

Climate impact perceptions and associations with reported behaviors and policy support in three countries

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ABSTRACT

To accelerate climate change mitigation, substantial lifestyle changes and more ambitious climate policies are urgently needed. However, realizing behavior changes is challenged by widespread misperceptions about the relative climate impact of different behaviors, making it difficult even for motivated individuals to identify which actions to prioritize and which policies to support. Little is known about the cross-national variability of such impact perceptions and their association with climate-relevant outcomes. We aim to address this gap with a pre-registered cross-country study ($N = 2742$) in China, Germany, and the United States. Using a novel experimental paradigm, we investigated carbon footprint accuracy (how accurately individuals judge the objective size of carbon footprints) and impact perceptions (the perceived contribution of specific behaviors to carbon footprints). We then examined associations between these two constructs and self-reported climate-related behavior and support for behavior-targeted climate policies. Across the three countries, participants showed low accuracy in estimating carbon footprints and underestimated the impact of carbon-intensive behaviors on those footprints. Despite prevalent behavior-specific misperceptions, the impact perceptions of different behaviors were independent of each other, showing no evidence for compensatory judgments. Participants' carbon footprint accuracy and impact perceptions were associated with corresponding self-reported behavior across all countries. However, the association between impact perceptions and climate policy support varied across countries, with impact perceptions having a direct effect in Germany, no effect in China, and a moderated effect by political orientation in the United States. Our study highlights the need for cross-national research to further uncover which contexts foster (in)accurate behavioral knowledge and corresponding climate-friendly behavior.

1. Introduction

Belief in anthropogenic climate change has steadily increased, and there is global recognition that individual behavior change is important for tackling climate change (Andre et al., 2024; Milfont et al., 2021). However, beliefs about which behavior changes are needed to substantially and rapidly reduce greenhouse gas (GHG) emissions are riddled with misperceptions, partly due to the complexity of accessing and comprehending information about behaviors' climate impact (Johnson et al., 2024). Research conducted in Western countries shows that the climate impact of high-impact behaviors is often underestimated (e.g., flying or red meat consumption), while the impact of

low-impact behaviors tends to be overestimated (e.g., recycling or avoiding plastic packaging) (Cologna et al., 2022; Grinstein et al., 2018; Johnson et al., 2024; Truelove & Parks, 2012; Wynes et al., 2020). In addition to misperceptions about specific behaviors, recent research shows that most people also misperceive the climate impact of different lifestyles, with a tendency to underestimate the carbon footprints¹ of high-income and high-emitting individuals (Andretti et al., 2024; Nielsen et al., 2024; Nockur et al., 2025).

Misperceptions about the relative climate impact of different behaviors are problematic for several reasons. First, without accurate knowledge about behaviors' climate impact, even people who are motivated to act may struggle to prioritize which behaviors are most

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¹ We define carbon footprint of individuals as the total greenhouse gas emissions caused directly or indirectly by (some of) their activities across the whole lifecycle of those activities (i.e. including production, transport, and consumption of goods and services).

effective in addressing climate change. Additionally, since people tend to underestimate high-impact behaviors, they may overlook them and allocate their resources to less impactful behavior changes (Johnson et al., 2024; Kolenatý et al., 2022; Marghetis et al., 2019; Wynes et al., 2020). Second, misperceptions may lead people to oppose policies addressing high-impact behaviors, such as taxes on air travel or meat consumption as they underestimate their effectiveness (Choi & Hart, 2021; Hart & Feldman, 2016; Tobler et al., 2012; Tschötschel et al., 2021). Third, policymakers and companies may suboptimally dedicate effort to promoting or changing behaviors with limited potential for reducing GHG emissions, even at scale (Johnson et al., 2024; Moser & Kleinhüchelkotten, 2018; Winterich et al., 2023). Lastly, misperceptions of carbon footprint inequality within and between countries may similarly affect support for climate policies and the perceived responsibility for engaging in climate change mitigation (Chancel, 2022; Ivanova & Wood, 2020; Nielsen et al., 2024; Nockur et al., 2025).

So far, most studies have documented such misperceptions using samples from single Western countries, while little is known about how people's ability to accurately judge the climate impact of behaviors and lifestyles varies across countries. The focus on individual countries prevents identifying potentially important cultural and national variability (Henrich et al., 2010; Weber & Morris, 2010; Hsee & Weber, 1999). Likewise, there is limited understanding of how the national context moderates the relationship between people's impact perceptions and their own climate-related behavior and policy support. Gaining insights into the contextual variability and influences on climate-impact perceptions of behaviors and lifestyles is essential for identifying the conditions that lead to accurate perceptions and ultimately to more climate-friendly decisions and behavior. Accordingly, in this study we will investigate individuals' understanding of carbon footprints (*carbon footprint accuracy*) and the perceived impact of different behaviors (*behavioral impact perceptions*) (see *H1*, *H2*) and test how these relate to self-reported behavior and climate policy support across three countries (see *H4* - *H5*).

1.1. The role of individual differences

Research shows that impact perceptions are related to different climate-relevant outcomes (Bostrom et al., 2019; Choi & Hart, 2021; Tobler et al., 2012; Winterich et al., 2023). However, the extent to which improving the accuracy of these perceptions translates into behavior change likely depends on other psychological and socio-demographic characteristics, such as people's climate change concern, political orientation, and income. These individual differences may have three-fold effects: (1) they can have direct effects on climate-relevant behaviors, (2) they can have direct effects on impact perceptions, and (3) they can moderate the relationship between impact perceptions and behavior (Cologna et al., 2022; Jylhä et al., 2023; Kolenatý et al., 2022). For example, people with a more left-leaning political orientation are often more willing to engage in high-impact behavior changes and are more likely to perceive these high-impact behaviors as more impactful (Cologna et al., 2022). Thus, their impact perceptions may also influence their behaviors and support for climate policies to a higher degree. In contrast, for those with more right-leaning political orientations, impact perceptions may have little to no effect on these outcomes (see exploratory analyses).

Income is not only directly related to higher individual carbon footprints (Chancel, 2022; Sommer & Kratena, 2017), but also to the perceived fairness of carbon footprint inequality (Nielsen et al., 2024). This suggests that individuals with the highest incomes, who also usually have the largest footprints, are more likely to view this unequal distribution as fair, a pattern consistent with self-serving attitudes (Nielsen et al., 2024). Such attitudes may similarly extend to perceptions of high-impact behaviors. Within high-income groups, carbon-intensive behaviors, such as frequent flying, are widespread and often normalized (Duncan et al., 2023). Consequently, individuals with higher incomes

may underestimate the climate impact of their own behaviors and show lower overall accuracy in judging carbon footprints (see *H1a*).

Importantly, the extent to which these individual differences play a role in predicting individuals' perceptions or moderating the relationship with climate-relevant outcomes may vary across national contexts. While research conducted in the United States has produced mixed findings regarding the association between climate change concern or political orientation and the accuracy of impact perceptions of different behaviors (Bostrom et al., 2019; Johnson et al., 2024), studies in European countries suggest both direct associations and moderation effects (Cologna et al., 2022; Jylhä et al., 2023; Kolenatý et al., 2022). Individuals with greater climate change concern may therefore judge carbon footprints more accurately (see *H1b*), although this relationship may emerge only in some countries.

1.2. Joint evaluation of climate-relevant behaviors

Existing research has primarily examined perceptions of the climate impact of behaviors in isolation. However, people often evaluate behaviors in a comparative or integrative manner, rather than summing up their effects independently (Gorissen & Weijters, 2016; MacCutcheon et al., 2020). We refer to this pattern as non-additive evaluation, where the perceived climate impact of one behavior is shaped by the presence of others in the judgment context. For example, individuals may perceive taking a long-haul flight as less climate impactful if they bike to work every day. Several studies have documented such compensatory biases, indicating that people assume that the consequences of climate-friendly behaviors can compensate for the negative effects of harmful ones, even when the two behaviors are objectively unrelated (Hope et al., 2018; Kaklamanou et al., 2015). Similarly, research on moral licensing suggests that people tend to justify highly climate-harmful behaviors with the prior performance of a low-impact behavior (Burger et al., 2022; Tiefenbeck et al., 2013). When evaluating other people's behavior, moral judgments about the intentions behind performing a given behavior are often considered, which could further amplify the extent to which different actions are evaluated in an integrative manner when judging carbon footprints (Malle, 2021). All of these mechanisms may lead to non-additive effects, where the overall perceived carbon footprint is not simply the sum of all impacts of individual behaviors, but may be perceived as lower (or in some cases higher) due to a joint behavioral evaluation (see *H3*).

1.3. Social and contextual influences

Alongside psychological and sociodemographic factors, myriad contextual factors shape impact perceptions. These factors include cognitive heuristics people use when judging the climate impact of behaviors, such as: familiarity with climate-friendly behaviors, prevailing social norms, and characteristics of information environments and exposure to misinformation. Below, we highlight and discuss some of the factors examined in the literature that may directly shape impact perceptions and moderate their effect on behavior and policy support. Because many of these factors vary across countries, cross-country differences in impact perceptions are likely to emerge.

Recent research suggests that when faced with the difficult task of judging the climate impact of behaviors, individuals may engage in attribute substitution, relying on more accessible cues such as recommendation frequency, familiarity, or perceived social norms instead of the actual emissions impact (Constantino et al., 2022; Johnson et al., 2024; Remshard et al., 2025). For instance, familiarity with climate-friendly behaviors appears to be used as a heuristic when judging impact (Remshard et al., 2025). As familiarity is in part influenced by national infrastructures, which shape both perceived and actual behavioral opportunities (Barr, 2007; Thøgersen, 2005), this may lead to cross-country variation. For example, recycling is more visible and routinely practiced in some countries than others due to extensive

infrastructure (Yang & Thøgersen, 2022), and in such contexts, people may overestimate its importance for reducing GHG emissions.

Individuals may also use their own behavior as a cue to judge impact. Individuals leading a high-carbon lifestyle may be motivated to downplay the carbon intensity of their behavior to protect their self-image (Druckman & McGrath, 2019). Similarly, the behavior of others may influence impact perceptions. When unsustainable behaviors are common and socially accepted, they may appear less harmful simply because they are normalized. Indeed, social norms and the perceived frequency with which individuals' social circles perform climate-relevant behaviors have been found to influence impact perceptions (Doherty & Weblor, 2016). Since norms differ across countries, perceptions of what constitutes meaningful climate action may likewise vary (Saracevic & Schlegelmilch, 2021). Differences in impact perceptions may therefore arise when people base their judgments of impact on how normalized carbon-intensive behaviors are for themselves and within their social network (Sparkman et al., 2021; Sunstein, 2005).

