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EMPIRICAL ARTICLE

Mitigating climate change with financial investments: exploring sustainable investment strategies in a novel experimental investment paradigm

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Abstract

Sustainable financial investments play a role in mitigating climate change. With this research, we explored how decision-makers use three investment strategies illustrating different primary motives: (1) money maximization (economic self-interest), (2) exclusion (not personally harming the environment), and (3) inclusion (helping the environment most efficiently). The relative use of these strategies was tested within a novel investment paradigm, aiming to artificially create a trade-off between financial payoffs (money maximization), environmental purity (exclusion), and environmental impact (inclusion). We recruited 1422 participants online and let them make ten consecutive investment choices, with incentivized outcomes, both monetary (i.e., potential bonus payment) and environmental (i.e., number of trees planted). We tested the change in investment choices using a between-subject design with four conditions, a control, and one default condition for each investment strategy. The three strategies were chosen about equally often in the control condition, but we find that this investment pattern could be altered by a default intervention. Preliminary evidence suggests that participants primarily using the exclusion and inclusion strategies differ in their moral reasoning. Utilitarianism better predicted the inclusion strategy, whereas high self-importance of moral identity better predicted the exclusion strategy.

1. Introduction

Climate change is significantly impacting global health and the economy, and it directly threatens housing, food, and water supplies. People are already suffering from these consequences today and the number of directly affected people is only predicted to increase over the coming decades (IPCC, 2022; WHO, 2021).

Financial decisions, from individual consumer behavior, to how assets are managed, can either help mitigate climate change or continue to fuel it (Campiglio, 2016; Cunha, Meira, and Orsato, 2021; UNEP, 2017). The flow of financial capital to sustainable versus non-sustainable activities has a major influence on global environmental outcomes (IPCC, 2022). However, financial markets have fallen short and progressed too slowly in meeting their climate change mitigation potential, for example in facilitating a reduction in greenhouse gas emissions (IPCC, 2022).

In this study we used a novel experimental investment paradigm to study how people make financial investments, in situations where they can choose between (1) a business-as-usual money maximization strategy; (2) a green exclusion-based strategy (e.g., avoiding investing in fossil fuel); and (3) a green inclusion-based strategy (e.g., invest in green innovations).

1.1 Sustainable financial investments

The use of sustainable investment strategies has increased over the last decades, rising by 20 % (i.e., of managed assets in USD) between 2020 and 2022 (GSIA, 2022). It is estimated that between 13% (United States) and 47% (Canada) of the assets, which are under management in five major global markets (i.e., Europe, United States, Japan, Canada, and Australasia), are invested "sustainably" in the sense that they consider environmental, social, and governance factors (ESG; [GSIA, 2022]). Thus, most investments made in the global financial market still do not consider sustainability to any degree.

There are different ways of "considering" ESG factors and sustainable investments encompass a diverse range of investment strategies (GSIA, 2022). In this study, we focus on two of the most prominent strategies: exclusion investing (or negative screening) which means personally avoiding investments in unethical companies, and inclusion investing (or positive screening) which involves actively investing in companies that support ethical progress. The latter form of investing can take several forms which include what is sometimes called community investing (i.e., funds invested in supporting needing communities) and impact investing (i.e., investing with measurable environmental impact; [Sandberg, 2008]).[1]

1.1.1 The exclusion investment strategy

Sandberg (2008) analyzed a few of the different investment strategies employed by investors and their theoretical impact on climate change mitigation. His research suggests that exclusion investments have a negligible real-world impact. As long as there is a large number of non-sustainable investors on the market, i.e., investors only interested in the profit potential of a given investment, the sell orders from sustainable investors will simply be countered by buy orders from non-sustainable investors. Thus, Sandberg (2008) suggests that the exclusion strategy ends up supporting the status quo or keeping the current line. The IPCC (2022) has predicted that keeping with the current policies will lead to a global increase in temperature by 3.2 °C, far exceeding the Paris agreement of 1.5 °C.

