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The Future Could be Greener: A Randomized Choice Experiment on Cognitive Alternatives and Sustainable Food Choices

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ABSTRACT

Carbon footprint information via labels has raised interest as a tool to encourage pro-environmental behavior. We propose cognitive alternatives to the environmental status quo (*Environmental cognitive alternatives*; ECAs), the ability to imagine what a sustainable relationship with nature could look like, to improve the effectiveness of carbon labels. Using a discrete choice experiment with intervention and control groups, we investigate the effect of ECAs on low emission labeled, sustainable choices in a grocery shopping context. German participants ($N = 150$) were randomly assigned to three groups, activating either cognitive alternatives of a positive relationship with nature, or perceived environmental threat (PET), or nothing in a full control group. In the ECAs activation group, participants chose options with lower carbon emissions compared to the other two groups, and had stronger preferences on rating scales for these options. In the PET activation group, participants also had stronger preferences on rating scales than the control group, but this effect was not found for the choice of options. Activating ECAs might be a promising intervention for promoting sustainable choices, and carbon labeling could be helpful when paired with interventions that activate ECAs.

1 | Introduction

Pro-environmental action is needed to fight climate change, which will require both structural changes as well as long-lasting behavior change from individuals (Sachs et al. 2019; Van De Ven et al. 2018). Much research has been dedicated to the study of possible interventions (e.g., Grilli and Curtis 2021) and models, especially in relation to intergroup relations to foster collective action (e.g., Bamberg et al. 2018; Carmona-Moya et al. 2021; Fielding and Hornsey 2016; Fritsche et al. 2018; Koustova 2017) to increase sustainable choices and pro-environmental behavior. Carbon footprint labeling has been discussed as a promising political measure to inform and support consumers in their choices. Research supports this assumption (Rondoni and Grasso 2021) and investigates how to make such labels more compelling and convincing (e.g., Kuhn et al. 2022).

Habits and status quo thinking, however, are major barriers in the sustainability context (Huang et al. 2020; Linder et al. 2022; Russell and Knoeri 2020). One potential way to overcome this barrier could be to trigger the ability to imagine what a sustainable relationship with nature might look like, and facilitate the accessibility of cognitive alternatives to the environmental status quo (*Environmental cognitive alternatives*; ECAs; Wright et al. 2020). In our study, we investigated the accessibility of

ECAs (Wright et al. 2020, 2022) in a setting that requires pro-environmental decision-making, i.e., in the context of a grocery shopping scenario. Food is one of the biggest contributors to worldwide carbon emissions (Ritchie et al. 2022). It is estimated that 21–37% of total human-made greenhouse gas emissions can be attributed to the food system. A shift to a more sustainable diet from the consumer's side is considered having a substantial effect on reducing these emissions (Intergovernmental Panel on Climate Change IPCC 2022).

Shopping has been shown to be a matter of habit and self-regulation (Faber and Vohs 2011; Machín et al. 2020), so changes in this habitual behavior may be particularly impactful due to the potential longevity. Further, consumers are already used to labeling (e.g., for dietary information), so that carbon labeling might well be accepted.

Real shopping behavior is extremely difficult to measure for larger samples, including the need to control for potential large variances in behaviors. Although the technology to observe in-store behaviors has created opportunities to better capture people's behavior compared to self-report measures (Larsen et al. 2017), it has not been applied in sustainability research. Therefore, current research often resorts to online experimental settings (e.g., Panzone et al. 2021). Aiming at better capturing the trade-offs people have to make during grocery shopping, we employed a discrete choice experiment paradigm approach (Louviere et al. 2000) in our study.

1.1 | Cognitive Alternatives to the Environmental Status quo

Cognitive alternatives are conceptualized as the ability to envision concrete ways in which the current status quo can be altered (Reicher and Haslam 2006). The concept is derived from Social Identity Theory (Tajfel and Turner 1979), highlighting its relevance especially in the context of group action. ECAs were introduced as a subconstruct of cognitive alternatives in the sustainability context by Wright et al. (2020, 2022), where ECAs serve as a predictor for pro-environmental activist behavior, building on the idea that social identity is crucial for promoting pro-environmental behaviors and action (Fritsche et al. 2018). The ECAs scale was developed and tested as a correlate of environmental activist identification in a Canadian sample, explaining variance beyond control variables such as identification with nature, perceived (in)stability and (il)legitimacy, and beliefs about anthropogenic climate change (Wright et al. 2020). In a subsequent study, Wright et al. (2022) found that access to environmental cognitive alternatives was associated with stronger politicized pro-environmentalist activist behavior, and increased the likelihood of writing and signing a letter to the Canadian Minister of the Environment and Climate Change. Extensive control variables were included. Even though ECAs were conceptualized in the context of collective action, whereas individual grocery shopping behavior could be considered a personal choice, we argue that individual food choices on an aggregated level can be interpreted as a form collective action. As presented in Section 1, the collective effect of changes in diet can lead to substantial change in greenhouse gas emissions, thus a shift in personal diet preferences towards a more sustainable diet can be a form activism. In a similar vein, veganism is considered a form of activism (Judge et al. 2022). We therefore expect the effects of ECAs to be wider than just political activism. Other, similar constructs employing the usage of mental imagery (Kosslyn 1988) have previously been employed in a similar vein for the environmental context (for an overview see Boomsma et al. 2016). Going beyond motivational effects as suggested by Boomsma et al. (2016), in the concept of mental contrasting, a desired future (e.g., a sustainable world) is contrasted with the current situation and existing obstacles (e.g., dependency on fossil fuels) (Oettingen et al. 2001, 2009). Combined with expectations of success, mental contrasting has been shown to lead to high goal commitment (Oettingen et al. 2009), and more sustainable consumption in an experimental study (Loy et al. 2016).