Additionally, both misinformation and well-intentioned information efforts can shape how people perceive the climate impact of specific behaviors. Misinformation about the impact of specific behaviors can contribute to distorted beliefs, as the focus is placed on behaviors with lower effectiveness to delay or avoid impactful changes (Remshard et al., 2025). As media environments differ, with countries varying in their exposure to accurate climate information, misinformation, and discourses of delay (Lamb et al., 2020), this may also lead to cross-country variability in the degree of misperception regarding specific behaviors. Likewise, efforts to convey accurate information, for example via national educational programs on climate-relevant issues, may vary across countries in presence, focus, and depth. An analysis of governmental recommendations in Western countries revealed a more dominant focus on lower-impact behaviors, potentially reinforcing misperceptions about more meaningful climate actions (Wynes & Nicholas, 2017). When people use the frequency with which different climate-friendly behaviors are recommended to them as a cue to make impact judgments, this may therefore lead to varying degrees of misperceptions about low-versus high-impact behaviors (Johnson et al., 2024).

Some of the factors mentioned above may shape how and if impact perceptions translate into climate-relevant outcomes (e.g., the performance of climate-friendly behaviors or support for climate policies). For example, political systems and landscapes can influence how individuals' impact perceptions translate into political preferences by shaping expectations about the extent of public influence on (climate) political decision-making (Tan & Zhu, 2023). Additionally, differing levels of trust in government and abilities to efficiently and fairly govern can affect the extent to which individual beliefs predict policy support (Davidovic et al., 2020; Fairbrother et al., 2019). Impact perceptions may therefore only translate into support for governmental action when the political context fulfills some of these criteria. Relatedly, contextual factors may also influence the extent to which impact perceptions are associated with climate-relevant behavior. Prior research has suggested that when contexts either strongly constrain behavior (e.g. due to strong social norms) or strongly facilitate it (e.g. well-functioning public transport infrastructure), the influence of attitudes and values on behavior weakens (Kaiser, 2021; Kollmuss & Agyeman, 2002; Taube et al., 2018). For example, in contexts with few viable alternatives to car or air travel, or where these behaviors are highly normalized, even people who believe these behaviors are highly harmful for the climate may still engage in them.

1.4. The current study and hypotheses

In this study, we investigated climate-impact perceptions and their behavioral consequences using an online experimental study conducted in China, Germany, and the United States ($n = 2742$). We selected these countries due to their significant historical and current contribution to

GHG emissions and their substantial differences in geography and vulnerability to climate change, political systems, media landscapes, norms and culture, and average per capita carbon footprints. Our research uses a newly developed experimental paradigm focusing on two related but distinct constructs: *carbon footprint accuracy* and *behavioral impact perceptions*. In line with our main research motivation, we tested all hypotheses across the overall sample and subsequently examined the pattern of these effects within each country to explore potential country-specific differences.

First, we investigate the impact of individual differences on the accuracy of individuals' judgments about carbon footprints. Specifically, we hypothesized that income would be negatively and climate change concern would be positively associated with *carbon footprint accuracy* ($H1a$, $H1b$). For specific behaviors, we examined how people perceive the impact of six different climate-relevant behaviors (*behavioral impact perceptions*), hypothesizing that people would underestimate the impact of high-impact behaviors and overestimate low-impact behaviors ($H2$).

Second, we examined how people make inferences about carbon footprints when judging multiple behaviors jointly, hypothesizing that behavioral impact perceptions influence each other in non-additive ways ($H3$). Here, we specifically tested two pre-registered interactions between high- and moderate-impact behaviors within the same domain, as well as two interactions between high-impact behaviors across domains.

Third, we examined the relationships between carbon footprint accuracy, impact perceptions, self-reported behavior, and policy support. Specifically, we hypothesized that higher carbon footprint accuracy and higher impact perceptions would be associated with lower self-reported engagement in carbon-intensive behaviors and greater support for behavior-regulating climate policies ($H4a$, $H4b$, $H5a$, $H5b$). We moreover tested whether these relationships were moderated by levels of climate change concern or, in Germany or the United States, political orientation (pre-registered as exploratory analyses).

2. Materials and methods

2.1. Participants

Ethics approval was granted by the Faculty of Psychology's Ethics Committee at the University of Basel (application number 028-23-1). All participants provided their informed consent to provide their data. Data collection was conducted via a panel provider. It included two other experimental modules in randomized order, not reported here, as part of the larger research project on cross-cultural variability in sustainable judgment and decision-making.

We gathered representative samples in terms of gender, age, and population size of city (rural/urban region) in all countries. In Germany and the US, the samples were additionally representative of income among the population of 18- to 75-year-olds. All deviations from the intended representative sample can be found in [Supplementary Table 1](#). Sampling deviations were small in Germany (all <6%), moderate in the US (10% undersampling of the highest income group, 20% oversampling rural areas), and mostly low in China, aside from undersampling older women ($\approx 6.5\%$) and oversampling ages 30–39 (14%).

Data were collected from April 03, 2024 to April 24, 2024 in Germany and in the United States, and in China from April 03, 2024 to June 04, 2024 due to requiring more time to reach the defined quotas. The targeted sample size of 1000 participants per country was adjusted to adhere to the project budget, following a longer-than-expected survey duration. After applying data quality checks (see [Supplementary Note 1](#) and [Supplementary Tables 7–10](#) for a detailed description of exclusions), this resulted in a final sample of 2742 participants (China: 979, Germany: 883, United States: 880). Sample size deviations are explained in the section 'Statistical analyses and deviations from the pre-registration'. Importantly, our a priori power analysis for $H2$ and $H4a/H5a$ indicated that this reduction would still allow for the detection of small

effect sizes (Cohen’s $d \leq 0.2$). Furthermore, we conducted a post hoc power analysis, accounting for multiple comparisons (six t-tests across three countries) with a corrected alpha criterion of 0.0027. Even with the lowest country-specific sample (United States, 880 participants), this analysis indicated that the power to detect a small effect size (Cohen’s $d = 0.2$) remained high in our study (0.998).

2.2. Assessment of demographic and psychological variables

After providing consent, participants answered demographic questions and an attention check (only participants who gave the correct answer were allowed to proceed). An overview of demographic items and levels can be found in [Supplementary Table 1](#). These included age, gender, income, and urban/rural, which were quota-controlled, as well as education.

After completing the experimental tasks, participants indicated their level of climate change concern (with 3 items, on a scale from 1 - *not at all* to 10 - *very much*, taken from refs (Chu & Yang, 2019; Lu & Schuldt, 2015).), trust in government (2 items concerning local and national government, on a scale from 1 - *not at all* to 10 - *very much*, taken from ref (Wu & Wilkes, 2017).); and political orientation (on a scale from 1 - *strongly liberal (left-wing)* to 10 - *strongly conservative (right-wing)*, only for the German and United States samples). Descriptive statistics for all relevant variables are detailed in [Supplementary Table 2](#). The survey also included measures of climate change belief, emotions, and world-views as part of the larger data assessment, including multiple study modules ([Supplementary Table 3](#)).

2.3. Assessment of carbon footprint accuracy and behavioral impact perceptions: carbon footprint task

To assess participants’ carbon footprint accuracy and behavioral impact perceptions, participants rated individual carbon footprints consisting of six different climate-relevant behaviors across a series of 16 trials. Each carbon footprint encompassed the same six behavioral categories with two different levels each: diet (vegetarian/meat-based), regionality of food consumption (only regional/regional and imported), electricity contract (renewable/mixed), recycling (yes/no), commute to work (by bike/by bus), vacation travel mode (by train/by plane). The behaviors and behavior levels were chosen to represent the three domains with the highest mitigation potential (transport, food, and housing (Ivanova et al., 2020);) and to have one high impact level and one moderate/low impact level per behavior to capture a wide range of actual carbon footprints (Dubois et al., 2019; Moran et al., 2020).

To ensure that participants had consistent and sufficient information to make their judgments, we provided detailed information about each behavior, such as the frequency of occurrence, distance, and other values needed to make an estimation about the behaviors’ carbon impact (see [Supplementary Information 2](#) for full details). For example, the ‘type of diet’ referred to the diet of an adult needing around 2000 kcal daily, and the carbon impact was based on a full year of following either a vegetarian or a meat-based diet. Participants also received an explanatory text introducing the concept of carbon footprints and providing detailed information on the task. To reduce burden and time, the full factorial of 64 different carbon footprint combinations was reduced to 16 combinations using the R packages ExpertChoice (Stephens, 2020) and DoE.base (Grömping, 2018) (see [Supplementary Table 5](#) for the combinations). This reduced design was sufficient to test all main effects and the pre-registered four interactions effects to test

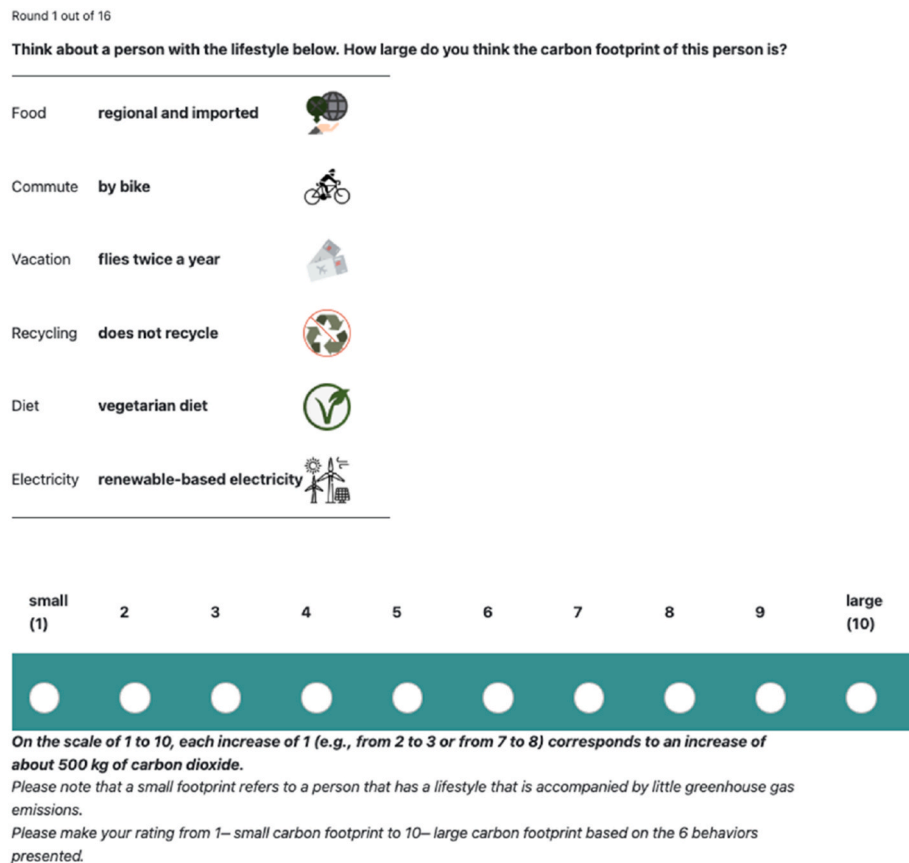


Fig. 1. Example of the carbon footprint task in the study
 Note. The figure shows an example of a carbon footprint shown to participants.

non-additive effects (H2, H3).

