

Does Reframing Fund Carbon Emissions to Increase Their Personal Relevance Boost Investment in Sustainable Funds? Evidence from a Discrete Choice Conjoint Experimental Design

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ABSTRACT The market for green investments can be expanded by providing investors with clear information about the environmental impact of their investment options. Using a discrete choice conjoint experimental design with retail investors ($N_{\text{choices}} = 20,874$, $N = 499$), we investigate the impact of presenting environmental information in different formats on investment decisions. Drawing on psychological theories of attention and information processing, we test whether reframing the presentation of a fund's carbon emissions to make them more personally relevant and easier to evaluate leads to increased investment in more sustainable funds. We compare the effectiveness of visual and numeric carbon labels, designed to improve the clarity and comparability of emissions, with analogies equating fund emissions to everyday activities such as cooking, commuting, and watching Netflix, which aim to increase the personal relevance of emissions. We find that, contrary to our predictions, carbon emission labels outperformed analogies in increasing green investment choices.

Climate change poses a significant threat to the planet and its inhabitants, with global temperatures projected to increase by 3°–5°C by 2100 (NASA 2020). To mitigate this risk, reducing global carbon emissions is crucial. Financial markets have the potential to play a significant role in achieving this goal, as redirecting investments toward low-carbon funds can encourage corporate sustainability (Louche et al. 2019) and increase low-carbon asset capital (Webster 2020). However, investors often do not choose sustainable funds (Vörösmarty et al. 2018), and 75% of US dollars remain invested unsustainably (Bernow, Klempner, and Magnin 2017). This research aims to identify and test interventions that can promote sustainable investment choices among retail investors.

Despite evidence suggesting that investors are interested in sustainability and want to invest in environmentally friendly

financial products (Friedman and Heinle 2016; Hartzmark and Sussman 2019), effectively assessing the environmental impact of different investments and incorporating this information into decision making remains a challenge for investors. This study focuses on two barriers that may prevent investors from making sustainable investments: the lack of evaluability and personal relevance of sustainability-related information. First, the sustainability-related information that investors have access to is often not evaluable (Hsee 1996; Hsee et al. 1999). Firms often communicate information concerning environmental practices in ESG disclosures, but such disclosures tend to focus on firm-specific changes in practices and lack specific detail regarding the overall impact of their operations. Such information is therefore difficult to use in comparisons between investment options, or in judgments of any one investment's absolute impact (Vörösmarty et al. 2018).

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Second, sustainability information is often presented in a way that does not feel personally relevant to the investor and therefore is not salient. The extent to which people incorporate information into their decision is strongly related to the extent to which they attend to this information (Bordalo et al. 2013). Yet during financial decision making, investor attention is typically split across a number of factors that are central to making financial predictions goals, such as market information, individual-firm financial performance indicators, and news headlines (Barber and Odean 2008; Da, Engelberg, and Gao 2011; Ramos, Latoeiro, and Veiga 2020). Partially as a result, people often fail to attend to sustainability information and to use it as a factor in their decisions (Hartzmark and Sussman 2019; Osman and Thornton 2019). Indeed, in the absence of evaluable information concerning fund sustainability, investors largely ignore sustainability information (Moss, Naughton, and Wang 2020).

Our experiment aims to overcome these barriers by manipulating the framing of sustainability information: we present some participants with a common metric for ordinal comparisons (i.e., eco-labels) and others with analogies that translate the information into more familiar and personally relevant units.

Presenting Carbon Fund Information Using Eco-Labels

The difficulty in using information to evaluate an investment is a significant challenge for retail investors in making sustainable investment decisions. The ease of evaluating information, known as evaluability, is dependent on the individual's ability to process and understand the information (Hsee 1996). People's sensitivity to changes in the value of an attribute, such as a stock's dividend yield or a fund's carbon emissions, depends on how evaluable that information is to them (Hsee et al. 1999; Hsee and Zhang 2010). One approach to increasing the evaluability of sustainability information is to present it in a form that facilitates ordinal comparisons between available alternatives (Bassen et al. 2019). The use of eco-labels (Taufique et al. 2019), symbolic representations of environmental information, is one way to improve evaluability. These labels, such as the Carbon Trust's¹ carbon footprint labels and Morningstar's² sustainability ratings, have been found to be effective in conveying

environmental information to investors and shaping investment decisions (Døskeland and Pedersen 2016; Hartzmark and Sussman 2019). Eco-labels that incorporate features such as traffic lights, bronze-to-gold ratings, or five-star ratings have been found to be more effective in promoting sustainable investment compared to other forms (Drescher et al. 2014; Li et al. 2018; Osman and Thornton 2019).

However, visual eco-labels also have drawbacks (Lusk and Marette 2012; Rubik and Frankl 2017). First, there is evidence that people can find eco-label frames confusing (Brécard 2014), unreliable (Taufique et al. 2019), oversimplified (D'Souza, Taghian, and Lamb 2006), and inconsistent (Czarnecki et al. 2014). As such, there are also empirical reasons to doubt the efficacy of visual eco-label frames for promoting sustainable investment.

Presenting Carbon Fund Information Using Relatable Analogies

We propose a new approach to presenting carbon emission information by using relatable analogies, which aim to convey the abstract concept of carbon emissions in a more understandable manner by comparing it to everyday activities. This method uses the cognitive process of transferring information about the carbon output of an investment to that of an everyday activity for easier comprehension, as opposed to eco-labels which allow comparison on an ordinal scale. Translating numbers from unfamiliar or abstract values into units that people experience more frequently and directly (Barrio, Goldstein, and Hofman 2016; Chaganty and Liang 2016; Riederer, Hofman, and Goldstein 2018) has been shown to make the information more salient and influential in decision making. We label these interventions as relatable analogies. We use the term analogy in a broad sense to refer to translating information about the carbon output of an investment to that of an everyday activity for easier comprehension.