Based on the notion that climate change often is seen as a distant future threat which impedes risk perception, Lee et al. (2020) introduced episodic future thinking as an interventive method to foster pro-environmental behavior. This would be in line with the construal-level theory of psychological distance (Liberman and Trope 2008), which argues that events that are mentally represented at concrete rather than abstract levels will be perceived as temporally closer. Episodic future thinking (with vivid imagery of life events under climate change impacts) was positively related to a pro-environmental meal choice, compared to a writing task (mere description of events) (Lee et al. 2020). The importance of future-orientation (oneself in the future at 60 years old vs. in the present) on sustainable resource allocation in a fishing simulation has also been highlighted (Engle-Friedman et al. 2022). The notion of future orientation has also been related to ECAs in a study by Pittaway et al. (2024), who found an association between higher consideration of future consequences and lower consideration of immediate consequences with intentions to take conventional pro-environmental action (such as picking up a plant-based diet or signing a campaign). Eco-anxiety and/or ECAs were found to be mediators for this effect, thus being a potential mechanism explaining why future thinking interventions are effective.

A recent string of literature is investigating positive, utopian, future thoughts as an impactful driver for societal activism (Badaan et al. 2022; Fernando et al. 2018). Envisioning a positive future of a decarbonated society in 2050 has been found to increase both intentions for individual pro-environmental consumption behaviors as well as for collective action (Bosone et al. 2024). A study by Daysh et al. (2024) further compared negative and positive future visions and found that both increased collective action intentions.

ECAs combine the idea of mental imagery in a pro-environmental context with future orientation and a focus on a positive outcome: the cognitive alternatives represent a vision of a more sustainable, "better" world. However, research on pro-environmental action often concentrates on threat appeals and negative feelings being related to motivation for behavior change (Brosch 2021) including the creation of scales to measure perceived environmental threat (e.g., Dunlap 2003; Schmitt et al. 2018). Here, some studies have found that environmental threat is positively related to pro-environmental behavior and

support of pro-environmental policies (E. W. Johnson and Frickel 2011; Lim and Moon 2020; Lubell et al. 2007; Schmitt et al. 2018, 2019).

News and social media often resort to threat appeals when reporting about the climate crisis. Pictures of the devastating consequences of climate change-caused nature catastrophes serve as an attention attraction and evoke emotion (Schwartz and Loewenstein 2017). Further, practical eco-anxiety as an emotional response to climate change threats is hypothesized to be positively related to pro-environmental attitudes (Kurth and Pihkala 2022). Yet, research has shown that affect-laden ads only have short-term effects on pro-environmental intentions and do not lead to long-lasting behavior change (Schwartz and Loewenstein 2017). Threat appeals are commonly used in health education with the intention to change people's behavior for the better. Here, discussions about drawbacks follow from protection motivation theory, which highlights the necessity of not just showing threatening information, but at the same time introducing coping appraisals such as calls to action on how to prevent this (Rogers 1975; Witte and Allen 2000). Threat appeals could trigger the development of feelings of helplessness and therefore paralyzing, or even desensitization when used regularly, as research on social media in the context of, for example, COVID 19 and school shootings has shown (Li et al. 2017; Stevens et al. 2021).

Therefore, positive emotions should not be overlooked as important antecedents and consequences of pro-environmental behavior (Schneider et al. 2021). Positive appeals could foster motivation to sustain such behaviors long-lastingly, whereas threat appeals could lose their power over time by giving way to moral licensing or returning to old habits (Buttlar et al. 2017; Leviston and Uren 2020; Truelove et al. 2014). Thus, the positive focus within the ECAs scale could be one of the central attributes that drive the cognitive processes behind the scale. It remains to be seen whether ECAs will affect decision-making across various contexts and behaviors and replications, and which mechanisms could best explain such effects. While in our study, we are not testing long-term effects, we still aim to contribute a piece of evidence to the superior effect of ECAs compared to perceived environmental threat as a motivator for pro-environmental behavior, and we analyze both scale ratings as well as choices to better capture differences.

1.2 | Choice Modeling in Pro-Environmental Behavior Research

Choice modeling builds on the theory of revealed preference (Samuelson 1938), which assumes that consumers' preferences can be deduced from their purchasing behavior. Choice models simulate purchasing decisions by confronting participants with multiple successive choice scenarios (Cohen 1997) with multiple options, each varying in the levels presented. Regression analysis then makes it possible to infer which attributes were most decisive for decision-making (R. M. Johnson and Orme 1996).

For this study, we chose a discrete choice experiment (DCE), a subset of choice modeling where participants must choose one out of two given options as an indicator of their preference. This approach has become increasingly popular in research on consumption choices over the last 20 years (Lizin et al. 2022). DCEs have been claimed to well mimic the choices people face in real-world stores, as food products vary on attribute levels, and consumers must make trade-offs between them for a final choice (Lizin et al. 2022). Moreover, there is evidence that sustainability information is effective in such scenarios: in a DCE grocery shopping scenario, sustainability information was found to be equally important for choices as price, indicating that providing information would be beneficial to help people make more sustainable decisions (Stöckigt et al. 2018). Similarly, a DCE using a restaurant meal scenario found that consumers make more pro-environmental choices based on sustainability information provided (Contini et al. 2017). We therefore judged it well-suited as a paradigm for testing potential effects of ECAs. In addition to the DCE, we added rating scales of preference for each option. Previous research found mixed results on the congruence of these two measures, with some studies showing differences (Wijnen et al. 2015) whereas others showed a high agreement (Bridges et al. 2012; Gronau et al. 2022). Rating scales are assumed to give further insights into attribute preferences; therefore, we aimed to strengthen our study design by conducting both measures (Gronau et al. 2022; Wijnen et al. 2015).

1.3 | Study Aims and Hypotheses

Our experiment consisted of a one-factorial design with three levels: we compared how our dependent variables, choice of grocery options (binary) and preference rating of grocery options (Likert scale), were affected by ECAs activation (via ECAs scale (Wright et al. 2020)), compared to two controls: one, the activation of environmental threat (via *Perceived Environmental Threat* (PET) scale (Schmitt et al. 2019)), and the other, control without any intervention. Questionnaire design, for example, answering prior questions (scales), can make a concept more salient, which increases the influence of that concept on other cognitive processes (Bless and Schwarz 2010; Strack 1992).