Participants rated the 16 consecutive carbon footprints in regards to their overall size on a scale from 1 - *small footprint* to 10 - *large footprint* (“Think about a person with the lifestyle below. How large do you think the carbon footprint of this person is?”, see Fig. 1). Participants were informed of the range of tons of carbon emissions (CO₂) associated with the lowest and highest carbon footprints among the 16 carbon footprints they rated. This allowed us to calculate the size of each carbon footprint in the task based on the scientific literature (details in Supplementary Table 4). This is needed to compute carbon footprint accuracy (see Supplementary Fig. 1 for a comparison of participants ratings and actual footprint sizes).

Carbon footprint accuracy was calculated as the Spearman correlation between participants’ ratings (which were transformed into ranks) and the actual rankings of the carbon footprints. **Behavioral impact perceptions** were extracted as the relative importance of each behavior in predicting individuals’ carbon footprint ratings (as described in the pre-registration), which reflect participants’ perception of the how impactful a given carbon-intensive behavior versus the climate-friendly alternative is in determining the overall carbon footprint.

2.4. Assessment of self-reported climate-relevant behavior and support for climate policies

Climate-relevant behavior was used in two related ways: (1) as an aggregate measure representing individuals carbon footprints based on all reported behaviors (for H4a), and (2) as behavior-specific measure reflecting the CO₂ emissions associated with each reported behavior (for H4b). We assessed this with self-reports matching the five moderate- and high-impact behaviors included in the behavioral impact perceptions task. We did not include a corresponding measure for recycling due to its low climate impact. Specifically, we asked 14 questions in total concerning: diet (frequency of consuming five different types of food items (different meats and dairy), commuting (average car and public transport distances and the fuel used for the car), flying (frequency of flying for three different distances), type of electricity contract, and proportion of regional and imported foods (adapted from ref (Berger & Wyss, 2021)). All responses were then converted into corresponding numeric CO₂ values based on information in the scientific literature (See Supplementary Table 6 for the CO₂ emissions associated with each behavior). This transformation into CO₂ values allowed us to analyze all behaviors in a common quantitative metric, despite differences in their original response formats (e.g., flight frequency, commuting distance, proportion of regional foods). For behaviors where we asked multiple questions (e.g., diet, commuting and flying), emissions associated with each behavior were added into one score (e.g. for diet: the sum of CO₂ emissions from total beef, poultry, lamb, pork dairy consumption). These CO₂ values for each behavior were then used for H4b. For H4a the associated CO₂ emissions were aggregated across all behaviors into one combined total carbon footprint value.

Support for **climate policies** was similarly used in two related ways: (1) as an average measure of policy support across different consumer policies (for H5a) and (2) as policy-specific measure reflecting support for specific consumer policies (for H5b). We assessed this by asking for the degree of support for policies regulating the same five moderate and high impact behaviors for which we assessed behavioral impact perceptions (5 items, e.g., “Increase or introduce taxes on fuel for vehicles (i.e. diesel and gasoline)”, on a scale from 1 - *strongly oppose* to 10 - *strongly support*, adapted from refs (Montfort et al., 2023; Nielsen et al., 2024)). These values were then used in the mixed effects models for H5b. For H5a the answers were aggregated across all five behaviors into one average climate policy score (for the carbon footprint accuracy analysis).

2.5. Statistical analyses and deviations from the pre-registration

The pre-registered hypotheses and analyses can be found on the Open Science Framework (<https://osf.io/gytd5>). All analyses adhered to the preregistration, except for the deviations outlined in Supplementary Note 1 and the following, which pertained to the sample size. Analyses involving carbon footprint accuracy had a sample size of N = 2688 instead of N = 2,742, as it was impossible to compute a correlation coefficient for 54 participants due to them giving the same rating in all 16 trials of the carbon footprint task. For analyses regarding participants’ self-reported behavior, we restricted the range to exclude outliers (including total carbon footprints of 126–561 tons of CO₂), leading to an exclusion of 11 participants.

For readability, the hypotheses were renumbered in this manuscript. The original numbering from the preregistration is provided in Supplementary Table 11. For all analyses where it was possible we ran analyses for the full sample, followed by country-specific analyses. These are all analyses, that do not include income or political orientation as key variables, since the latter was not assessed in China and income was assessed with country-specific answer categories. All analyses included the following control variables: age, gender, education, income, and climate change concern. Analyses with the full sample include a categorical country variable. Analyses of policy support additionally controlled for trust in governments and (in Germany and the United States) political orientation (see Supplementary Fig. 2 for the bivariate correlations). For H2, we pre-registered t-tests to test over and underestimation (reported in Supplementary Table 12). To investigate and visualize in more detail how participants estimate high and low impact behaviors, we additionally ran a mixed-effects model with participants’ carbon footprint ratings as the dependent variable, the six behaviors as fixed effects and the above-mentioned control variables.

3. Results

3.1. Cross-national variability in carbon footprint accuracy and its determinants

First, we investigated carbon footprint accuracy, reflecting the ability to accurately judge the accumulated carbon footprint based on multiple behaviors. As illustrated in Fig. 2, there were notable country differences in the distribution and average level of carbon footprint accuracy. On average, carbon footprint accuracy was significantly higher in Germany (mean $r = 0.39$, median $r = 0.49$, SD = 0.36) compared with the United States (mean $r = 0.20$, median $r = 0.23$, SD = 0.32; $b_{\text{Germany-United States}} = 0.20$, 95 % CI [0.17; 0.23], $p < .001$) and China (mean $r = 0.20$, median $r = 0.23$, SD = 0.33; $b_{\text{Germany-China}} = 0.21$, 95 % CI [0.17; 0.25], $p < .001$). However, there was no significant difference in accuracy between the United States and China ($b_{\text{United States-China}} = 0.01$, 95 % CI [-0.03; 0.05], $p = .507$). Next, we tested whether carbon footprint accuracy was related to climate change concern and income, and whether this relationship varied between countries. Overall, climate change concern was positively related to carbon footprint accuracy ($b = 0.04$, 95 % CI [0.00; 0.08], $p = .048$). This indicates that participants with higher climate change concern were more accurate in estimating carbon footprints, thereby supporting pre-registered H1b.

Country-specific analyses showed that the association between climate change concern and carbon footprint accuracy was primarily driven by the German sample: In Germany, higher levels of climate change concern ($b_{\text{Germany}} = 0.14$, 95 % CI [0.07; 0.21], $p < .001$) were associated with higher carbon footprint accuracy. By contrast, in China and the United States, this relationship was not statistically significant ($b_{\text{China}} = -0.05$, 95 % CI [-0.11; 0.01], $p = .103$; $b_{\text{United States}} = 0.03$, 95 % CI [-0.04; 0.10], $p = .415$). Similarly, income was only a significant predictor in Germany, with the two higher income brackets exhibiting higher levels of carbon footprint accuracy compared to the lowest income bracket ($b_{\text{quintile4}} = 0.31$, 95 % CI [0.08; 0.54], $p = .008$; $b_{\text{quintile5}}$

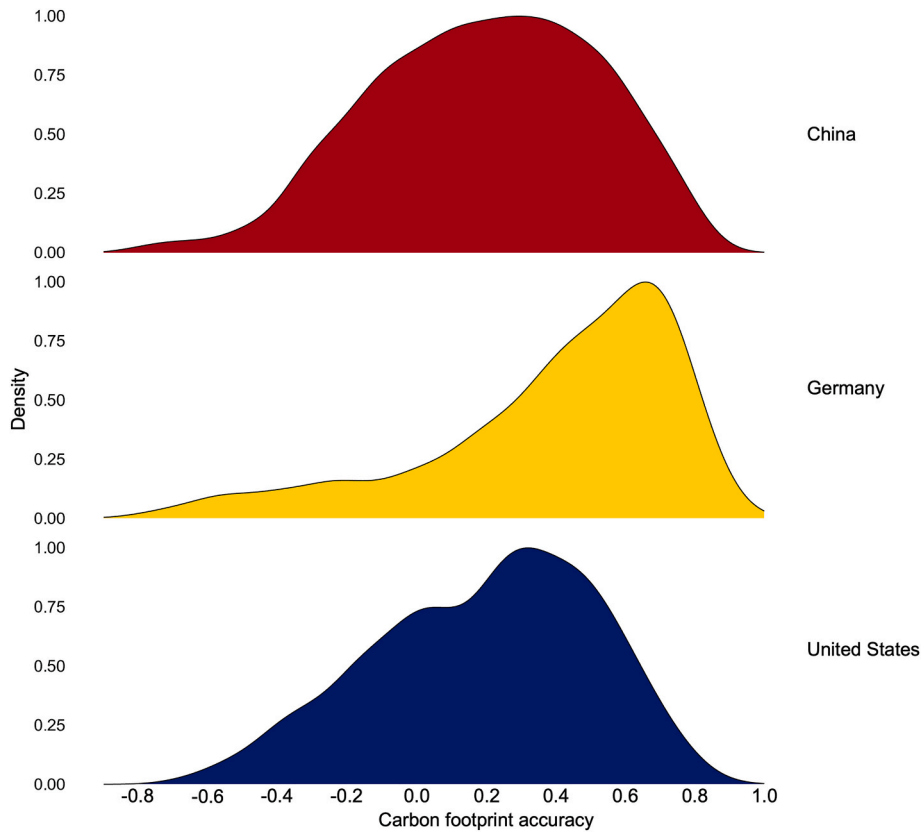


Fig. 2. Distribution of carbon footprint accuracy scores in the three target countries
 Note. The x-axis displays carbon footprint accuracy scores (the correlation between participants' carbon footprint ratings and actual rankings), and the y-axis displays density. Colors indicate country and are ordered on the y-axis accordingly (red = China, yellow = Germany, blue = United States). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