Research has also shown that using similar kinds of analogies can enhance comprehension and decision making regarding sustainability specifically. For instance, framing a particular number of calories (e.g., 300 calories) in terms of the number of minutes one would have to walk to burn those calories (e.g., 1.5 hours) allows people to better assess the desirability of consuming that number of calories and nudges them toward consuming fewer calories (Dowray et al. 2013). Previous research has demonstrated that presenting abstract concepts in a more relatable and concrete manner can increase people's understanding and engagement with the topic at hand. For example, studies have shown that framing biodiversity loss through local wildlife, rather than

1. For more information, see <https://www.carbontrust.com/what-we-do/assurance-and-certification/product-carbon-footprint-label>.

2. For more information, see <https://www.morningstar.com/articles/745467/article>.

arctic polar bears, can foster a stronger sense of psychological closeness and increase people's engagement with the issue (Trope and Liberman 2010). In the context of carbon emissions, investors may find it more challenging to comprehend the magnitude of emissions represented by a standard metric such as .5 kgCO₂eq/\$1K (i.e., a kilogram of carbon emitted per \$1000). However, by translating this metric into a relatable analogy, such as "the equivalent of half a year of charging your phone," investors may find it easier to grasp the significance of the emissions and make more informed investment decisions. Additionally, research has shown that when people are presented with salient information, they tend to weigh that information more heavily in their decisions (Taylor and Thompson 1982; Bordalo, Gennaioli, and Shleifer 2013; Mrkva et al. 2021). By making carbon emissions information more salient through relatable analogies, we may be able to increase its importance in investors' decision-making processes.

Eco-Labels versus Analogies

The primary objective of our research was to compare the effectiveness of eco-labels and analogies in encouraging sustainable investment decisions. Our literature review suggests that both interventions may be beneficial in promoting greener investment choices. However, we hypothesized that presenting carbon emission information in a relatable format, such as analogies, would be more effective than presenting it in an evaluable format, such as eco-labels. This is due to the limitations identified in the presentation of eco-labels (Lusk and Marett 2012) and the expectation that a personally relevant format would increase the likelihood of investors choosing funds with lower carbon emissions. As such, we predicted that the impact of analogies would be stronger than that of visual eco-labels and numeric labels.

H1: Presenting consumers with carbon emission information in the form of analogies will significantly increase pro-environmental investment choices compared to presenting the information in numerical or graphical form (i.e., eco-labels).

Visual versus Numeric Eco-Labels

While we expected analogies to out-perform labels, we expected differences in performance based on how those labels were designed. We expected sustainability information to be more salient to decision-makers if it is visually highlighted or presented through imagery (e.g., Osman and Thornton 2019). For example, Morningstar's sustainability ratings are

often displayed in the form of globe icons (with ratings ranging between one and five globes). Although potentially less granular, such image-based representations should be more attentionally engaging than plain numbers or text and may thus be more heavily weighted in people's decisions. This led us to our second hypothesis, that we expected a stronger relative effect from visual over numeric eco-labels, given the additional visual salience.

H2: Presenting consumers with carbon emission information in the form of a visual eco-label will significantly increase pro-environmental investment choices compared to presenting the information in only numerical form.

Neutral versus Loss-Framed Analogies

We also test whether presenting consumers with carbon emission information in the form of relatable analogies framed as losses (emphasizing the personal sacrifices that would be incurred to offset fund emissions) will be more effective in promoting pro-environmental investment choices compared to presenting the information as analogies framed in a neutral manner. This is based on the principle of loss aversion, where individuals are more motivated to take action to avoid losses rather than gain something. This has been supported by research showing that loss-framed information receives more attention and engagement (Pachur et al. 2018; Sheng et al. 2020) and can lead to increased sustainable consumption (Segev, Fernandes, and Wang 2015). An alternative interpretation is that loss-frames are more effective because people generally value losses more than gains (Kahneman and Tversky 2012). These two accounts are closely related, as recent research suggests that the tendency to value losses more strongly than gains is itself driven at least partially by increased attention to losses (Pachur et al. 2018). Based on these arguments, we test the effectiveness of using loss-framed analogies in promoting pro-environmental investment decisions.

H3: Presenting consumers with carbon emission information using relatable analogies framed as losses will be more effective in promoting pro-environmental investment choices compared to presenting the information in a neutral manner.

The Role of Environmental Attitudes and Past Performance

The effectiveness of presenting carbon emission information in the form of analogies or eco-labels may vary depending

on the individual's level of environmental attitudes and past performance in making sustainable investments. Prior research has shown that individuals with stronger green attitudes tend to make more sustainable consumer decisions (Roberts and Bacon 1997; Maki and Rothman 2017). This led us to expect an overall positive effect of consumers holding stronger green attitudes on the sustainability of their investments.

Additionally, we expected that the effectiveness of the carbon emission treatments would vary based on the green attitudes of the evaluator. On one hand, the benefits of the experimental treatments could increase due to individuals' general tendency to pay attention to this information. Sustainability information should already be more salient to individuals who are more concerned with sustainability in their daily lives and less salient for those who place less importance on sustainable behavior. As a result, increasing the salience of carbon emission information should increase its weighting in general, and most strongly among participants who are more concerned with sustainability. On the other hand, the interventions could instead be more effective for those with weaker green attitudes, as these are individuals who would not typically pay attention to this information. Furthermore, while environmental concern, beliefs, and awareness have been shown to predict responsiveness to eco-label frames (Haws, Winterich, and Naylor 2014; Moussaoui, Desirichard, and Milfont 2020), they have not been found to predict sustainable investment behavior (Bassen et al. 2019; Gutsche, Wetzel, and Ziegler 2023). We therefore performed additional analyses to investigate the potential interaction between the experimental conditions and participants' green attitudes.

