable consumption: green consumer behaviour when purchasing products. Sustain. Dev. 18 (1), 20–31.