The two controls serve the following purpose: the full control aims to test the potential effect of ECAs over no intervention, while the PET activation aims to control for such differences being the result of mere activation of pro-environmental awareness, and in the case of a significant difference, allows for a discussion on the effect of emotional valence.

Figure 1 shows the study design. (Figure 1) In Figure 2 we show an example stimulus material of a trial from the choice model task. (Figure 2) In Table 1, we present the levels and attributes of the DCE, which we will describe in further detail in the method section. (Table 1).

The following hypotheses were defined for the choice model analysis:

H1. *Options with lower carbon emission values will be chosen more often by participants in the ECAs group, compared to the other two groups.*

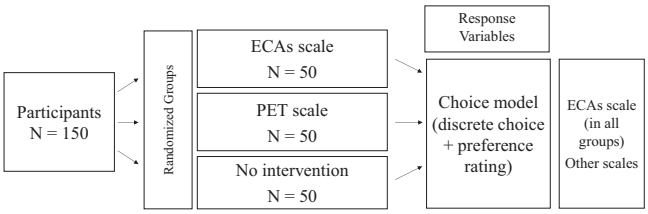

FIGURE 1 | Study design and survey order.

	Option 1	Option 2
Nudeln	Spaghetti aus roten Linsen, ohne Ei	Spaghetti, Weizen, mit Ei
Fleisch(ersatz)	Sojagranulat	Sojagranulat
Tomatensoße	Tomaten, passiert, Tetrapak	Tomaten, passiert, Glas
Käse(ersatz)	Mozzarella	Mozzarella
Obst	Weintrauben, Deutschland	Ananas, Costa Rica
CO2	3252 g	560 g
Preis	6,85 €	4,60 €

FIGURE 2 | Example of a choice model trial. *Note:* Table as presented in the study in German. Participants were presented with two options per trial. The values for the attributes are randomly pulled from Table 1.

H2. *Options with lower carbon emission values will be rated more highly on preference by participants in the ECAs group, compared to the other two groups.*

H3. *The attribute carbon emissions per shopping will be of higher importance (higher importance weight) for choices of participants in the ECAs group, compared to the other two groups.*

Exploratively, we investigated whether after the choice model task, participants in the ECAs condition would subjectively rate their own choices in the grocery choice model as more sustainable compared to the other two groups, whether their true carbon emission scores would match this perception, and whether other predictors such as willingness to show pro-environmental behavior, the ECAs score and past activist behavior might also play a role.

2 | Methods

2.1 | Procedure

Data was collected using an online survey (median time *Median* = 9 min 16 s) via *SosciSurvey* between 11/24/2022 and 12/02/2022. We recruited our sample on *Prolific*, a commonly used online panel, making it a convenience sample. Participants received a financial reward of £1.50. We strove to achieve an age and gender distribution close to German internet usage population (Destatis 2023). Participants had to be fluent German speakers and above 18 years old. We excluded participants who did not complete the survey, and who failed any of two attention checks ($n = 1$; see Appendix A for a detailed description of attention checks).

Participants were informed about the study topic (shopping and sustainability), the investigators, duration of participation, compensation after completion, and their data protection rights After giving consent to participation in the study, participants were randomly assigned to the three experimental groups. For this, we used the random generator question type in SosciSurvey, which lets each participant draw a number when starting the questionnaire, in a hidden way. As the intervention, the position of the ECAs scale was manipulated. In the ECAs intervention group, the ECAs scale was measured both before and after the choice model task. In the control group, the ECAs scale was only conducted after the choice model task and all other items. In the Threat group, the ECAs scale was measured after the choice model task and all other items, but the PET scale was placed before the choice model task (see Figure 1).

We asked participants to imagine that they plan to have dinner with one friend, and want to serve Spaghetti Bolognese for the main course, and fruit for dessert. The task was to grocery shop for this two-person meal, with different choice sets representing different supermarket options. The task consisted of 10 trials with two product sets presented in each, so each participant saw 20 different stimuli in total, in line with Johnson and Orme (1996). All sets were randomly chosen from all possible attribute combinations. In each of the trials, participants had to choose the option they would rather buy, and rate their willingness to buy both options on a 7-point Likert scale. Sets varied on seven attributes, which were always presented in the same order (see Table 1). After completion of the choice model task, participants rated how sustainable their ten shopping choices were on a 7-point Likert scale to control for the subjective impression. Then the ECAs and PET scales followed, if not measured before. Only in the ECAs group, ECAs were measured both before and after the choice model task to control for test-retest reliability and whether the task influenced the ECAs value. Also, sociodemographic data including socioeconomic status and political orientation were collected.

2.2 | Scales

Items of all scales can be found in detail in Appendix A. Translations into German were back translated to English to check for possible discrepancies, and reviewed by a coauthor. Our main independent variable was the presence/absence of ECAs/PET before the dependent variable. We also included control variables in line with the preceding research by Wright et al. (2020, 2022).

2.2.1 | Environmental Cognitive Alternatives

We measured how easily ECAs can be imagined with the 10-item ECAs scale introduced by Wright et al. (2020). We reduced the introductory text and emphasized imagining a sustainable relationship between humans and nature. Items were translated and rephrased in a way to reflect the original meaning best in German and were measured on a 7-point Likert scale ranging from "(I) can imagine with much difficulty" to "can imagine easily", for example, "the idea of a world in which

TABLE 1 | Overview of attributes and levels of the choice model task.

Attribute	Level 1	Level 2	Level 3	Level 4
Pasta	Spaghetti, whole grain, without egg	Spaghetti, red lentil, without egg	Spaghetti, wheat without egg	Spaghetti, wheat, with egg
Meat (replacement)	Red lentils	Granulated soy	Vegetables (eggplant, zucchini, carrots)	Ground beef
Tomato sauce	Strained tomatoes, Tetrapak	Strained tomatoes, can	Strained tomatoes, glass	
Cheese (replacement)	Yeast fakes	Vegan cheese	Mozzarella	Parmesan
Fruit	Apple, Germany	Grapes, Germany	Mango, Brazil	Pineapple, Costa Rica
CO_2	560 g	1906 g	3252 g	4598 g
Price	2.35 €	4.60 €	6.85 €	9.10 €

Note: Attributes were displayed in the presented order and levels were assigned randomly in each trial (considering the restriction for meat, for further information see below). The sustainability of levels decreases from left to the right side.

fossil fuels are no longer used". Scale reliability was Cronbach's Alpha $\alpha = 0.84$ and $\alpha = 0.86$ for the ECAs scale pre-conjoint-task measurement in the ECAs group, respectively.