Nevertheless, the exclusion strategy is the most classic sustainable investment strategy and is still very popular in the industry (15–24% of all sustainable investments; [GSIA, 2022]). We posit that the widespread appeal of the exclusion strategy can be attributed to both a lack of knowledge such as financial illiteracy, and divergent moral perspectives, specifically the contrast between deontology and consequentialism. A low level of financial literacy can limit investors and hinder them from actively partaking in how their assets are managed. Further, a lack of knowledge increases the risk of falling prey to greenwashing campaigns, while wanting to invest in companies that effectively help the environment (for review see Goyal and Kumar, 2021; Vörösmarty et al., 2018). In addition, the exclusion investment strategy has a moral allure. Deontological morality, emphasizing the importance of actions over outcomes, aligns well with exclusion investing (Sandberg and Nilsson, 2015). The attractiveness of this moral perspective is rooted in decision-makers sense of "keeping one's hands clean," thereby achieving a form of moral purity. The appeal of the exclusion strategy may, therefore, stem from the desire to avoid directly and personally contributing to harm, which is consistent with findings highlighting that avoiding harm is a prominent attribute in decision-making (Persson et al., 2022; Erlandsson, 2021; Schein and Grey, 2018). Put in other words, exclusion can easily be related to two of the systems posed by the Moral Foundation Theory, the system of care (i.e., avoiding harm) and purity (i.e., no degradation; [Graham et al., 2011]).

[1] Some alternative strategies that we will not consider here are ESG "integration" (i.e., consideration of ESG factors to improve returns) and shareholder activism (or stewardship, i.e., changing unethical companies from the inside).

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Table 1. *Monetary, environmental, and moral characteristics of the investment strategies.*

	Money maximization strategy	Exclusion strategy	Inclusion strategy
Expected monetary profit	Higher profit	Lower profit	Lower profit
Probability of personally harming the environment	High	None	Some
Expected climate change mitigation	Negative	Status quo	Positive
Preferred by which morality	Egoistic (As it maximizes your profit)	Deontological (As it assures that you do not personally harm the environment)	Consequentialist (As it has the most positive expected impact on the environment)

Note: Characteristics of the three investment strategies. Monetary outcome concerns expected profit in $ to be paid as a bonus. Mitigation refers to climate change mitigation (i.e., reducing carbon dioxide in the atmosphere); Negative = increased carbon dioxide, Status qua = current level of carbon dioxide, Positive = decreased carbon dioxide.

1.1.2 The inclusion investment strategy

The inclusion investment strategy is suggested to hold real mitigation potential, in that it supports risker ventures, aimed at directly mitigating climate change (e.g., investing in companies developing green innovations; [Sandberg, 2008]), but paradoxically the inclusion strategy is employed to a much smaller extent than the exclusion strategy (1–5% of all sustainable investments; [GSIA, 2022]). In particular, evidence indicates that new and small ventures are to a larger extent affected by capital allocation from investors (for a review, see Kölbel et al., 2020). Inclusion investing is compatible with a consequentialist moral perspective, focusing on the outcome and not the action itself (Sandberg and Nilsson, 2015). The inclusion strategy strives for environmental impact by supporting ventures, for example, the development of new environmentally friendly technology, with the potential of directly mitigating climate change (Sandberg and Nilsson, 2015). However, this may be perceived as a much more distant long-term goal, whereas avoiding personal harm (i.e., exclusion investment) is something the investor could experience direct positive affective experience from, "feel good when doing what they perceive is the right thing to do" (Braaten, 2014).

1.2 A novel investment paradigm

Economic games have long been utilized to study pro-social behavior and allow testing of causal relationships while still using real incentives (e.g., money; Thielmann et al., 2021). To understand the exclusion and inclusion investment strategies, an investment task was developed. This investment task allows us to experimentally explore how the use of the strategies can be altered by different interventions. Further, it allows us to test how individual differences are related to each strategy, as well as how individual differences impact the effect of intervention.

In the investment paradigm the strategies` monetary outcome (i.e., $ paid as bonus to participants), and environmental outcome (i.e., number of trees planted) are manipulated. To mimic real financial investments made, the participants' choices were made under risk and uncertainty, artificially created by including a digital die-throw determining what outcome their choice would lead to. In the current study, we assessed the use of three types of investments, the business-as-usual money maximization strategy, and the exclusion and inclusion strategies (see Table 1). The money maximization strategy was characterized by always having the highest average monetary payoff, but at a cost for the environment. The exclusion strategy was characterized by assuring that the investor would not personally harm the

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environment, whereas the inclusion strategy was characterized by having the highest expected positive impact on the environment but also a small probability that it would lead to personally harming the environment.

Like other economic games used when researching pro-social decision-making (e.g., dictator game or ultimatum game), this investment paradigm was designed to simplify the trade-offs between maximizing the monetary payoff, not letting your money be used for harm and wanting to maximize climate change mitigation (Pisor et al., 2020). Specifically, the paradigm creates two distinct trade-offs: the first is between financial gain and environmental impact, while the second concerns how participants choose to engage in environmentally friendly actions, whether through inclusion or exclusion strategies.