Finally, we also investigated how the effects of the sustainability information on investment choices varied across funds with different levels of past performance. This reflects the real-life trade-off that consumers often believe they are making when deciding to invest sustainably. The primary goal of most investors is to earn a financial return on their investments, and so they must balance these financial motivations against any more pro-environmental or pro-social motivations when investing (Irwin and Spira 1997; Chernev and Blair 2021). While a number of studies have reported superior historical returns to sustainable strategies (e.g., Edmans 2011; Nagy, Kassam, and Lee 2016), others have shown a negative perceived correlation between sustainability and efficacy (Van Doorn and Verhoef 2011; Wood et al. 2018). Our conjoint paradigm allowed us to assess prior claims for an overall greater influence of financial over envi-

ronmental attributes on fund selection (Bassen et al. 2019; Gutsche et al. 2023) in our experimental context.

METHOD

Participants

We recruited UK participants ($N = 499$) who had self-reported prior investment experience from the Prolific panel and paid them £1.50. Sample size calculations and demographics are presented in appendix A (apps. A–F are available online). Participants' response quality was tested through two attention checks (Hauser and Schwartz 2015), of which 32 participants failed at least one. We repeated our analyses after removing these participants, which did not change our results, and therefore we included these respondents in our reported analyses.

Procedure

The study employed a conjoint experiment using the Sawtooth Software module SSI Web 8 to assess the impact of carbon emission information on investment choices. Conjoint analysis is a widely used method to understand how consumers trade-off multiple attributes when making decisions, such as risk, performance, and fees in the case of investment decisions (Lohrke et al. 2010; Apostolakis et al. 2018). Participants were presented with 14 rounds of hypothetical investment choices, each consisting of three fund options. The funds varied in terms of their past performance, risk, fees, and carbon emissions and were randomly generated to be unique combinations of these attributes. The order of presentation of fund attributes was based on real-world contexts and Key Investor Information Documents (KIID) and replicating the format used by Bassen and colleagues (2019).

The study also presented participants with graphs visualizing the performance and risk of the funds over the last 10 years to further mimic real-life choice contexts (Hoffmann, Cam, and Camilleri 2019). The levels of the attributes were chosen to reflect real-world contexts and replicate previous literature. For example, the range of carbon emissions used in the study was based on real fund data from the Carbon Disclosure Project. More details about the calculations and references used for attribute levels can be found in appendix B. A diagram explaining the design is shown in figure 1, and the attribute levels are shown in table 1.

Experimental Conditions

We randomly allocated participants to one of five experimental conditions, each with different fund carbon emissions frames. The *control condition* provided no information

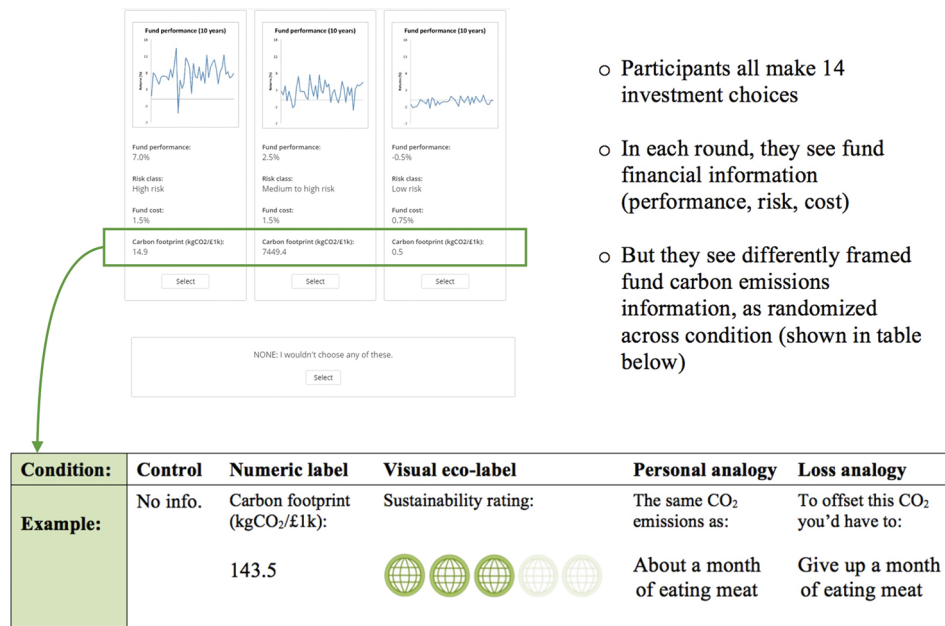


Figure 1. Example schematic of choice-based conjoint study format across condition.

about fund carbon emissions. The *numeric eco-label condition* presented fund carbon emissions in kgCO₂eq/£1K. The *visual eco-label condition* expressed fund carbon emissions as a sustainability rating out-of-five, which was included alongside the kgCO₂eq/£1K. In the visual information condition, one to five globes are used for the one to five carbon emissions levels in table 1 (see fig. S15; figs. S1–S17 are available online). The *neutral analogy condition* presented fund carbon emissions through familiar “day-to-day” analogies, incorporating multiple common carbon-emitting behaviors (travel, energy use, food consumption), presented randomly. The *loss-framed analogy condition* expressed fund carbon emissions by explaining what “day-to-day” sacrifices a participant would have to make to offset the fund’s emissions. Examples of each analogy frame can be found in table 2. For both anal-

ogy conditions, participants were shown one of the eight analogies per investment decision, which was randomized for each decision to remove confounding effects across different analogies. Randomization was built into our conjoint model using Sawtooth Software.