2.2.2 | Perceived Environmental Threat

PET was measured using a 4-item scale by Schmitt et al. (2019), for example, "Life as we know it is directly threatened by the destruction of the environment". Agreement with the statements given in the items was measured on a 7-point Likert scale ranging from "not at all" to "very much". Scale reliability was Cronbach's alpha $\alpha = 0.82$.

2.2.3 | Past Pro-Environmental Activism

We used two items on activism from the Willingness to Engage in Activist Behavior measure by Schmitt et al. (2019) reverted to past tense. Frequency was measured on a 7-point Likert scale ("very seldom" to "very often"). Scale reliability was Cronbach's Alpha α $\alpha = 0.75$.

2.2.4 | Imagination

To control for general imaginative propensity within the sample, we used two items from the IPIP NEO-PI O:1 (*NEO Key facets/domains*, 2022; Maples et al. 2014). Agreement with the statements given in the items was measured on a 7-point Likert scale ranging from "not at all" to "very much". Scale reliability was Cronbach's Alpha $\alpha = 0.68$.

2.2.5 | Sociodemographic Data and Diet

Sociodemographic data like age and gender as well as education, employment status, and average net income of the household to control for socioeconomic status and political orientation (10-point left-right scale) were measured. Finally, participants were asked about their typical diet to control for vegans and vegetarians within the sample.

2.2.6 | Willingness to Engage in Future Pro-Environmental Behavior

PEB was measured with five items on willingness to perform pro-environmental consumption choices, for example, "Preferring to buy locally produced food than food from far away", on a 7-point Likert scale ranging from "very unwilling" to "very willing", using a adapted version of the scale by Schmitt et al. (2019). Scale reliability was Cronbach's Alpha $\alpha = 0.74$.

2.2.7 | Subjective Judgment of Sustainable Choices

After the discrete choice experiment, participants were asked to rate how sustainable they judged their previously conducted 10 shopping choices were, on a scale from 1 = "not at all" to 7 = "very much".

2.3 | Choice Model

The discrete choice task was created using the *Conjoint Survey Design Tool* (Conjoint SDT) by Strezhnev et al. (2022). Lists of carbon emissions of products make it possible to calculate the total carbon emissions or ecological footprint of a purchase (GoClimate 2021; Reinhardt et al. 2020; Tagesspiegel 2022). Based on these, we chose a range of products with higher and lower carbon emissions out of which variations of the meal Spaghetti Bolognese and fruit for dessert can be created - five attributes with three to four levels were defined (See Table 1). We measured our attribute of most interest, carbon emissions per purchase, with four levels of varying carbon emissions (g) per shopping.

To determine the quantity of product needed for each portion, common recipes were used and adapted to two portions. For the attribute CO_2, the lowest and highest possible combinations in carbon emissions per two portions were computed based on the product lists reported above to create a range. According to that range, the four levels were chosen at periodic intervals. Prices of products were taken from an average German middle-class supermarket brand (*Rewe*). Again, a range from lowest to

highest possible price per two portions was computed and used to create a range of four levels. This means, that carbon emissions and prices were based on a real range, but the levels were presented randomly and not according to the actual carbon emissions or price of the respective product. An overview of all products, including carbon emissions and prices can be found in Table B1 in Appendix B.

Combinations of levels were fully randomized, with the only restriction for "Ground beef", so that this level was only shown in combination with the highest carbon emission level (4598 g), reflecting the fact that the needed amount of ground beef in this scenario would equal 3400 g of carbon emissions, which is 15 times higher than the second highest product on the list, and for which we expected participants could better estimate environmental impact. In each of the 10 trials, participants were first asked to choose an option (choice) and then to rate how likely they were to buy each option on a scale from 1 = "wouldn't buy at all" to 7 = "would absolutely buy" (preference).

2.4 | Participants

For determining the minimum sample size needed, we followed the rule of thumb-formula by Johnson and Orme (1996). We further were restricted by costs, leading to a sample of $N = 150$. The sample had a mean age of $M = 36.4$ (SD = 11.39, *Median* = 35, range 19–65), and gender was evenly distributed with 76 men, 73 women, and one nonbinary participant; gender will be reported dummy coded (female, not female). Most of the sample was highly educated, 60% reported finishing a higher education degree, 27% completed high school and 13% finished at least middle school or an apprenticeship. Participants were approximately normally distributed across the political left-right spectrum, with a tendency towards left, liberal views ($M = 4.01$, SD = 1.54). 74% of participants reported an omnivore diet, 15% vegetarian, 11% vegan, slightly higher than trends in the German (internet) population (10% vegetarian, 2% vegan (Veganivore 2022).

Each group contained 50 participants. We did not find any significant issues with randomization when checking the distribution for political orientation ($p = 0.65$), diet ($p = 0.71$), imagination ability ($p = 0.24$), or past activism ($p = 0.92$).