This investment paradigm allows for studying investment decisions in a controlled environment. Particularly, it ensures a clear understanding of real-world impact by informing all participants about three investment strategies and explicitly detailing their financial and environmental outcomes. In addition, the paradigm makes it possible to explore how individual differences in moral intuitions and reasoning are related to strategy preferences. In the present work, we focus on moral constructs as well as nudge interventions in the form of informed defaults.

1.3 Overview

In the current study, we were interested in seeing if we could alter the relative use of the three investment strategies, between conditions within the investment paradigm. Thus, in consequence, we tested if the investment paradigm is sensitive to interventions and can be used experimentally to develop interventions to increase sustainable investing. Our primary objective was to develop and explore the investment paradigm for use in future intervention experiments.

In a pilot study, we used a factorial design to explore the effect of activating and reflecting on personal values using a value-centered task, and the effect of three levels of default architecture (no default, exclusion strategy default, and inclusion strategy default). In five consecutive rounds, participants chose to invest using one of the three investment strategies. We aimed to answer if a value-centered task and defaults as singular interventions and/or in combination could; (1) reduce the use of the money maximization strategy; (2) increase the use of the proposed more impactful pro-environmental investment strategy (i.e., the inclusion strategy).

The results from the pilot study were limited by the inclusion and exclusion strategy characteristics, in that they were different both regarding monetary and environmental outcomes which limits our findings to sustainable investment funds with these characteristics (i.e., exclusion leading to higher monetary profit than inclusion). An additional limitation was the imbalance between the monetary incentive and the hypothetical environmental incentive. Due to the experimental issues, we focus on the main study below. However, a complete method and results for the pilot study can be found in Supplementary 6.

Before the main study, we adapted the investment paradigm over three additional pilot studies (N_{total} = 299; for details about the pilots see Supplementary 7). The experiment employed a between-subject design to explore four levels of default architectures (no default, exclusion default, inclusion default, or money maximization default). This design gave us the possibility to assess what investment strategies participants prefer within the paradigm without intervention, and whether these patterns are sensitive to simple interventions, such as a default architecture. The results show that there was no clear preference for any strategy when presented without intervention (i.e., no default). In addition, we find that simple interventions (i.e., default) alter the investment preferences within the novel paradigm in expected ways. Lastly, preliminary evidence indicates that moral constructs are relevant to participants' choices in the investment paradigm. In particular, the inclusion strategy seems to be predicted by utilitarianism, whereas exclusion is more closely related to the self-importance of moral identity.

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2. Method

2.1 Participants

A priori power analysis was conducted using G*Power, to reach an acceptable power of (0.8) for our main analysis, correcting for multiple comparisons, we needed to collect 1492 participants.

The participants were recruited online (Prolific) from an American sample and responded through an online survey tool (Qualtrics). All data were collected during a single session (4–13th December 2023). To be included in the study, participants had to be at least 18 years of age and have an approval rate of 95% on the platform, participants from the pilot studies were excluded from the potential subject pool. Participants received monetary compensation for their participation. Informed consent was collected from all participants.

Data from a total of 1501 participants completed the full experiment. Due to exclusions (failing at least one attention check of the two included [$N = 79$]), the sample used in the analyses consisted of 1422 participants (94.74% of the recruited sample).

2.2 Procedure and materials

All participants first received a demonstration of the investment task (for the complete survey see Open Science Framework). Following this they were informed about the three different investment strategies (i.e., money maximization, exclusion, and inclusion) and the strategies' relative impact on the environment (See Figures 1 and 2). The participants received the following information about the three investment strategies: *Money maximization* - "For those seeking to maximize their profit, regardless of its impact on the environment"; *Exclusion* - "For those aiming to profit while not personally causing harm to the environment by reducing the number of trees planted"; *Inclusion* - "For those aiming to profit while having a chance to significantly help the environment by increasing the number of trees planted". Each participant was next randomized to one of four conditions: (1) Control; (2) Money maximization default; (3) Exclusion default; and (4) Inclusion default.

2.2.1. Investment task

The investment task consisted of ten consecutive rounds where participants, in each round, chose to invest using one of the three investment strategies. The outcome of the investment task was measured with two currencies, one monetary and one environmental. Both the monetary and environmental outcomes were incentivized. To introduce real risk and uncertainty to the investment task we used a six-sided digital die element. For each consecutive choice participants made they were presented with the three investment strategies and six outcomes for each strategy. Thus, the actual outcome was determined both by their choice, but also by the digital die-throw made after each investment choice.

The monetary outcome consisted of a bonus that was paid to a subset of the participants. To make the environmental outcome incentivized the participant's investment choices impacted how many trees were going to be planted by a charity organization (Vi-skogen), the environmental outcome was set in reforestation (increasing the number of trees that were going to be planted) vs deforestation (decreasing the number of threes that were going to be planted) context. *Vi-Skogen* works with replanting forests in areas of Kenya, Uganda och Tanzania that have been deforested. The expected monetary and environmental outcome was only paid to a subset of participants, to allow for a higher possible bonus (Gutsche, Wetzel, and Ziegler, 2023; Heeb et al., 2023).