Green Attitudes

To assess the impact of our interventions on investment choices across different types of consumers, we included measures of participants’ attitudes toward sustainability. We used three self-report items, developed and validated in previous research (Roberts and Bacon 1997; Maki and Rothman 2017; Obery and Bangert 2017). Participants were asked to indicate their agreement with the statements: (a) “I often engage in pro-environmental behaviors”;

Table 1. Fund Attributes and Their Levels

Fund attribute	Number of levels	Levels of the attribute							
		Lowest	Middle				Highest		
Fund performance (%)	8	−.5	1.0	1.75	2.5	4.0	5.5	7.0	8.5
Fund risk	5	Low	Low to medium		Medium	Medium to high		High	
Fund cost (%)	3		.75		1.50			2.25	
Fund carbon emissions (kgCO ₂ /£1K)	5	.5		14.9	143.5		354.0		7,449.4

Note.—Levels are combined randomly to generate fund choices during the choice-based conjoint test.

Table 2. Frames from the Neutral Analogy and Loss-Framed Analogy Conditions

	Neutral analogy	Loss-framed analogy	Amount of behavior required to meet the varying magnitudes of carbon emissions per fund (kgCO ₂ /£1K)			
Introductory passage	“In other words (per £1K invested), the same CO ₂ emissions as . . .”	“In other words (per £1K invested), to offset the same amount of CO ₂ you’d have to . . .”	.5	14.9	143.5	354.0
Meat consumption	Eating meat for 1 meal	Give up eating meat for 1 meal	1 meal	About a month of eating meat	About 10 months of eating meat	About 2 years of eating meat
Car journeys	1 short car journey	Give up your next short car journey	One short car journey	About 30 short car journeys	About 290 short car journeys	About 710 short car journeys
Charging your phone	Half a year of charging your phone	Give up the next half a year of charging your phone	Half a year	About 15 years	About 140 years	About 350 years
Cooking micro-wave meals	Cooking 10 microwave ready-meals	Give up cooking your next 10 microwave ready-meals	10 microwave ready-meals	About 300 micro-wave ready-meals	About 2,900 micro-wave ready-meals	About 7,100 micro-wave ready-meals
Sending emails	Sending 125 emails	Give up sending your next 125 emails	125 emails	About 3,725 emails	About 36,000 emails	About 90,000 emails
Making Google searches	Making 2,500 Google searches	Giving up making 2,500 Google searches	2,500 Google searches	About 74,500 Google searches	About 720,000 Google searches	About 1,800,000 Google searches
Watching Netflix	Watching 9 hours of Netflix on your laptop	Give up watching the next 9 hours of Netflix on your laptop	9 hours	About 270 hours	About 2,500 hours	About 6,400 hours
Boiling a cup of tea or coffee	Boiling about 40 cups of tea or coffee	Give up boiling your next 40 cups of tea or coffee	About 40 cups	About 1,200 cups	About 11,500 cups	About 28,300 cups
						About 575,000 cups

(b) “Most people around me worry too much about sustainability” (reverse-scored); and (c) “I’m worried about the worsening quality of the environment.” These items were standardized and averaged, with higher scores indicating stronger pro-environmental attitudes. Due to a small number of outliers, we applied winsorization (1%, 99%) to the variable before conducting our analyses. To minimize the potential influence of priming and social desirability on investment decisions, we administered these measures after the hypothetical investment choices were made. However, it is worth noting that the repeated investment decisions could have plausibly influenced the self-report measures of green attitudes.

Open Science Practices

The data and code to replicate all our results are provided on the OSF website (https://osf.io/xvyd6/?view_only=f83e9e60191b40eda38c8ae4f6df68cb). The study was granted ethical approval from University College London.

Analyses

We employed two distinct analytical approaches to test our results. The first approach utilized Bayesian importance scores, which were calculated at the participant level using a hierarchical Bayesian regression model (Toubia 2018). These scores represent the relative importance of each feature in the conjoint design in terms of its influence on the participants’ investment decisions. Specifically, we used the Bayesian importance score for the carbon emissions level and compared these scores across the experimental conditions. For these analyses, we employed a simple OLS linear regression model, with a binary variable representing the experimental conditions (coded 0 vs. 1) as the independent variable and the carbon emission importance score as the dependent variable.

The second approach utilized the raw choice data to build multilevel mixed-effects logistic regression models. The choices were clustered within participants and investment rounds (1–14), with each participant and investment round given their own intercept. Whereas the importance scores were calculated at the participant-level ($N = 499$), the choice data had 20,874 observations, with a separate observation for each fund offered. This approach had greater power to detect hypothesized differences across the experimental groups. In these analyses, we tested the significance of the interaction between the experimental conditions and the amount of carbon emissions presented in the investments (1–5). These models enabled us to plot the probability

of an investment choice being made and how this varied across carbon emission levels and by condition.

The appendixes include additional analyses comparing the label and analogy treatment groups against the control group. As expected, each of the experimental conditions increased the probability of choosing more sustainable investment options (see app. C).

RESULTS

The central goal of our research was to determine the effectiveness of various presentations of carbon emission information in influencing investment choices. To achieve this, we utilized a conjoint experiment and calculated relative importance scores for each of the four experimental conditions. The findings, presented in table 3, indicate that the numeric and visual eco-label conditions had the highest importance scores, followed by the two analogy conditions. This suggests that these forms of carbon emission information had the greatest impact on participant’s investment decisions.

Presenting Carbon Information with Eco-Labels versus Analogies

Our results indicate that presenting carbon emission information through numeric and visual eco-labels had a greater impact on investment choices than presenting it through analogies. Specifically, an OLS regression model revealed that the importance score for carbon emissions was 6.21% higher for the label conditions compared to the analogy conditions ($b = -6.21$, $t = -5.29$, $p < .001$, 95% CI $[-8.51, -3.90]$). This finding supports hypothesis 1 and suggests that consumers respond more positively to carbon emission information when it is presented in the form of quantitative labels, rather than through analogies.