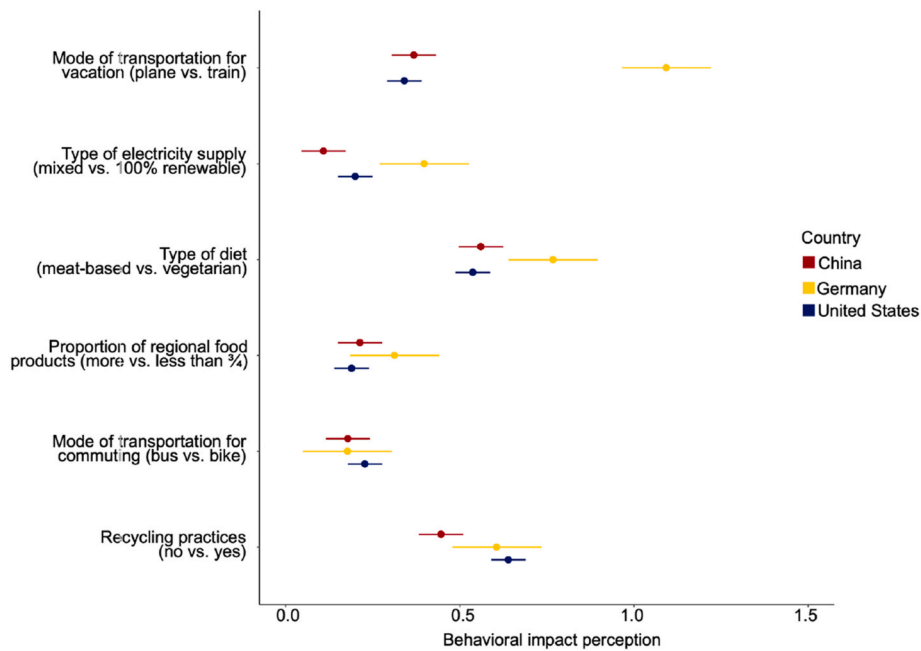


Fig. 3. Behavioral impact perceptions in the three target countries
 Note. The y-axis displays the different behaviors in the carbon footprints, listed top to bottom by order of actual climate impact. The x-axis displays the average estimated impact perceptions per behavior and country. Error bars indicate 95 % CIs. Colors indicate the different countries (red = China, yellow = Germany, blue = United States). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

= 0.29, 95 % CI [0.05; 0.52], $p = .016$). In China and the United States, income was unrelated to carbon footprint accuracy ($b_{\text{China} > 50k \text{ RMB}} = 0.11$, 95 % CI [-0.30; 0.51], $p = .547$; $b_{\text{United States quintile 5}} = 0.17$, 95 % CI [-0.10; 0.44], $p = .213$).

3.2. Cross-national variability in behavioral impact perceptions

Next, we moved from aggregate carbon footprints to specific behaviors. As displayed in Fig. 3, participants across all three countries took each of the six behaviors into account simultaneously when estimating carbon footprints. On average, participants perceived the type of diet (vegetarian or meat-based) to have the largest impact on carbon footprints ($b = 0.62$, 95 % CI [0.55; 0.69], $p < .001$), followed by mode of transportation for vacation (plane or train) ($b = 0.58$, 95 % CI [0.52; 0.66], $p < .001$), recycling practices (yes or no) ($b = 0.56$, 95 % CI [0.49; 0.63], $p < .001$), proportion of regional food products (more or less than ¼ is regional) ($b = 0.24$, 95 % CI [0.17; 0.31], $p < .001$), electricity supply (100 % renewable or mixed) ($b = 0.23$, 95 % CI [0.16; 0.30], $p < .001$), and mode of transportation for commuting (bike or bus) ($b = 0.19$, 95 % CI [0.12; 0.26], $p < .001$). Overall, participants underestimated the climate impact of mode of transportation for vacation, electricity supply, and diet (see Supplementary Table 12 for the pre-registered t-tests of over- and underestimation of behavioral impact perceptions). Interestingly, the climate impact of recycling, the least impactful behavior, was overestimated in all countries and was perceived to be among the three most impactful behaviors (see Supplementary Table 13 for the country-specific behavioral impact perception values). These results support the pre-registered H2. The relatively higher impact of the type of diet compared to the proportion of regional food products, however, was perceived accurately in all countries, such that the type of diet was, on average, perceived as more impactful than the proportion of regional food products (see Fig. 3).

The behavioral impact perceptions varied between countries (Fig. 3 and Supplementary Table 13). Most behaviors were perceived as more impactful in Germany than in the United States and China, especially the three high-impact behaviors: flying ($b_{\text{Germany-China}} = -0.72$, 95 % CI [-0.79; -0.66], $p < .001$; $b_{\text{Germany-United States}} = -0.75$, 95 % CI [-0.82; -0.69], $p < .001$), electricity supply ($b_{\text{Germany-China}} = -0.29$, 95 % CI [-0.35; -0.22], $p < .001$; $b_{\text{Germany-United States}} = -0.20$, 95 % CI [-0.26; -0.13], $p < .001$), and diet ($b_{\text{Germany-China}} = -0.21$, 95 % CI [-0.27; -0.14], $p < .001$; $b_{\text{Germany-United States}} = -0.23$, 95 % CI [-0.30; -0.16], $p < .001$), as well as the moderate impact behavior regional food ($b_{\text{Germany-China}} = -0.10$, 95 % CI [-0.16; -0.03], $p = 0.003$; $b_{\text{Germany-United States}} = -0.12$, 95 % CI [-0.19; -0.06], $p < .001$). While still overestimated, recycling was perceived as significantly less impactful in China compared to both Germany and the United States ($b_{\text{China-Germany}} = 0.16$, 95 % CI [0.09; 0.25], $p < .001$; $b_{\text{China-United States}} = 0.19$, 95 % CI [0.13; 0.26], $p < .001$). Additionally, in the United States, recycling was perceived as more impactful than the most impactful behavior flying ($X^2(1, N = 880) = 70.224$, $p < .001$), demonstrating substantial misperceptions of the relative differences in the behaviors' climate impact. As illustrated in Fig. 3, there was greater variability between the three countries in the perceptions of the high-impact behaviors (flying, electricity supply, diet) compared to the variability of the low- and moderate-impact behaviors (regional food, commute, recycling) (see also Supplementary Table 13 for comparison of country-specific estimates and CIs).

3.3. Non-additive effects in behavioral impact perceptions

We next examined whether impact perceptions of the different behaviors influence each other in a non-additive way in determining people's overall carbon footprint ratings. To this end, we added interactions between impact perceptions of the pre-registered combinations of behaviors. For instance, we tested whether the perceived impact of a meat-based vs. a vegetarian diet on the total carbon footprint was

influenced by the objectively unrelated climate-relevant behavior of taking the train vs. flying. As pre-registered, we tested four interactions total, two between high- and moderate-impact behaviors within the same domain (diet and regional food; commuting and flying), as well as two interactions between high-impact behaviors (diet and flying, diet and electricity supply). We found no statistically significant interactions in the full sample for the tested behavioral combinations ($b_{\text{diet and regional}} = -0.03$, 95 % CI [-0.17; 0.12], $p = .694$; ($b_{\text{flying and commute}} = -0.03$, 95 % CI [-0.17; 0.12], $p = .694$; $b_{\text{diet and flying}} = -0.06$, 95 % CI [-0.20; 0.09], $p = .434$; ($b_{\text{diet and electricity}} = -0.11$, 95 % CI [-0.24; 0.02], $p = .087$). Consequently, we did not find support for pre-registered H3. We also found no statistically significant interactions in the country-specific samples (see Supplementary Tables 14–17). This suggests that participants independently combined the different climate-relevant behaviors into an overall carbon footprint rating, rather than perceiving the impacts of different behaviors as influencing or compensating for each other.

3.4. Effects on personal self-reported climate-relevant behavior

We tested whether carbon footprint accuracy was associated with participants' own self-reported carbon footprints. Carbon footprint accuracy was significantly negatively associated with participants' own aggregated carbon footprints ($b_{\text{all countries}} = -0.13$, 95 % CI [-0.16; -0.09], $p < .001$; see Supplementary Fig. 3). This supports H4a, in that participants with more knowledge about carbon footprints reported lower carbon footprints themselves. This relationship was consistent across all country-specific samples ($b_{\text{China}} = -3.61$, 95 % CI [-4.88; -2.35], $p < .001$; $b_{\text{Germany}} = -1.26$, 95 % CI [-1.88; -0.64], $p < .001$; $b_{\text{United States}} = -2.43$, 95 % CI [-3.59; -1.27], $p < .001$) and remained stable when controlling for climate change concern. While there was no significant difference in this relationship between China and the United States ($b_{\text{China-United States}} = 1.13$, 95 % CI [-0.42; 2.67], $p = .154$), the effect was more pronounced in China and in the United States than in Germany ($b_{\text{China-Germany}} = 2.74$, 95 % CI [1.30; 4.18], $p < .001$; $b_{\text{United States-Germany}} = 1.61$, 95 % CI [0.10; 3.12], $p = .036$).

Next, we moved from the aggregate level of carbon footprints to the level of specific behaviors, investigating whether participants' behavioral impact perceptions were associated with the CO₂ emissions estimated from how frequently they reported performing each of the corresponding climate-relevant behaviors. We also investigated whether this relationship was moderated by climate change concern and, in Germany and the United States, political orientation. In line with the analysis of carbon footprint accuracy, there was a negative main effect of participants' behavioral impact perceptions on their self-reported behavior across all three countries ($b_{\text{all countries}} = -0.02$, 95 % CI [-0.03; -0.01], $p < .001$; see Fig. 4), offering support for H4b, indicating that stronger perceived behavioral impact was linked to lower CO₂ emissions from their reported behaviors. This effect emerged in all country-specific samples ($b_{\text{China}} = -0.06$, 95 % CI [-0.08; -0.04], $p < .001$; $b_{\text{Germany}} = -0.05$, 95 % CI [-0.08; -0.03], $p < .001$; $b_{\text{United States}} = -0.02$, 95 % CI [-0.03; -0.01], $p < .001$).