2.5 | Statistical Analysis

All statistical analyses were computed with R (R et al. 2022), with packages *Cjoint* (Hainmueller et al. 2014; Strezhnev et al. 2022), *Cregg* (Leeper and Barnfield 2020), *Radiant* (Nijs 2019) and *lme4* (Bates et al. 2015). We calculated descriptive statistics, correlations, and linear mixed effects models (lmer). Mixed models were used to predict shopping list choice and preference rating from the interaction of intervention group (we used Helmert contrasts (Control vs Threat, and ECAs vs Control/Threat) with option features (CO2, price, meat, cheese, pasta, sauce, dessert). Additionally, we controlled for gender, age, time spent on intervention, and we modeled the multiple trials with a random intercept per participant. All DCE predictors were coded as ordered factors (higher = better, i.e. more sustainable). In the results section, in line with our hypotheses, we will focus on CO_2 emission levels, but full model outputs are in Appendix C (Models C1a–C2b). Following our hypotheses, we start with the model for the choice and continue with the model for the preference rating. We also present plots of marginal means (MMs) as additional subgroup analysis (Hainmueller et al. 2014). As baseline levels we defined the levels with the highest real carbon emissions in each attribute (Spaghetti, wheat, with egg; Ground beef; Strained tomatoes, glass; Parmesan; Pineapple, Costa Rica) as well as the highest carbon level for CO_2 (4598 g) and the highest price level (9.10 €) for price. We also report importance weights for the discrete choices (Nijs 2019).

The methods of analysis were determined before and during data collection, but not pre-registered. Additional analyses are indicated as explorative.

3 | Results

3.1 | Choice Model Experiment

Summary statistics and a correlation matrix of all numerical variables are reported in Tables C2–C6 in Appendix C. For H1, in line with our hypothesis, we found that the more sustainable options were chosen more often by participants in the ECAs group, compared to those in Control and Threat groups ($\beta = 0.18$, Odds Ratio (OR) = 1.20, CI95 1.07–1.35, $p = 0.002$), while we could not find a significant difference between the latter two ($\beta = 0.05$, OR = 1.05, CI95 0.86–1.29, $p = 0.622$.). Figure 3 (left) showcases the marginal effects of emissions on choice. (Figure 3)

As can be seen in Figure 4, comparing Control with ECAs, this pattern can be observed on the marginal means, as we found lower emission values chosen significantly more often (with values above 0.5 indicating features that increase profile favorability). (Figure 4)

Exploratively, we found meat alternatives (Granulated Soy, Red Lentils, Vegetables) being preferable ($\beta = 0.36$, OR = 1.01, CI95 1.05–1.96, $p = 0.024$) only in the Threat condition.

We also observed an expected linear relationship of price with preference across all three groups, and overall, lower preferences for exotic fruit. This is in line with main effects found in the regression, with a preference overall for cheaper options ($\beta = 1.22$, OR = 3.39, CI95 2.89–3.97, $p < 0.001$) and for German-sourced fruit ($\beta = 0.37$, OR = 1.45, CI95 1.24–1.69, $p < 0.001$). Full model output and an unadjusted model can be found in Appendix C (Models C1a and C2a).

For H2, in line with our hypothesis, we found that more sustainable options with lower carbon emission values were rated more highly by participants in the ECAS group, compared to those in Control and Threat groups ($\beta = 0.16$, CI95 0.02–0.31, $p = 0.025$). However, for the preference rating, we did find a significant difference between the latter two ($\beta = 0.14$, CI95 0.05–0.22, $p = 0.001$) (Figure 3, right). Figure 5 shows the marginal effect of emission on preference rating. Here, the

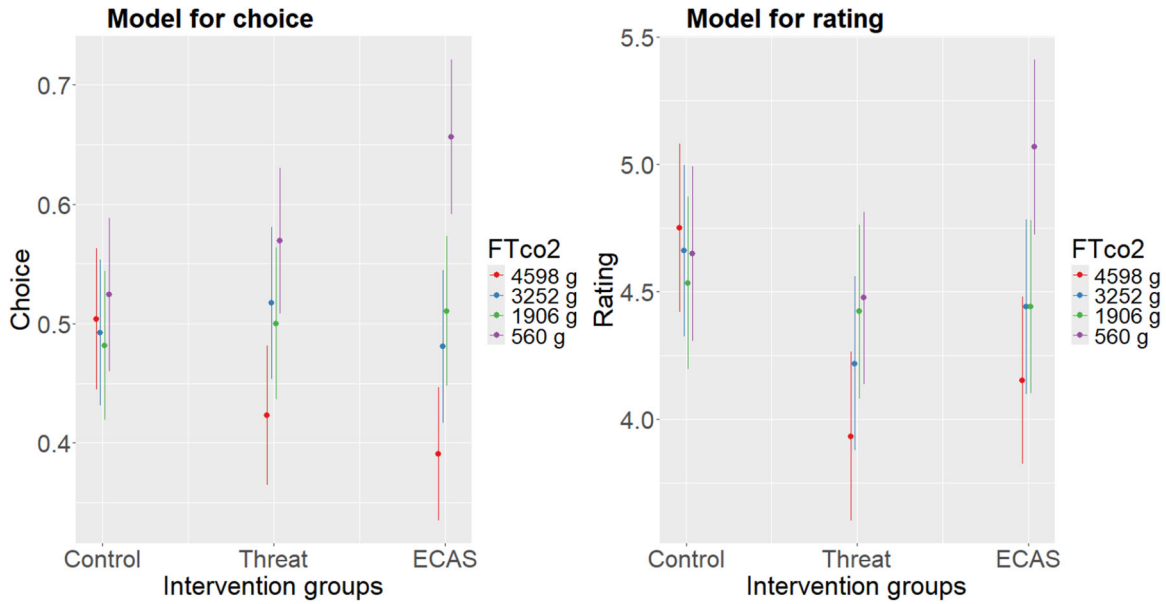

FIGURE 3 | Marginal effects of carbon emissions on shopping; left shows predicted probabilities for choice (0–1), right shows predicted probabilities for rating (1–7). Higher values indicate more likely choice/higher rating. Error bars represent the confidence intervals for predicted probabilities.