Evidence that numeric and visual eco-labels had a greater impact on carbon emission importance than analogy conditions was also found using the raw choice data. The mixed effects logistic regression showed a significant interaction between the carbon amount and the pooled labels versus analogy conditions variable ($b = -.22$, $z = -8.90$, $p < .001$, 95% CI $[-.17, -.27]$). This interaction is visualized in figure 2A. The graph shows that as the amount of carbon produced by an investment fund increases, the probability of investing in that fund decreases in both conditions. We also see differences in the probability of investment choices across the label and analogy treatments. Funds with the lowest carbon emissions were selected 45.6% of the time in the label condition, compared to 37.0% in the analogy

Table 3. Carbon Emission Bayesian Importance Scores for Experimental Conditions

	Condition			
	Label		Analogy	
	Numeric	Visual	Neutral	Loss
$\bar{x}$	25.67	25.30	17.62	20.73
[95% CI]	[23.04, 28.29]	[22.68, 27.92]	[16.03, 19.20]	[18.80, 22.66]

condition. Similarly, funds with the highest carbon emissions were selected 13.4% of the time in the label condition, compared to 20.9% in the analogy condition.

These results imply that analogy-based carbon emission frames are less effective in promoting green investments than numeric or visual eco-labels. This finding is consistent across both sets of analyses and runs counter to our initial hypothesis.

Presenting Carbon Information with Visual versus Numeric Labels

We hypothesized (hypothesis 2) that visual eco-labels would be more effective than numeric labels, due to the added visual salience provided by images. However, the carbon emission relative importance scores for the numeric (25.67) and visual (25.30) conditions were highly similar, and our re-

gression model revealed no significant difference between the two conditions ($b = -.367$, $t = -0.19$, $p = .847$, 95% CI $[-4.10, 3.37]$).

In contrast, the mixed effects regression using the choice data did show a small but significant interaction between carbon emission level and condition ($b = -.08$, $z = -2.08$, $p = .038$, 95% CI $[-.15, -.004]$). The results are plotted in figure 2B, which illustrates the small difference between the two conditions, with the visual eco-label only increasing investment likelihood for investments with low carbon emissions. Overall, these findings provide mixed support for hypothesis 2, with the data suggesting that while visual eco-labels may be slightly more effective for low carbon emissions investments, there is no substantial difference in effectiveness between the two types of labels.

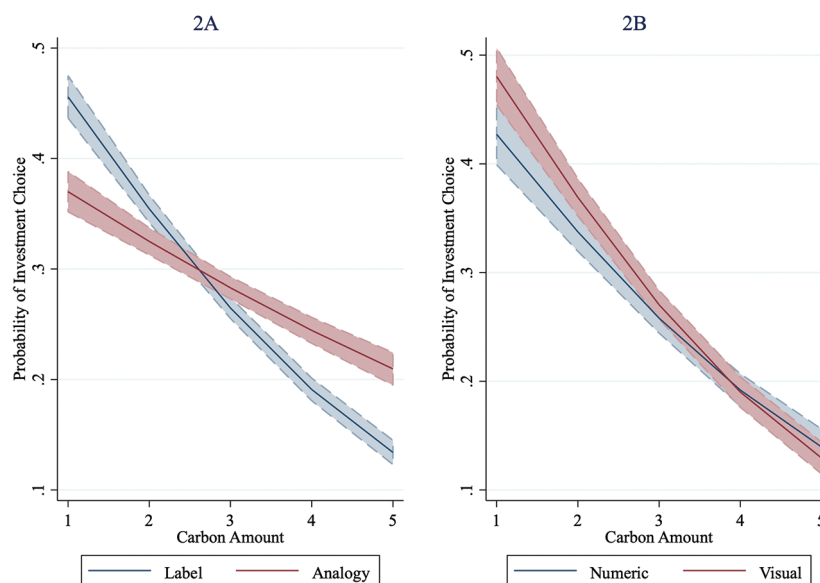


Figure 2. Likelihood of choosing investment fund across carbon emission amounts and by pooled analogy versus pooled label conditions (A) and by numeric versus visual label conditions (B).

Presenting Carbon Information with Neutral versus Loss-Framed Analogies

We had also predicted that loss-framed analogies would be more effective than neutral analogies (hypothesis 3), given the additional persuasiveness of loss aversion. Our findings revealed a significant difference in the carbon emission importance scores for the two conditions, with loss-framed analogies leading to greener investment decisions ($b = 3.11$, $t = 2.41$, $p = .017$, 95% CI [.57, 5.65]; see fig. 3). However, when analyzing the raw choice data, we did not observe a significant difference between the two conditions ($b = -.01$, $z = -0.28$, $p = .776$, 95% CI [-.08, .06]; see fig. 4). These results provide mixed support for our hypothesis that loss-framed analogies would be more effective than neutral analogies.

Pro-environmental Attitudes

Our research aimed to investigate the impact of pro-environmental attitudes on participant's investment choices. We found that as expected, participants with more pro-environmental attitudes were more likely to invest in funds that had lower carbon emissions. A regression analysis on carbon importance scores revealed a positive correlation between environmental attitudes and investment choices ($b = 1.71$, $t = 2.95$, $p = .003$, 95% CI [.57, 2.85]). Furthermore, the raw choice data also showed a significant interaction between carbon amount and green attitudes ($b = -.07$,

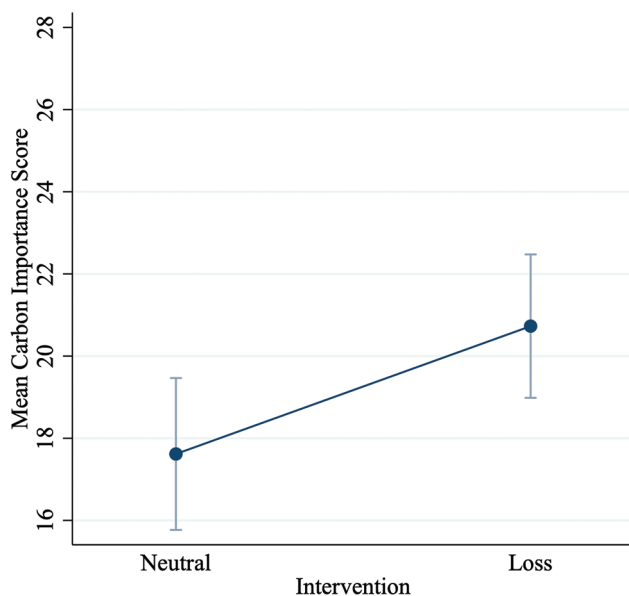


Figure 3. Comparing carbon emission importance scores across loss-framed versus neutral analogy conditions.