Climate change concern did not moderate the relationship between behavioral impact perceptions and self-reported behavior, neither in the overall sample nor in the country-specific samples ($b_{\text{all countries}} = 0.01$, 95 % CI [-0.00; 0.02], $p = .156$, see Supplementary Table 18 for the country-specific analyses). In Germany, political orientation significantly moderated the relationship between behavioral impact perceptions and self-reported behavior (see Fig. 4 and Supplementary Fig. 4). Accordingly, left-leaning participants who perceived the target behaviors as having a larger relative climate impact were less likely to report engaging in corresponding carbon-intensive behaviors, whereas behavioral impact perception was not associated with the behavior of more right-leaning individuals ($b = 0.04$, 95 % CI [0.02; 0.06], $p = .001$). Surprisingly, no moderation effect for political orientation was observed in the United States ($b = 0.00$, 95 % CI [-0.00; 0.01], $p =$

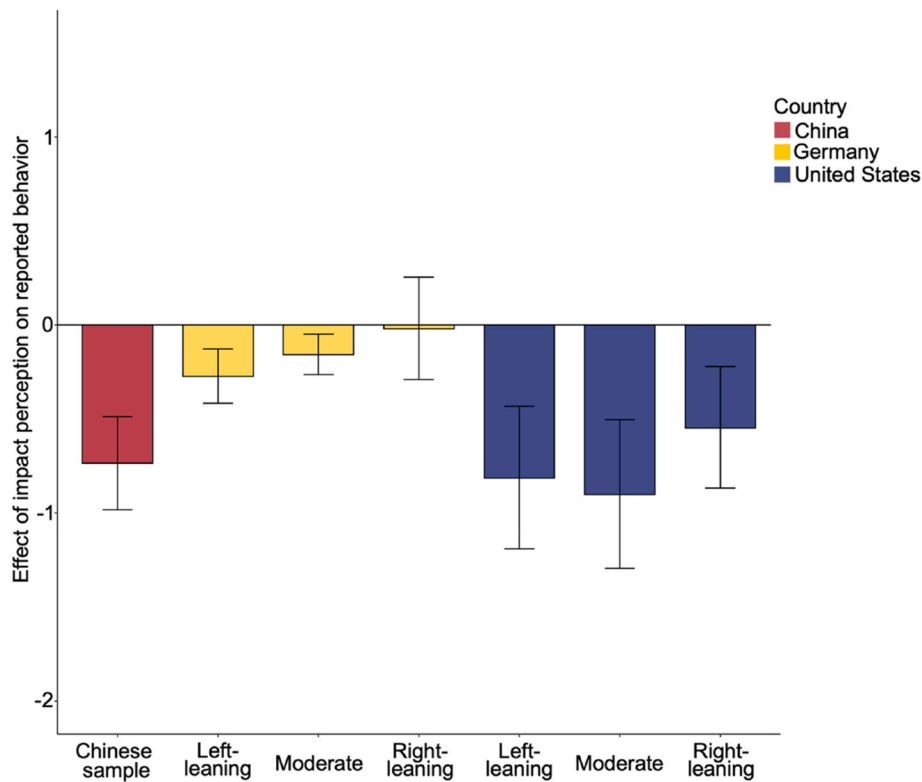


Fig. 4. The effect of behavioral impact perceptions on individual's self-reported climate-relevant behaviors as a function of country and political orientation. Note. The y-axis displays the effect of participants' behavioral impact perception on their self-reported behavior (i.e., the regression coefficient) by country and political orientation. The x-axis displays levels of political orientation in Germany and the United States and the overall sample in China. Error bars indicate 95 % CIs. Colors indicate the different countries (red = China, yellow = Germany, blue = United States). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

.508), where higher behavioral impact perceptions consistently resulted in a lower likelihood to report engagement in the corresponding behavior. To clarify whether substantial differences in impact perceptions across levels of political orientations might explain the absence of moderation, [Supplementary Fig. 5](#) displays their distribution in the United States sample.

3.5. Effects on support for climate policies

Finally, we examined the relationship between carbon footprint accuracy and behavioral impact perception on the support of climate policies. Carbon footprint accuracy was positively related to policy support ($b_{\text{all countries}} = 0.05$, 95 % CI [0.02; 0.08], $p = .001$), supporting pre-registered *H5a* that participants with more accurate judgments of carbon footprints were more likely to support climate policies addressing carbon-intensive behaviors. Country-specific analyses showed differences in the relationship between carbon footprint accuracy and policy support across countries (see [Supplementary Fig. 6](#)). Higher carbon footprint accuracy was found to be significantly associated with higher policy support in Germany ($b_{\text{Germany}} = 0.94$, 95 % CI [0.57; 1.31], $p < .001$, including in the presence of climate change concern, political orientation and trust in government as control variables), while there was no statistically significant main effect in China and the United States ($b_{\text{China}} = -0.04$, 95 % CI [-0.22; 0.26], $p = .795$; $b_{\text{United States}} = 0.19$, 95 % CI [-0.26; 0.64], $p = .409$).

Subsequently, we examined the relationship between behavioral impact perceptions and support for corresponding behavior-focused climate policies and whether this relationship was moderated by climate change concern and, in Germany and the United States, political orientation. Overall, higher behavioral impact perceptions were related to higher support of corresponding climate policies ($b = 0.02$, 95 % CI

[0.00; 0.03], $p = .014$), supporting pre-registered *H5b*. That is, the more participants perceived a given behavior to have a climate impact on carbon footprints, the more likely they were to support corresponding policies aimed at changing that behavior to reduce emissions. This relationship was not moderated by climate change concern, neither in the overall sample ($b_{\text{all countries}} = 0.00$, 95 % CI [-0.01; 0.02], $p = .589$) nor in the country-specific samples (see [Supplementary Table 19](#)).

As illustrated in [Fig. 5](#), country-specific analyses revealed variation in the relationship between behavioral impact perceptions and policy support across countries ($b_{\text{Germany-China}} = -0.22$, 95 % CI [-0.25; -0.19], $p < .001$; $b_{\text{Germany-United States}} = -0.09$, 95 % CI [-0.12; -0.06], $p < .001$, see [Fig. 5](#)). In Germany, the more impactful participants perceived a given behavior, the more they supported corresponding climate policies ($b = 0.07$, 95 % CI [0.04; 0.10], $p < .001$). The main effect in Germany was not moderated by political orientation ($b = 0.01$, 95 % CI [-0.01; 0.03], $p = .344$). In the United States, while there was no main effect ($b = 0.00$, 95 % CI [-0.02; 0.03], $p = .743$), the relationship between behavioral impact perceptions and policy support was moderated by political orientation ($b = -0.02$, 95 % CI [-0.04; -0.00], $p = .030$). This suggests that there was a significant difference in the direction of the association between behavioral impact perception and policy support depending on political orientation (see [Fig. 5](#)). However simple effect analyses show that the effect of impact perceptions on policy support was not significantly different from zero neither for left-leaning nor for right-leaning participants (see [Supplementary Table 20](#)). There was no significant relationship between behavioral impact perceptions and policy support in China ($b = -0.00$, 95 % CI [-0.03; 0.02], $p = .804$).

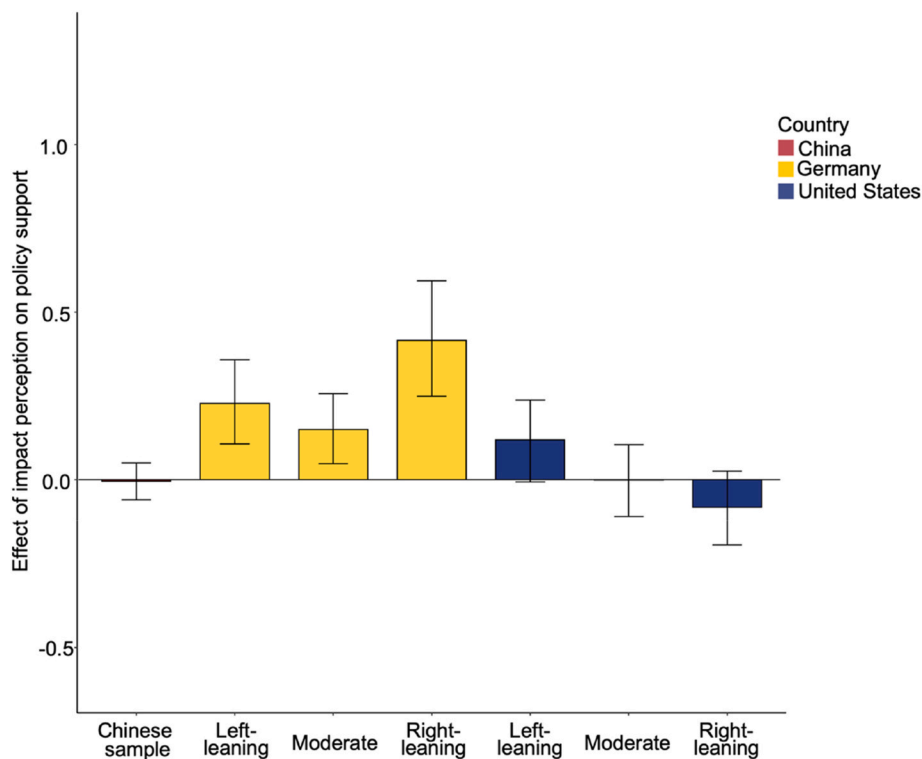


Fig. 5. The effect of behavioral impact perceptions on support for behavior-focused climate policies as a function of country and political orientation. Note. The y-axis displays the effect of participants' impact perception on stated policy support for behavior-related policies (i.e. the regression coefficient). The x-axis displays levels of political orientation in Germany and the United States and the overall sample in China. Error bars indicate 95 % CIs. Colors indicate the different countries (red = China, yellow = Germany, blue = United States). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

4. Discussion

Our results reveal widespread misperceptions of the climate impact of different lifestyles and behaviors across three culturally diverse countries, replicating and extending previous research that primarily focused on single Western countries. We also uncover important perceptual differences between the countries. These include differences in the ability to accurately judge the carbon impact of different lifestyles and the specific contribution of different behaviors, predictors of accuracy, and moderators of the relationship between behavioral impact perceptions and climate-relevant outcomes. This suggests that contextual factors—such as media environments, cultural variability in behavioral and social norms, and awareness of sustainable alternatives—may shape how people perceive carbon footprints and the climate impact of different behaviors.

Cross-country differences were particularly pronounced in the perceptions of high-impact behaviors, such as flying, eating meat, and choosing electricity supply. These behaviors were perceived as more impactful in Germany than in China and the United States, leading to overall more accurate judgments of carbon footprints in Germany. The observed differences may stem from cross-country variability in public attention and communication frames about these behaviors. For instance, a comparative media analysis found that while the sustainability aspect of food consumption, including the role of meat consumption as a driver of GHG emissions, remains a marginalized topic, the frame is employed more extensively in Germany than in the United States (Brüggemann et al., 2022).