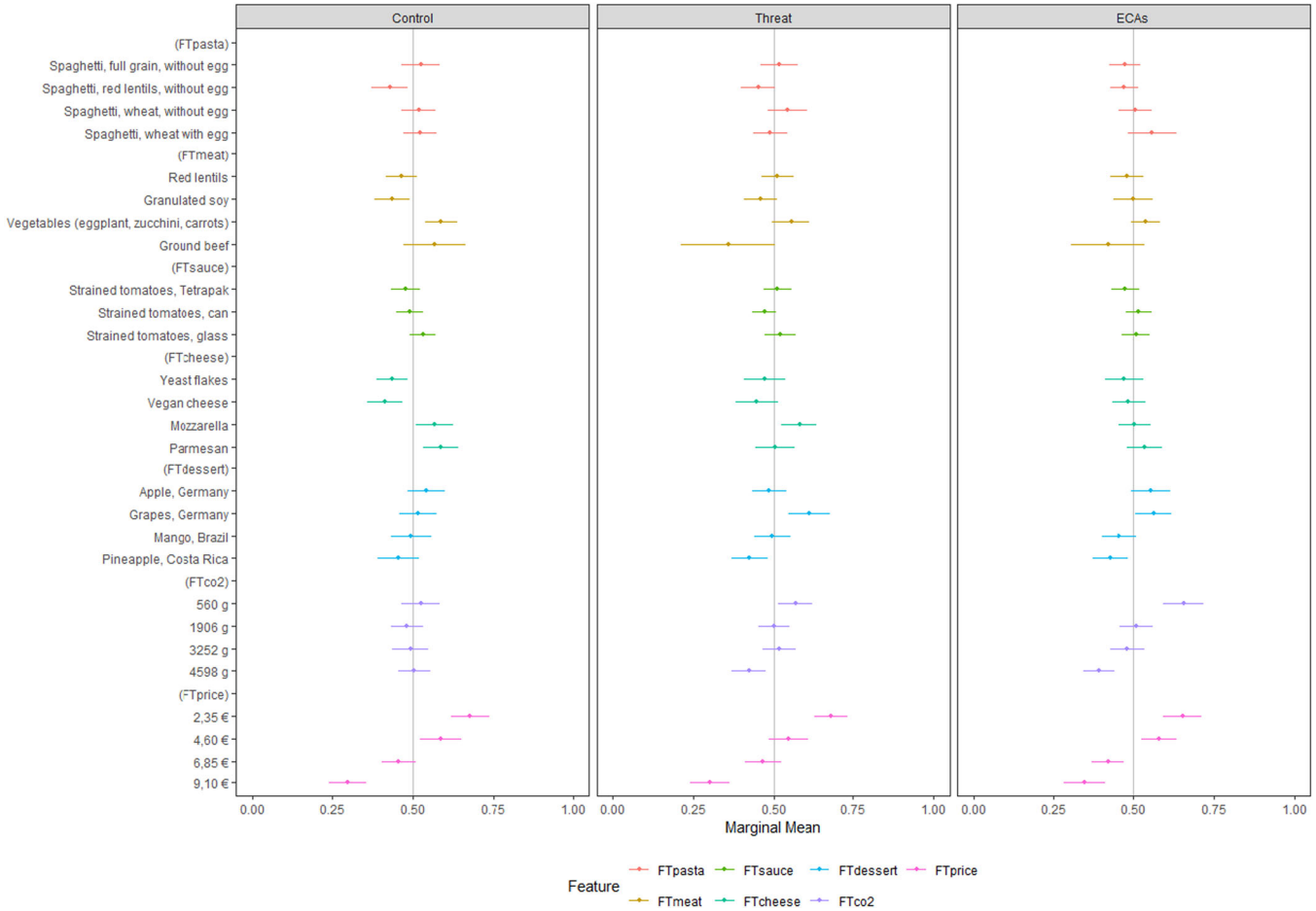

FIGURE 4 | Marginal means for shopping list choices.