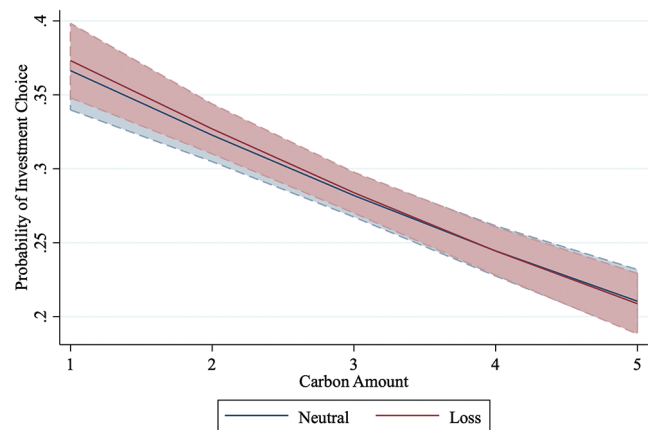


Figure 4. Likelihood of choosing investment fund across carbon emission amounts and by loss-framed vs. neutral analogy conditions.

$t = -5.52$, $p < .001$, 95% CI [-.09, -.05]). Figure 5 illustrates the marginal effect of increasing the level of carbon emissions by one level on the probability of fund choice, which is plotted across the distribution of green attitudes. The figure illustrates that while increasing the carbon amount reduces the likelihood across the spectrum of green attitudes, the effect is strongest for those with the most pro-environmental attitudes, providing further evidence of the impact of pro-environmental attitudes on investment decisions.

We next examined how individual pro-environmental attitudes may have influenced the results of our experimental conditions. To do this, we included the interaction of green attitudes with each of the experimental condition comparisons in our analyses, both in terms of importance scores and raw choice data. It is worth noting that our sample size may not have been sufficient to detect interactions between these factors (see app. A). However, we found consistent results across both sets of analyses, indicating that pro-environmental attitudes did indeed moderate the effects of the visual versus numeric label conditions (importance scores: $b = -3.51$, $t = -1.82$, $p = .070$, 95% CI [-7.31, .29]; choice data: $b = .10$, $t = 2.72$, $p = .007$, 95% CI [.03, .17]), as well as the loss-framed versus neutral analogy conditions (importance scores: $b = -3.21$, $t = -2.45$, $p = .015$, 95% CI [-5.81, -.63]; choice data: $b = .08$, $t = 2.15$, $p = .032$, 95% CI [.01, .15]). However, we did not find a significant interaction in the pooled analogy and label conditions (importance scores: $b = -1.93$, $t = -1.40$, $p = .162$, 95% CI [-4.02, .67]; choice data: $b = .03$, $t = 1.13$, $p = .259$, 95% CI [-.02, .08]). We have presented these interactions using the Bayesian importance scores in figure 6 for further illustration.

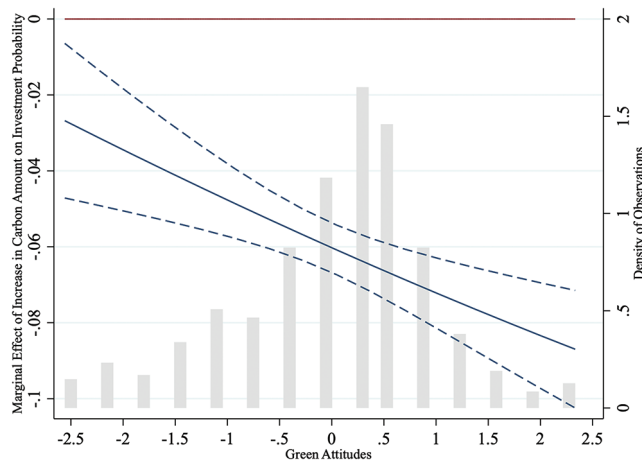


Figure 5. Marginal effect of increasing carbon amount on probability of investment across green attitudes.

Past Fund Performance

In this study, we also aimed to understand how investors balance historical performance and sustainability information when making investment choices. We analyzed the choice data in a mixed-effects logistic regression model to determine the impact of past performance and carbon emissions levels on investment choice. Results indicated that past performance ($b = .654, z = 29.47, p < .001, 95\% \text{ CI } [.611, .697]$) and carbon emissions ($b = -.218, z = -5.41, p < .001, 95\% \text{ CI } [-.297, -.139]$) both had a significant effect on investment choice. Furthermore, we found that the effect of carbon emissions on investment choice varied depending on the past performance of a fund ($b = -.02, z = -2.81, p = .005, 95\% \text{ CI } [-.033, -.006]$). A response surface plot, illustrated in figure 7, demonstrated that when presented with a high-performance, low-emission fund, participants had a high likelihood of selecting it (~78% likelihood). However, when presented with a high-performance but also high-emission fund option, participants chose these funds ~45% of the time. Conversely, when presented with a low-performance, low-emission fund, consumers were only expected to choose this option ~5% of the time. These results are consistent with previous research which indicates that historical performance is given more weight than emissions levels in determining investment choice.

GENERAL DISCUSSION

Our study tested the impact of presenting environmental information in different formats on the selection of investment funds. We presented information as eco-labels for ordinal comparisons and as analogies for increased personal relevance. Despite previous research indicating that analo-

gies can improve comprehension (Dowray et al. 2013; Barrio, Goldstein, and Hofman 2016; Chaganty and Liang 2016), our results showed that eco-labels led to a higher rate of green investment choices.