Differences in impact perception may further reflect country differences in the social norms and experiences regarding certain behaviors, as social norms have been found not only to predict behaviors, but also perceptions of their effectiveness (Doherty & Webler, 2016). For example, in our study, German participants indicated that they ate less

meat on average and took fewer flights than those from China and the United States (see Supplementary Table 21). It is therefore possible that differences in social norms influenced the perception of dietary impact and of flying, as research has shown that the more normalized a behavior is, the more easily people can justify it and relinquish personal responsibility (Bastian & Loughnan, 2017). Additionally, as behaviors diffuse through social connections and people base their judgments of the prevalence of behaviors in the population on the experience in their social circles (Geiger et al., 2019; Pachur et al., 2005), a high percentage of individuals flying often and eating meat regularly may increase the perceived normativity such behaviors. In China and the United States, where average meat consumption and flights taken were higher, such stronger perceived norms could in turn have increased the underestimation of their climate impact. This may generalize to other behaviors, as unsustainable behaviors such as flying, driving, and eating meat are the norms in many contexts which may impede recognition of the substantial impact these behaviors have and is seen as major hurdles to collective action on climate change (Sparkman et al., 2021).

Another factor that may explain cross-country differences in impact perceptions is that people have different degrees of awareness and exposure to climate-friendly behaviors. When assessing the climate impact of behaviors, they may therefore rely on the familiarity of sustainable behavioral alternatives as a cue for effectiveness (Remshardt et al., 2025). This could help explain the larger overestimation of recycling in Germany and the United States, and the relatively larger underestimation of electricity supply in China and the United States. In Germany, the demand for green electricity tariffs is around 40 %, as it is relatively easy and common for households to switch providers and tariffs (Bundesnetzagentur, 2023). In contrast, choosing renewable energy at the private household level is more complicated or not possible in the United States and China (National Energy Administration Beijing, 2024; United States Environmental Protection Agency, 2022). As a

results, German citizens are likely more exposed to renewable electricity contracts and more aware of their climate benefits, whereas the lower consumer exposure in China and the United States may have led to comparatively higher underestimation of the impact of electricity contracts. Similarly, recycling, which was overestimated more in Germany and the United States, is likely more accessible to people in those countries due to more exposure to extensive urban household recycling infrastructure, higher household waste sorting rates (Yang & Thøgersen, 2022), and its prominent place in educational campaigns that present it as a core ‘sustainable’ behavior in many Western countries (Wynes & Nicholas, 2017). Individuals likely erroneously inferred from this high exposure to the behavior, that it is also impactful.

Beyond cross-country differences in perceptions, we also observe variation between countries in the relevance of psychological and sociodemographic factors in predicting carbon footprint accuracy. In Germany, but not in the United States and China, higher income was associated with higher levels of accuracy. While we expected a negative association between income and accuracy in line with self-serving attitudes and a higher normalization of carbon-intensive behaviors, a positive association was previously observed in German samples (Kretschmer, 2024). Similarly, we found an association between people’s level of climate change concern and carbon footprint accuracy only in Germany. These mixed findings reflect the broader literature on the link between concern and efficacy or impact beliefs, which also indicates that the association emerges in certain contexts and countries but not in others (Bostrom et al., 2019; Cologna et al., 2022; Garfin et al., 2024; Johnson et al., 2024; Jylhä et al., 2023). More cross-country research is needed to disentangle whether these differences reflect contextual factors or methodological differences in how impact perceptions are measured and the extent to which such measures capture nuance. Future research, including a broad range of countries, should therefore investigate the conditions and contexts under which higher concern is associated with higher behavioral knowledge, and whether this connection can be strengthened with evidence-based interventions.

We also find country-specific patterns in how impact perceptions relate to participants’ own self-reported behavior and policy support. While higher impact perceptions were directly linked with more reporting of corresponding climate-friendly behaviors in China and the United States, this association was moderated by political orientation in Germany. These findings align with previous research revealing mixed and context-dependent findings on the relationship between political orientation and individual behaviors (Chuvienco et al., 2021; Huddart Kennedy et al., 2015; Orellano & Chuvienco, 2022; Watkins et al., 2016). The results should, however, be interpreted with caution, as our use of self-reported behavior may lead to an overestimation of the strength of the observed relationships compared to actual behavior. Our findings also suggest that impact perceptions of individual behaviors may be more consistently associated with participants’ own behavior, whereas their association with behavior-regulating policy support appears to be more context dependent. Interventions specifically targeting policy support may therefore benefit from additionally addressing collective efficacy beliefs, or constructs such as trust in government or responsibility perceptions.

The observed cross-country variability in how impact perceptions related to policy support may be shaped by differences in the political landscape, given varying degrees of public participation and influence of public opinion on political processes and differing overall levels of governmental climate action across the three countries (Tan & Zhu, 2023). Such differences can shape public expectations of what policy support can achieve and can create conditions where citizens’ concerns and beliefs are not as strongly related to policy support. For instance, research shows that in countries with a high capacity to perform affairs efficiently, fairly, and without corruption, political ideology and concern are stronger predictors of support for environmental taxes (Davidovic et al., 2020). This is consistent with evidence from a cross-national study of 23 European countries, which found that the

association between climate change beliefs and support for climate taxes was stronger in countries with high levels of political trust, whereas in countries with low levels of trust the association was weak at most. Our findings are consistent with this pattern: in Germany, where political trust is comparatively high, impact perceptions were positively related to policy support, while in the United States, where political trust is lower and polarization more pronounced, this link was absent (OECD, 2024; Smith & Mayer, 2019). Additionally, while political orientation did not moderate the relationship between impact perceptions and policy support in Germany, there was a significant moderation in the United States. This is consistent with previous research illustrating that the effects of political orientation on climate change concern and policy support are more pronounced in the United States (Hornsey et al., 2018; Smith & Mayer, 2019) and comparatively smaller in other national contexts (Ziegler, 2017).

Although many participants misperceived the relative climate impact of specific behaviors, we found no evidence of non-additive effects in their evaluation of carbon footprints. This suggests that participants still made rational estimations of carbon footprints by aggregating the impact of different behaviors into a total carbon footprint. While we did not find evidence for a systematic bias in which perceptions of behavioral impact influence each other, qualitative and quantitative research has pointed to compensatory beliefs (Kaklamanou et al., 2015; MacCutcheon et al., 2020). One potential reason why these misperceptions did not emerge in our study might be that, unlike previous studies, our participants judged other people’s lifestyles rather than (justifying) their own behavior. Whether perceptions differ depending on the object of judgment should be explored in future research.

Methodologically, our findings highlight important differences and similarities in the perceived behavioral impacts between different countries that would not be as interpretable in ranking tasks. For example, while the perceived impact of recycling was almost identical in magnitude between Germany and the United States in our study, their respective ranks would differ in the two countries. This would not only lead to differences in magnitude between behavioral impacts being lost—as magnitude differences can be profound between ranks (Johnson et al., 2024)—but may also affect interpretations of over- and underestimation. For example, a behavior may appear less underestimated in one sample simply because it ranks lower, even though its perceived numeric impact is nearly identical. Unlike traditional approaches, which primarily rely on ranking tasks or Likert assessment with limited scales, our holistic assessment can account for relative magnitude differences in behavioral impact perceptions (Garfin et al., 2024; Johnson et al., 2024; Kolenatý et al., 2022). Our approach therefore most likely represents a more accurate measurement of impact misperceptions as it can provide more nuances and detect differences between samples and individual differences more easily. As a result, future research aiming to identify differences between individuals and samples could build on this methodology to make accurate interpretations and recommendations.

Our study has several limitations. While we retrieved impact perceptions of specific behaviors through a within-subjects experimental design, our analyses of the relationships between these perceptions and participants’ self-reported behavior and policy support cannot address questions of causality. Our study therefore leaves it open whether people with accurate impact perceptions are less likely to engage in climate-harmful behaviors (which we assume) or whether individuals (with higher carbon footprints) engage in motivated reasoning and infer impact perception ratings from their own behavior, thus using their behavior as a cue to answer complex questions about climate impact (as has been suggested by Johnson et al., 2024). To address this causal question, experimental studies, including intervention studies, that measure intervention effects on behavioral outcomes are needed.

Additionally, we assessed behavior with self-reported measures to ensure alignment with the specific behaviors assessed in the perception task. This approach is common in environmental psychology, as self-

reports are convenient and cost-effective, but present a limitation (Kormos & Gifford, 2014). We took care not to use verbal response descriptors, which are more subjective, and our analyses are not subject to common method bias due to the experimental task. Nonetheless, self-reports remain a limitation as they can be subject to memory biases and may therefore lead to overestimations of the strength of associations compared to what would be found with actual behavior measures (Kormos & Gifford, 2014).

Moreover, various factors could have caused the observed country differences beyond those already discussed, including the experience of extreme weather events, economic conditions, or socio-political events that all may independently or jointly influence impact perceptions. Lastly, observed cross-country differences may be driven by cultural response biases such as differences in acquiescence, central tendency, or social desirability. While we attempted to account for this to some extent by standardizing variables and conducting country-specific analyses, we cannot rule out the possibility that differences in these response tendencies across countries may have contributed to the observed cross-country results. In a similar vein, concepts such as political orientation or climate change concern may not carry identical meanings across country contexts, which raises uncertainty about whether observed associations can be interpreted in the same way across countries. This limitation is unlikely to affect the within-country results, nevertheless, cross-national comparisons should be interpreted with some care.

Despite these limitations, our study has important implications for future research and behavior change interventions. Across the diverse contexts studied here, there was a strong relationship between impact perceptions and self-reported behavior, even in the presence of other important predictors, such as income, climate change concern, and education. Despite this robust link, sustainable behaviors remain far from widespread in all of the three studied countries. This gap highlights opportunities for targeted interventions, suggesting that impact perceptions and corresponding carbon literacy might serve as a promising lever for promoting climate action at the individual, corporate, and political levels. While first intervention studies point to the potential to increase mitigation practices via improving individuals' understanding of behavioral impacts (Kretschmer, 2024; Marghetis et al., 2019) our findings illustrate that external and potentially malleable conditions not only shape impact perceptions directly but also shape whether they eventually translate into individual climate action.

CRedit authorship contribution statement

Nina L. Frings: Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Conceptualization. **Kristian S. Nielsen:** Writing – review & editing, Methodology, Conceptualization. **Zahra Rahmani Azad:** Software, Investigation. **Ulf J.J. Hahnel:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization.

Code availability

All R scripts used to produce the results of this study are available in the publicly accessible repository on OSF (<https://osf.io/zfmq7/>).