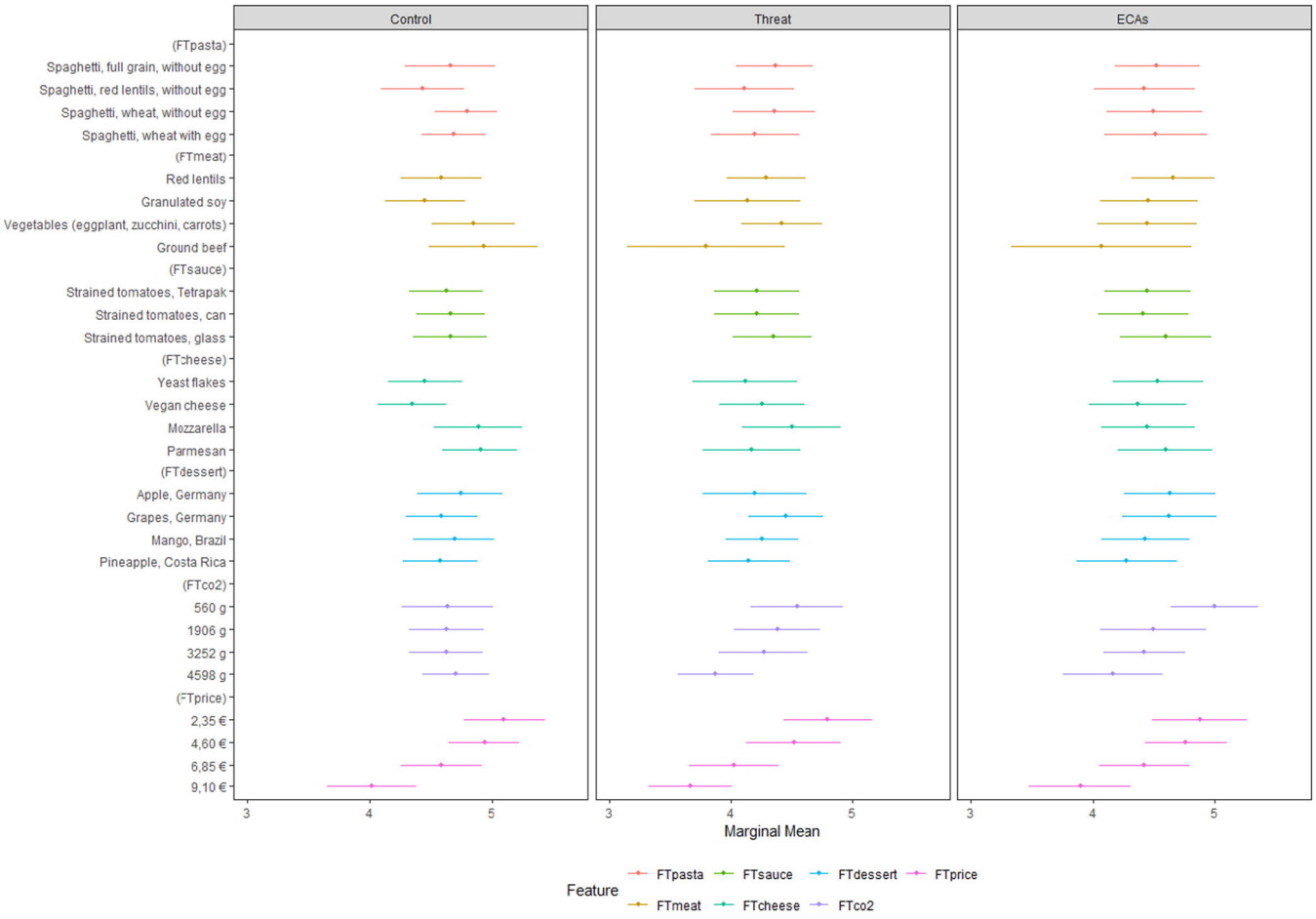

FIGURE 5 | Marginal means for the preference ratings.

TABLE 2 | Importance Weights for choice.

Attribute	ECAs *IW*	Threat *IW*	Control *IW*
FTprice	0.334	0.357	0.369
FTco2	0.272	0.121	0.080
FTdessert	0.147	0.169	0.077
FTcheese	0.068	0.111	0.145
FTpasta	0.065	0.066	0.103
FTsauce	0.060	0.037	0.065
FTmeat	0.054	0.139	0.160

marginal means relate to the mean of the ratings in the groups, with higher values indicating higher preference. (Figure 5)

Exploratively, we found a preference for more sustainable cheese alternatives for participants in the ECAs group ($\beta = 0.08$, CI95 0.01–0.16, $p = 0.036$).

Again, the expected linear relationship of higher preference with lower price could be observed ($\beta = 0.85$, CI95 0.74–0.96, $p < 0.001$), as well as a preference for Germany-sourced fruit ($\beta = 0.19$, C95 0.07–0.30, $p = 0.001$) and a generally low preference for cheese replacements ($\beta = -0.26$, CI95 −0.37 to −0.15, $p < 0.001$). Full model output and an unadjusted model can be found in Appendix C (Models C1b and C2b).

In line with H3, the attribute carbon emissions per shopping was found to be of higher importance for participants in the ECAs group (ranked second after price), compared to the other two groups (ranked fourth), see Table 2 (see Table C1 in Appendix C for importance weights for rating). (Table 2).

3.2 | Subjective Self-Assessment

In our explorative analysis, we did not find significant differences in subjective self-assessment of the sustainability of one's shopping choices as a result of our intervention ($p = 0.22$), nor for the Threat group compared to Control ($p = 0.76$). We also did not find an effect of our intervention when controlling for the total carbon emission value of participants' 10 choices—nor for this carbon emission value itself ($p = 0.30$). We did find past activism ($p < 0.001$), pro-environmental behavior intention ($p < 0.0001$) and ECAs score ($p < 0.001$) to be significant predictors.

4 | Discussion

We carried out an experiment that used a discrete choice model to test the effect of activating environmental cognitive

alternatives on sustainable choices in a grocery shopping context. We compared its effectiveness against the effectiveness of activation of perceived environmental threat, and against a control group. This was achieved by varying the order in which the scales measuring the related constructs were presented. Our hypotheses could be partly confirmed: when it came to choosing grocery shopping options, the ECAs intervention, with a small effect size, led participants to make more sustainable choices, compared to the other groups, between which we found no significant difference. This was also supported by the importance weights, as carbon emissions were shown to hold more weight for participants with ECAs activation. In the case of preference ratings, both ECAs and Threat groups rated products with lower carbon emissions as more attractive to purchase compared to the control group.

We also investigated correlational relationships between ECAS scores (with higher ECAs scores reflecting a more successful activation of cognitive alternatives) – we found, as reported by Wright et al. (2022) a correlation between ECAs and PEB, though of smaller size. While we found a positive correlation with imagination ability, we did not, as theorized by Wright et al. (2022), find a correlation with activist behavior.

Finally, while subjectively judged sustainability of one's choices was not impacted by our intervention, higher scores on ECAs, past activism and PEB were related to higher subjective judgment. Contrary to expectation, the actual emission sum of participants' choices did not predict their subjective judgment here, which might speak for self-assessments being a stronger factor in subjective judgments of own's own sustainable behavior, rather than the actual chosen products' carbon emissions.

4.1 | Theoretical Implications

Our findings suggest that inducing cognitive alternatives of a better relationship between humans and nature can lead to individuals making more sustainable grocery shopping choices, at least in a DCE setting. As the discrete choices should by definition better capture deciding trade-offs than preference ratings, it might be possible that an activation of sustainable cognitive alternatives might actually lead to more sustainable choices, while an activation of threat might merely lead to a more positive appraisal of sustainable products.

A few potential explanations for our findings present themselves:

The ECAs entails visionary elements in form of the cognitive alternatives and positive valence, which could serve as self or value affirmation and therefore buffer negative backlashes from confronting people with the climate crisis (Buttlar et al. 2017; Leviston and Uren 2020). These assumptions would align with self-regulation theories and would need further testing in future research, e.g., by relating the construct to mental contrasting (Oettingen et al. 2001, 2009). PET as a confrontation with the climate crisis could not just activate motivation to act more sustainably, but also trigger obstructive defensive thoughts due to the implied personal limitation of freedom, known as reactance (Chan and Lin 2022; Steindl et al. 2015). This could account at least for people who have low efficacy beliefs to act upon the threat or question the necessity to react to climate change (Chinn and Hart 2023; Peters et al. 2018; Scharks 2016). Yet, these assumptions of threat risks have scarcely been tested in the sustainability context (Scharks 2016). Recent research by Palosaari et al. (2023) and Shrum (2021) put into question the relevance of threat appeals in comparison to just activating climate change salience. There might be no further benefit of using threat appeals in a sustainability context, but rather potential risks like paralyzing, desensitization and potentially even backlashing effects such as moral licensing. as discussed above (Buttlar et al. 2017; Li et al. 2017; Stevens et al. 2021; Truelove et al. 2014). All of these unwanted reactions could be avoided with ECAs, which elicit positive emotions, a potentially powerful tool in sustainable behavior change (Schneider et al. 2021).