When comparing visual eco-labels with numeric information, and loss-framed versus neutral analogies, our results were mixed. Previous studies have shown that eco-labels can have a positive impact on promoting sustainable

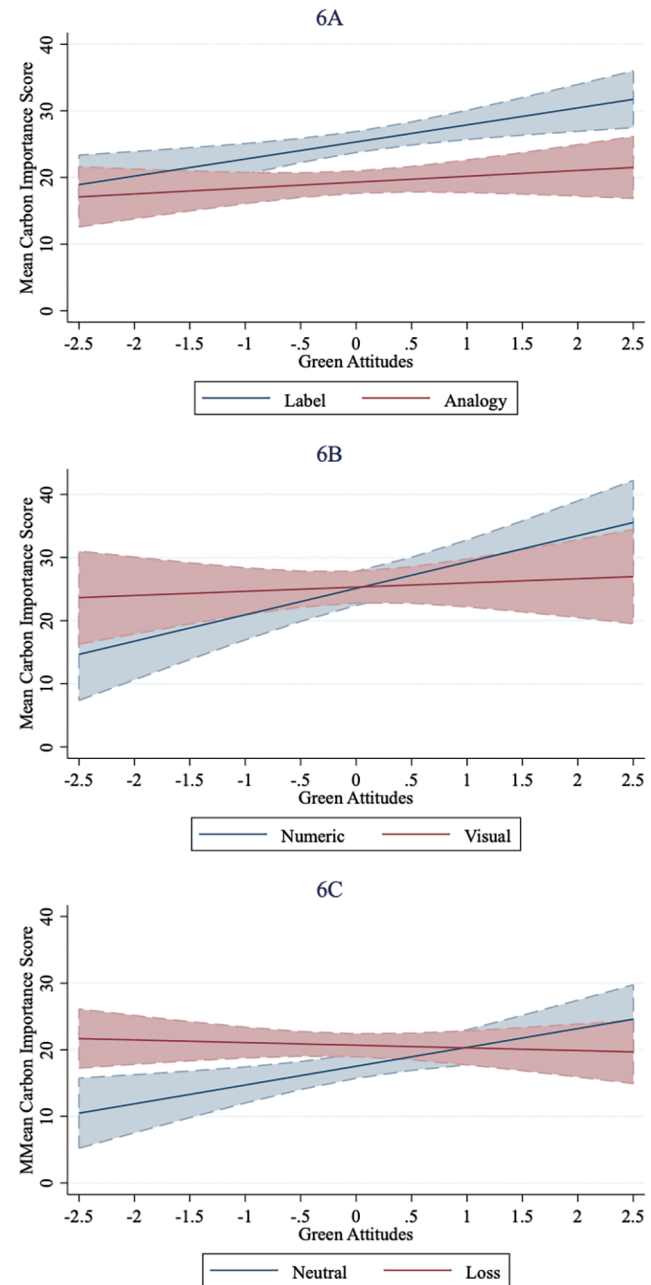


Figure 6. (A–C) Comparing carbon emission importance scores across experimental conditions and green attitudes.

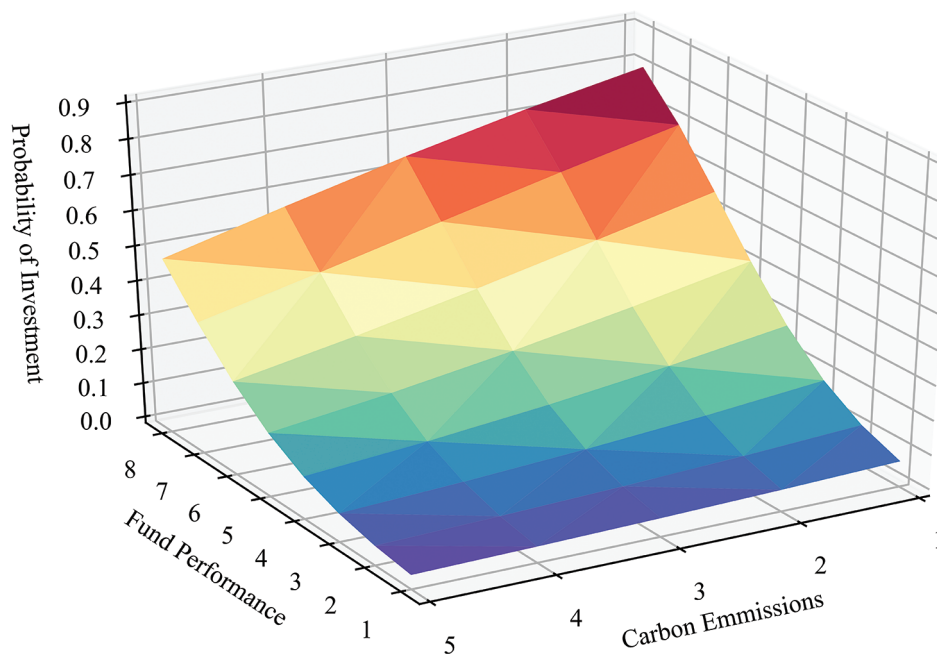


Figure 7. Response surface plot displaying probability of fund investment at different combinations of fund performance and fund carbon emissions.

choices in other product categories (Li et al. 2018; Osman and Thornton 2019), and we had expected that loss-framed analogies would attract more attention due to their emphasis on losses (Kahneman and Tversky 2012; Sheng et al. 2020). However, the mixed findings mean we cannot rule-out the null hypothesis that there is no statistically different effect between these conditions.