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Declarations of interest

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jenvp.2025.102841>.

Data availability

The raw data and all data sets created with R scripts used to produce the results of this study are available in the publicly accessible repository on OSF (<https://osf.io/zfmq7/>).

References

- Andre, P., Boneva, T., Chopra, F., & Falk, A. (2024). Globally representative evidence on the actual and perceived support for climate action. *Nature Climate Change*, 1–7. <https://doi.org/10.1038/s41558-024-01925-3>
- Andretti, B., Vieites, Y., Ramos, G. A., Elmor, L., & Andrade, E. B. (2024). Underestimations of the income-based ecological footprint inequality. *Climatic Change*, 177(4), 66. <https://doi.org/10.1007/s10584-024-03719-0>
- Barr, S. (2007). Factors influencing environmental attitudes and behaviors: A U.K. case study of household waste management. *Environment and Behavior*, 39(4), 435–473. <https://doi.org/10.1177/0013916505283421>
- Bastian, B., & Loughnan, S. (2017). Resolving the Meat-Paradox: A motivational account of morally troublesome behavior and its maintenance. *Personality and Social Psychology Review*, 21(3), 278–299. <https://doi.org/10.1177/1088868316647562>
- Berger, S., & Wyss, A. M. (2021). Measuring pro-environmental behavior using the carbon emission task. *Journal of Environmental Psychology*, 75, Article 101613. <https://doi.org/10.1016/j.jenvp.2021.101613>
- Bostrom, A., Hayes, A. L., & Crosman, K. M. (2019). Efficacy, action, and support for reducing climate change risks. *Risk Analysis*, 39(4), 805–828. <https://doi.org/10.1111/risa.13210>
- Brüggenmann, M., Kunert, J., & Sprengelmeyer, L. (2022). Framing food in the news: Still keeping the politics out of the broccoli. *Journalism Practice*, 0(0), 1–23. <https://doi.org/10.1080/17512786.2022.2153074>
- Bundesnetzagentur. (2023). Monitoringbericht 2023. <https://www.bundesnetzagentur.de/DE/Fachthemen/ElektrizitaetundGas/Monitoringberichte/start.html>
- Burger, A. M., Schuler, J., & Eberling, E. (2022). Guilty pleasures: Moral licensing in climate-related behavior. *Global Environmental Change*, 72, Article 102415. <https://doi.org/10.1016/j.gloenvcha.2021.102415>
- Chancel, L. (2022). Global carbon inequality over 1990–2019. *Nature Sustainability*, 5(11). <https://doi.org/10.1038/s41893-022-00955-z>. Article 11.
- Choi, S., & Hart, P. S. (2021). The influence of different efficacy constructs on energy conservation intentions and climate change policy support. *Journal of Environmental Psychology*, 75, Article 101618. <https://doi.org/10.1016/j.jenvp.2021.101618>
- Chu, H., & Yang, J. Z. (2019). Emotion and the psychological distance of climate change. *Science Communication*, 41(6), 761–789. <https://doi.org/10.1177/1075547019889637>
- Chuvieco, E., Burgui-Burgui, M., Orellano, A., Otón, G., & Ruíz-Benito, P. (2021). Links between climate change knowledge, perception and action: Impacts on personal carbon footprint. *Sustainability*, 13(14). <https://doi.org/10.3390/su13148088>
- Cologna, V., Berthold, A., & Siegrist, M. (2022). Knowledge, perceived potential and trust as determinants of low- and high-impact pro-environmental behaviours. *Journal of Environmental Psychology*, 79, Article 101741. <https://doi.org/10.1016/j.jenvp.2021.101741>
- Constantino, S. M., Sparkman, G., Kraft-Todd, G. T., Bicchieri, C., Centola, D., Shell-Duncan, B., Vogt, S., & Weber, E. U. (2022). Scaling up change: A critical review and practical guide to harnessing social norms for climate action. *Psychological Science in the Public Interest*, 23(2), 50–97. <https://doi.org/10.1177/15291006221105279>
- Davidovic, D., Harring, N., & Jagers, S. C. (2020). The contingent effects of environmental concern and ideology: Institutional context and people's willingness to pay environmental taxes. *Environmental Politics*, 29(4), 674–696. <https://doi.org/10.1080/09644016.2019.1606882>
- Doherty, K. L., & Weblar, T. N. (2016). Social norms and efficacy beliefs drive the Alarmed segment's public-sphere climate actions. *Nature Climate Change*, 6(9), 879–884. <https://doi.org/10.1038/nclimate3025>
- Druckman, J. N., & McGrath, M. C. (2019). The evidence for motivated reasoning in climate change preference formation. *Nature Climate Change*, 9(2), 111–119. <https://doi.org/10.1038/s41558-018-0360-1>
- Dubois, G., Sovacool, B., Aall, C., Nilsson, M., Barbier, C., Herrmann, A., Bruyère, S., Andersson, C., Skold, B., Nadaud, F., Dörner, F., Moberg, K. R., Ceron, J. P., Fischer, H., Amelung, D., Baltruszewicz, M., Fischer, J., Benevise, F., Louis, V. R., & Sauerborn, R. (2019). It starts at home? Climate policies targeting household consumption and behavioral decisions are key to low-carbon futures. *Energy Research & Social Science*, 52, 144–158. <https://doi.org/10.1016/j.erss.2019.02.001>