Further, ECAs could have more positive effects than PET, especially in relation to choice, in contrast to ratings, as our findings suggest. In choice situations, participants are forced to make decisions that crystalize behavioral intentions more clearly, capturing trade-offs better than preference ratings (Wijnen et al. 2015). Our findings might support the findings from Schwartz and Loewenstein (2017) in that negative affect (in this case caused by the threat intervention) had superficial effects on pro-environmental intentions captured by the ratings, but did not show substantial attitude or behavioral change.

We only found past activism, pro-environmental behavior intention and ECAs score to be significant predictors of the subjective sustainability assessment, which could mean self-assessments are a stronger factor in subjective judgments of one's own sustainable behavior, rather than the objectively chosen products. This would be in line with the often-proposed methodological limits of subjective self-assessments to portray actual behavior, leading to the intention-behavior gap (Hanss et al. 2016). Further, it implies that ECAs could affect such a subjective self-perception – future research should clarify this relationship, as according to self-perception theory (Bem 1972), our subjective self-perception is an important influence on our identity, which in turn is crucial for establishing lasting pro-environmental behavior (Fritsche et al. 2018; Gatersleben et al. 2014; Udall et al. 2021).

4.2 | Practical Implications

Our findings support previous evidence by Stöckigt et al. (2018) and Contini et al. (2017) that participants use sustainability information when given. Food labels are reported to have a modest positive effect on food choices in the sustainability context (Abrahamse 2020). Our study shows that combining CO_2 labeling with ECAs activation could be a potential mechanism to foster pro-environmental choices in the supermarket. In line with prior research on positive messaging on labels (Elofsson et al. 2016; Vanclay et al. 2011) and eco-labelling (De-loyde et al. 2022) it is possible that consumers would benefit from emission information on how to shop more sustainably combined with the hopeful message that a more sustainable relationship with our environment is feasible. The provision of eco labels could lead to a virtuous cycle, by increasing motivation to act sustainably and thus, increasing

sustainable choices, which in turn could increase beliefs in a future of environmental alternatives.

4.3 | Limitations and Implications for Future Research

Firstly, our sample is a convenience sample collected on Prolific. Even though Prolific has a self-selection bias for study participation, it offers a minimum wage payment according to the participants' country, making it a more ethical choice. Our sample was not entirely representative of the German population—our participants were more highly educated, with ECAs ($M = 4.05$, SD = 1.04) and PET ($M = 6$, SD = 1.08) scores overall relatively high, indicating prevalent environmental concerns. Future research in this direction could also take into consideration collecting participants from socially disadvantaged groups and testing how ECAs might affect individuals without strong environmental concerns (Grandin et al. 2022; Unsworth and McNeill 2017). Further, we conducted the study online. Previous studies have indicated that findings of online studies might not translate to naturalistic, real-life settings (Clarke et al. 2021). Therefore, a replication of our findings in the field would be needed.

Secondly, due to the very early stage in the theoretical development of the ECAs concept, we decided to use the simplest intervention to activate the constructs, using the scales (ECAs and PET). Inspired by previous research on order effects of surveys on for example policy satisfaction and political identification (Van De Walle and Van Ryzin 2011; Weiner 2015) this conservative approach would avoid additional confounds due to for example differing wordings. For usage in real-life applications, it would require reworking to a small task or short message on a label. Previously, Wright et al. (2022) suggested using imagery about the Sustainable City in Dubai to activate ECAs. Similar urban community projects exist in other cities as well (e.g., Bahnstadt in Heidelberg, Jernbanebyen in Copenhagen, and Singapore to name a few) and could be used as material to test whether access to ECAs can be manipulated by showcasing examples close to home. In line with our findings, ECAs seem to be more than just an activation of environmental awareness and offer new promising opportunities for interventions on pro-environmental behavior promotion.

Finally, while our analysis only contends with instantaneous decision-making shortly after the intervention, the longer-term impact should be investigated, for example, with repeated reminders. In contrast to threat appeals, the positive valence entailed in the ECAs scale might help with fostering the longevity of effects (Schneider et al. 2021; Schwartz and Loewenstein 2017).

5 | Conclusion

We present first evidence from a discrete choice model of the effectiveness of ECAs in relation to carbon labeling for promoting more sustainable grocery shopping choices when comparing its effectiveness to perceived environmental threat activation and a control group. There is reason to believe that ECAs are more than activated environmental awareness, potentially due to the positive emotional valence and provision of cognitive alternatives. Future studies need to further clarify the processes behind ECAs, yet this study shows it has the potential for successful interventions to foster pro-environmental behavior.

Author Contributions

Theresa Lang: conceptualization, methodology, software, formal analysis, investigation, resources, data curation, writing – original draft preparation and editing, visualization, project adminstration, funding acquisition. **Roberto Ulloa:** software, formal analysis, visualization, writing – review. **Florian Kutzner:** writing – review, funding acquisition. **Michaela Wänke:** writing – review, supervision. **Celina Kacperski:** conzeptualization, methodology, formal analysis, data curation, writing–review and editing, visualization, supervision, funding acquisition.

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Ethics Statement

All participants were above 18 and gave written, informed consent to participate in the study. Information about consent and data protection was downloadable as a pdf file and consent was indicated via an item in the survey, which led to direct exclusion if not consented to.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Data and statistical analysis scripts are available at https://doi.org/10.17605/OSF.IO/QWFG8.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.