In additional analyses we found that the likelihood of choosing low-carbon funds was moderated by differences in green attitudes. Our results showed those with stronger pro-environmental attitudes were typically more likely to select low-carbon funds, supporting prior evidence that individual differences can moderate sustainable investment likelihood (Bassen et al. 2019; Gutsche et al. 2023). The interaction of green attitudes with the visual vs. numeric label effects, and the loss-framed versus neutral analogy conditions, was also significant. The interventions that increased green investments in the main effects analysis (i.e., visual labels and loss-framed analogies) were more effective for individuals with low green attitude scores. These findings support the idea that information salience plays a crucial role in decision making and that attention and salience depend on both the stimulus and the perceiver's characteristics (Hartzmark and Sussman 2019; Mrkva et al. 2021). Our results emphasize the importance of considering such systematic variation in the design of interventions.

While fund carbon emissions influenced fund choice, as we would expect, investors fund selection was ultimately more influenced by the financial performance of funds than their environmental attributes. This presents a significant challenge in promoting low-carbon fund investment, as many consumers continue to hold the misperception that sustainable funds underperform compared to other options (Bauer and Smeets 2015; Riedl and Smeets 2017). To overcome this, future research should investigate more effective ways to present fund emissions that help reduce the emphasis on financial performance. One possible solution could be to present environmental risks in monetary terms, leveraging investors' financial motivations rather than relying on their pro-environmental attitudes (Ezzine-de-Blas et al. 2019).

Why Were Analogies Less Effective than Eco-Labels?

The use of analogies in our study may have led to lower pro-environmental investment choices than eco-labels because analogies are more cognitively demanding and may have made participants expend less effort processing the information (Favilukis 2013). Similarly, consumers' tendency to underestimate the environmental impact of their consumption (e.g., Camilleri et al. 2019) may also contribute to the low effectiveness of analogies. The behavioral changes suggested by the analogies may appear small and insignificant compared to the actual impact. For example, a person who perceives giving

up meat for ten months as saving 50 kg of CO₂ may be more convinced by the actual savings of 143.5 kg CO₂, as presented in the eco-label conditions, than the impact presented in terms of meat consumption. Additionally, our analogies did not always accurately reflect the distinction between marginal and average environmental impact. For instance, the marginal impact of sending 125 emails is not 0.5 kg CO₂ as stated in the analogy, as this number represents the average impact. The primary source of the carbon impact of sending emails comes from the embodied emissions of creating the device (e.g., a laptop) to send them, not simply the energy used to send the emails.

A follow-up study (detailed in app. D) measured 200 participants' subjective perception of the carbon footprint associated with the various activities described in the analogies. The results indicated that participants tended to underweight the carbon impact of digital activities, such as sending emails ($M = 2.4$) and Google searches ($M = 2.8$). Conversely, participants seemed to perceive the carbon impact of tangible activities, such as charging a phone ($M = 4.5$) or taking an additional car journey ($M = 4.7$), to be higher. Our analyses confirmed that there were significant differences in the perceived carbon impact across the various activities. These results suggest that the distinction between marginal and average impact, as well as the extent to which people are unaware of the environmental impact of their actions, may be critical factors in determining the effectiveness of the analogies in influencing investment fund decisions.

Finally, given that analogies proved less effective at increasing green investment choices than eco-labels, it is also worth considering potential methods for enhancing their impact. One potential strategy is to personalize analogies to align with an individual's unique personality traits and preferences. Research has shown that consumers are drawn to products, people, and environments that match their personality (Matz et al. 2016; Gladstone et al. 2019, 2022), a phenomenon known as psychological fit. A recent field experiment, for example, demonstrated that messages tailored to individuals' personalities can increase rates of savings (Matz et al. 2023). In the context of environmental investing, individuals who are typically inclined to be pro-social and help others may find that analogies that connect carbon reduction to causes such as charitable giving or supporting loved ones may prove to be more motivating than self-focused analogies. Further research is needed to determine if analogies that align with individual personalities could boost engagement in environmentally friendly investment behaviors.

Limitations and Future Research

The present study has several limitations that should be acknowledged when interpreting the results. The first is the hypothetical nature of the design, which may limit the generalizability of our findings. The challenge of relying on an artificially designed choice environment is likely to be especially acute in the context of sustainable behaviors, as it is well known that in conjoint studies, subjects overstate their valuation for prosocial attributes. For example, studies into people's valuation of environmental causes (e.g., wildfire rehabilitation), have observed donation opt-in rates three times larger in the hypothetical treatment than in the equivalent real-payment treatment (Ready et al. 2010). Similarly, Tully and Winer's (2014) meta-analysis of over 80 research papers showed that participants reported willingness to pay (WTP) for socially responsible products was 16.8% higher. In light of these concerns, a more accurate assessment of the effectiveness of labels and analogies would likely require testing in real-world investment environments.

Second, we were unable to assess the individual effectiveness of each analogy due to the randomization method used in our conjoint software model. There may have been differential impact on investment choices due to variations in personal relevance and concrete conceptualization of carbon emissions among the different frames, as suggested by the additional analyses detailed in appendix D. Further research could examine specific analogies to determine which are most effective in promoting green investments. Additionally, future studies should consider the impact of changes in scale on the perception of carbon emissions. For example, in the meat consumption condition, participants were presented with giving up meat in terms of meals as well as in months and years, which could also influence the effectiveness of the analogies.

Third, the design of the study may have confounded the comparison between the loss-framed and neutral analogies. Specifically, the loss-framed and neutral conditions in our experimental design were not only differentiated by their framing, but also by the level of personal relevance. The loss-framed condition used the second-person pronoun ("you") making it more personal than the neutral frame which was impersonal. This confound may have influenced the results, making it difficult to interpret any comparison between the two frames.

Conclusion

As consumer interest in green investments develops, there is a growing need to empower investors with the information

needed to act on those preferences. Our research sheds light on the effective presentation of carbon emissions information, and its findings can aid the financial services industry and policy makers in standardizing ESG measures and disclosures. While we had hypothesized that analogies may be an effective means to boost green investments, the evidence from this conjoint experiment suggests that visual labels provide the most promising informational treatment for promoting the adoption of sustainable financial products.

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