- Duncan, S., Hjelmskog, A., & Papies, E. (2023). Preprint, A low-carbon future? Individuals with high socioeconomic status in the UK show little willingness to change high-carbon lifestyles for climate change mitigation. <https://doi.org/10.31234/osf.io/mh8dq>.
- Fairbrother, M., Johansson Sevå, I., & Kulín, J. (2019). Political trust and the relationship between climate change beliefs and support for fossil fuel taxes: Evidence from a survey of 23 European countries. *Global Environmental Change*, 59, Article 102003. <https://doi.org/10.1016/j.gloenvcha.2019.102003>
- Garfin, D. R., Zernick, M. V., & Wong-Parodi, G. (2024). Emotions, worry, efficacy, and climate change-related sustainability behaviors among a representative sample of Texas and Florida residents. *Climatic Change*, 177(3), 54. <https://doi.org/10.1007/s10584-023-03658-2>
- Geiger, N., Swim, J. K., & Glenna, L. (2019). Spread the green word: A social community perspective into environmentally sustainable behavior. *Environment and Behavior*, 51(5), 561–589. <https://doi.org/10.1177/0013916518812925>
- Gorissen, K., & Weijters, B. (2016). The negative footprint illusion: Perceptual bias in sustainable food consumption. *Journal of Environmental Psychology*, 45, 50–65. <https://doi.org/10.1016/j.jenvp.2015.11.009>
- Grinstein, A., Kodra, E., Chen, S., Sheldon, S., & Zik, O. (2018). Carbon innuery. *PLoS One*, 13(5), Article e0196282. <https://doi.org/10.1371/journal.pone.0196282>
- Grömping, U. (2018). R package DoE.base for factorial experiments. *Journal of Statistical Software*, 85, 1–41. <https://doi.org/10.18637/jss.v085.i05>
- Hart, P. S., & Feldman, L. (2016). The influence of climate change efficacy messages and efficacy beliefs on intended political participation. *PLoS One*, 11(8), Article e0157658. <https://doi.org/10.1371/journal.pone.0157658>
- Henrich, J., Heine, S. J., & Norenzayan, A. (2010). Most people are not WEIRD. *Nature*, 466(7302), 29–29. <https://doi.org/10.1038/466029a>.
- Hope, A. L. B., Jones, C. R., Webb, T. L., Watson, M. T., & Kakkamanou, D. (2018). The role of compensatory beliefs in rationalizing environmentally detrimental behaviors. *Environment and Behavior*, 50(4), 401–425. <https://doi.org/10.1177/0013916517706730>
- Hornsey, M. J., Harris, E. A., & Fielding, K. S. (2018). Relationships among conspiratorial beliefs, conservatism and climate scepticism across nations. *Nature Climate Change*, 8(7), 614–620. <https://doi.org/10.1038/s41558-018-0157-2>
- Hsee, C. K., & Weber, E. U. (1999). Cross-national differences in risk preference and lay predictions. *Journal of Behavioral Decision Making*, 12(2), 165–179. [https://doi.org/10.1002/\(SICI\)1099-0771\(199906\)12:2<165::AID-BDM316>3.0.CO;2-N](https://doi.org/10.1002/(SICI)1099-0771(199906)12:2<165::AID-BDM316>3.0.CO;2-N)
- Huddart Kennedy, E., Krahn, H., & Krogman, N. T. (2015). Are we counting what counts? A closer look at environmental concern, pro-environmental behaviour, and carbon footprint. *Local Environment*, 20(2), 220–236. <https://doi.org/10.1080/13549839.2013.837039>
- Ivanova, D., Barrett, J., Wiedenhofer, D., Macura, B., Callaghan, M., & Creutzig, F. (2020). Quantifying the potential for climate change mitigation of consumption options. *Environmental Research Letters*, 15(9), Article 093001. <https://doi.org/10.1088/1748-9326/ab8589>
- Ivanova, D., & Wood, R. (2020). The unequal distribution of household carbon footprints in Europe and its link to sustainability. *Global Sustainability*, 3, e18. <https://doi.org/10.1017/sus.2020.12>
- Johnson, E. J., Sugerma, E. R., Morwitz, V. G., Johar, G. V., & Morris, M. W. (2024). Widespread misestimates of greenhouse gas emissions suggest low carbon competence. *Nature Climate Change*, 1–8. <https://doi.org/10.1038/s41558-024-02032-z>
- Jylhä, K. M., Ojala, M., Odisho, S., & Riise, A. (2023). Climate-friendly food-choice intentions among emerging adults: Extending the theory of planned behavior with objective ambivalence, climate-change worry and optimism. *Frontiers in Psychology*, 14, Article 1178449. <https://doi.org/10.3389/fpsyg.2023.1178449>
- Kaiser, F. G. (2021). Climate change mitigation within the Campbell paradigm: Doing the right thing for a reason and against all odds. *Current Opinion in Behavioral Sciences*, 42, 70–75. <https://doi.org/10.1016/j.cobeha.2021.03.024>
- Kakkamanou, D., Jones, C. R., Webb, T. L., & Walker, S. R. (2015). Using public transport can make up for flying abroad on holiday: Compensatory green beliefs and environmentally significant behavior. *Environment and Behavior*, 47(2), 184–204. <https://doi.org/10.1177/0013916513488784>
- Kolenatý, M., Kroufek, R., & Činčera, J. (2022). What triggers climate action: The impact of a Climate Change Education Program on students' climate literacy and their willingness to Act. *Sustainability*, 14(16). <https://doi.org/10.3390/su141610365>
- Kollmuss, A., & Agyeman, J. (2002). Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research*, 8(3), 239–260. <https://doi.org/10.1080/13504620220145401>
- Kormos, C., & Gifford, R. (2014). The validity of self-report measures of proenvironmental behavior: A meta-analytic review. *Journal of Environmental Psychology*, 40, 359–371. <https://doi.org/10.1016/j.jenvp.2014.09.003>
- Kretschmer, S. (2024). Carbon literacy – Can simple interventions help? Effect of information provision on emissions knowledge of private households. *Energy Policy*, 188, Article 114060. <https://doi.org/10.1016/j.enpol.2024.114060>
- Lamb, W. F., Mattioli, G., Levi, S., Roberts, J. T., Capstick, S., Creutzig, F., Minx, J. C., Müller-Hansen, F., Culhane, T., & Steinberger, J. K. (2020). Discourses of climate delay. *Global Sustainability*, 3, e17. <https://doi.org/10.1017/sus.2020.13>
- Lu, H., & Schuldt, J. P. (2015). Exploring the role of incidental emotions in support for climate change policy. *Climatic Change*, 131(4), 719–726. <https://doi.org/10.1007/s10584-015-1443-x>
- MacCutcheon, D., Holmgren, M., & Haga, A. (2020). Assuming the best: Individual differences in compensatory “Green” beliefs predict susceptibility to the negative footprint illusion. *Sustainability*, 12(8). <https://doi.org/10.3390/su12083414>. Article 8.
- Malle, B. F. (2021). Moral judgments. *Annual Review of Psychology*, 72(72), 293–318. <https://doi.org/10.1146/annurev-psych-072220-104358>, 2021.
- Marghetis, T., Attari, S. Z., & Landy, D. (2019). Simple interventions can correct misperceptions of home energy use. *Nature Energy*, 4(10), 874–881. <https://doi.org/10.1038/s41560-019-0467-2>
- Milfont, T. L., Zubielevitch, E., Milojević, P., & Sibley, C. G. (2021). Ten-year panel data confirm generation gap but climate beliefs increase at similar rates across ages. *Nature Communications*, 12(1). <https://doi.org/10.1038/s41467-021-24245-y>. Article 1.
- Montfort, S., Fesenfeld, L., Stadelmann-Steffen, I., & Ingold, K. (2023). Policy sequencing can increase public support for ambitious climate policy. *Policy and Society*, 42(4), 454–477. <https://doi.org/10.1093/polsoc/puad030>
- Moran, D., Wood, R., Hertwich, E., Mattson, K., Rodriguez, J. F. D., Schanes, K., & Barrett, J. (2020). Quantifying the potential for consumer-oriented policy to reduce European and foreign carbon emissions. *Climate Policy*, 20(sup1), S28–S38. <https://doi.org/10.1080/14693062.2018.1551186>
- Moser, S., & Kleinhückelkotten, S. (2018). Good intents, but low impacts: Diverging importance of motivational and socioeconomic determinants explaining pro-environmental behavior, energy use, and carbon footprint. *Environment and Behavior*, 50, 626–656. <https://doi.org/10.1177/0013916517710685>
- National Energy Administration Beijing. (2024). Energy supply security focuses on “new” and “green electricity” illuminates the path of high-quality economic development in China—National energy Administration. https://www.nea.gov.cn/20250124/4269e042d5e34684982d129bc1ae9bb8/c.html?utm_source=chatgpt.com.
- Nielsen, K. S., Bauer, J. M., Debnath, R., Emogor, C. A., Geiger, S., Ghai, S., Gwozd, W., & Hahnel, U. J. J. (2024). Underestimation of personal carbon footprint inequality in four socio-economically diverse countries. <https://doi.org/10.31234/osf.io/3agzk>.
- Nocker, L., Pirla, S., & Pfattheicher, S. (2025). The misperception of carbon footprints of the rich and the poor. *Journal of Environmental Psychology*, 102, Article 102545. <https://doi.org/10.1016/j.jenvp.2025.102545>
- OECD. (2024). *Trust in government*. OECD. <https://www.oecd.org/en/data/indicators/trust-in-government.html>.
- Orellana, A., & Chuvieco, E. (2022). Examining the relationships between religious affiliation, external and internal behavioural factors, and personal carbon footprint. *Religions*, 13(5). <https://doi.org/10.3390/rel13050416>. Article 5.
- Pachur, T., Rieskamp, J., & Hertwig, R. (2005). In K. Forbus, D. Gentner, & T. Regier (Eds.), *The social circle heuristic: Fast and frugal decisions based on small samples* (pp. 1077–1082). Erlbaum. <http://edoc.unibas.ch/46350/>.
- Remshard, M., Goldberg, M., Ilori, V., Leiserowitz, A., & Linden, S. van der (2025). Understanding misperceptions of climate actions amongst climate-concerned individuals. <https://osf.io/6fjdr/download>.
- Saracevic, S., & Schlegelmilch, B. B. (2021). The impact of social norms on pro-environmental behavior: A systematic literature review of the role of culture and self-construal. *Sustainability*, 13(9), 5156. <https://doi.org/10.3390/su13095156>
- Smith, E. K., & Mayer, A. (2019). Anomalous Anglophones? Contours of free market ideology, political polarization, and climate change attitudes in English-speaking countries, Western European and Post-Communist states. *Climatic Change*, 152(1), 17–34. <https://doi.org/10.1007/s10584-018-2332-x>
- Sommer, M., & Kratena, K. (2017). The carbon footprint of European households and income distribution. *Ecological Economics*, 136, 62–72. <https://doi.org/10.1016/j.ecolecon.2016.12.008>
- Sparkman, G., Howe, L., & Walton, G. (2021). How social norms are often a barrier to addressing climate change but can be part of the solution. *Behavioural Public Policy*, 5(4), 528–555. <https://doi.org/10.1017/bpp.2020.42>. Cambridge Core.
- Stephens, J. (2020). ExpertChoice: Design of discrete choice and conjoint analysis [Computer software] Version 0.2.0. <https://cran.r-project.org/web/packages/ExpertChoice/index.html>.
- Sunstein, C. R. (2005). Precautions against What—The availability heuristic and cross-cultural risk perception meador Lecture series 2004-2005: Risk and the law. *Alabama Law Review*, 57(1), 75–102.
- Tan, R., & Zhu, Y. (2023). National stances and governance systems: A comparative study of low carbon governance in Germany, the United States, and China. *Global Public Policy and Governance*, 3(2), 219–242. <https://doi.org/10.1007/s43508-023-00071-4>
- Taube, O., Kibbe, A., Vetter, M., Adler, M., & Kaiser, F. G. (2018). Applying the Campbell Paradigm to sustainable travel behavior: Compensatory effects of environmental attitude and the transportation environment. *Transportation Research Part F: Traffic Psychology and Behaviour*, 56, 392–407. <https://doi.org/10.1016/j.trf.2018.05.006>
- Thøgersen, J. (2005). How May consumer Policy empower consumers for sustainable lifestyles? *Journal of Consumer Policy*, 28(2), 143–177. <https://doi.org/10.1007/s10603-005-2982-8>
- Tiefenbeck, V., Staake, T., Roth, K., & Sachs, O. (2013). For better or for worse? Empirical evidence of moral licensing in a behavioral energy conservation campaign. *Energy Policy*, 57, 160–171. <https://doi.org/10.1016/j.enpol.2013.01.021>
- Tobler, C., Visschers, V. H. M., & Siegrist, M. (2012). Addressing climate change: Determinants of consumers' willingness to act and to support policy measures. *Journal of Environmental Psychology*, 32(3), 197–207. <https://doi.org/10.1016/j.jenvp.2012.02.001>
- Truelove, H. B., & Parks, C. (2012). Perceptions of behaviors that cause and mitigate global warming and intentions to perform these behaviors. *Journal of Environmental Psychology*, 32(3), 246–259. <https://doi.org/10.1016/j.jenvp.2012.04.002>
- Tschötschel, R., Schuck, A., Schwinges, A., & Wonneberger, A. (2021). Climate change policy support, intended behaviour change, and their drivers largely unaffected by consensus messages in Germany. *Journal of Environmental Psychology*, 76, Article 101655. <https://doi.org/10.1016/j.jenvp.2021.101655>

- United States Environmental Protection Agency, O. (2022). *Utility Green Tariffs* [Overviews and Factsheets]. *Utility Green Tariffs*. <https://www.epa.gov/green-power-markets/utility-green-tariffs>.
- Watkins, L., Aitken, R., & Mather, D. (2016). Conscientious consumers: A relationship between moral foundations, political orientation and sustainable consumption. *Journal of Cleaner Production*, *134*, 137–146. <https://doi.org/10.1016/j.jclepro.2015.06.009>
- Weber, E. U., & Morris, M. W. (2010). Culture and Judgment and Decision Making: The Constructivist Turn. *Perspectives on Psychological Science*, *5*(4), 410–419. <https://doi.org/10.1177/1745691610375556>.
- Winterich, K. P., Reczek, R. W., & Makov, T. (2023). How lack of knowledge on emissions and psychological biases deter consumers from taking effective action to mitigate climate change. *Journal of the Academy of Marketing Science*. <https://doi.org/10.1007/s11747-023-00981-z>
- Wu, C., & Wilkes, R. (2017). Local–national political trust patterns: Why China is an exception. *International Political Science Review*, *39*, Article 019251211667758. <https://doi.org/10.1177/0192512116677587>
- Wynes, S., & Nicholas, K. A. (2017). The climate mitigation gap: Education and government recommendations miss the most effective individual actions. *Environmental Research Letters*, *12*(7), Article 074024. <https://doi.org/10.1088/1748-9326/aa7541>
- Wynes, S., Zhao, J., & Donner, S. D. (2020). How well do people understand the climate impact of individual actions? *Climatic Change*, *162*(3), 1521–1534. <https://doi.org/10.1007/s10584-020-02811-5>
- Yang, X., & Thøgersen, J. (2022). When people are green and greedy: A new perspective of recycling rewards and crowding-out in Germany, the USA and China. *Journal of Business Research*, *144*, 217–235. <https://doi.org/10.1016/j.jbusres.2022.01.086>
- Ziegler, A. (2017). Political orientation, environmental values, and climate change beliefs and attitudes: An empirical cross country analysis. *Energy Economics*, *63*, 144–153. <https://doi.org/10.1016/j.eneco.2017.01.022>