The descriptive financial information associated with each investment strategy varied over the ten rounds, but the internal relationship between the strategies was kept constant (See Figure 2 and Table 2). The money maximization strategy always represented the highest average monetary profit but constantly led to harming the environment (fewer trees planted). The exclusion strategy was characterized by between 0 to 1 additional tree being planted (i.e., inconsequential mitigation potential), whereas the environmental outcome of the inclusion strategy ranged from reducing the number of trees

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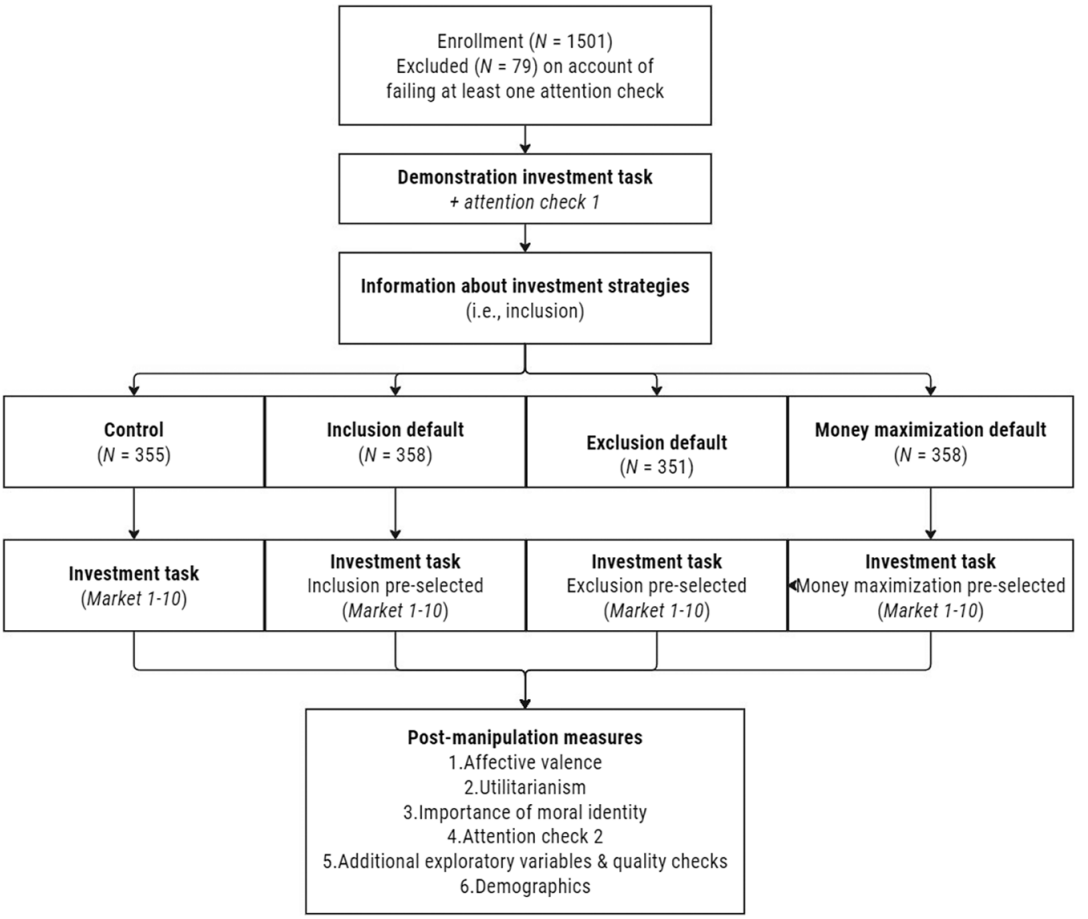

Figure 1. *Flowchart of the study procedure.*

Note: Overview of study procedures including interventions and measures.

planted by a few to increasing the trees planted to a high degree (i.e., representing higher risk but the potential of more impactful climate change mitigation). Both the exclusion and inclusion strategies had an average monetary profit that was around 60% of the average monetary profit outcome of the money maximization strategy. The ten rounds were always presented in the numerical order seen in Table 2; the order was kept constant across all four conditions. In summary, the monetary outcome created a trade-off between personal gain and environmental, whereas the environmental outcome created a trade-off between environmental help speaking to deontological vs. consequentialist moral reasoning.

To check the quality of the investment task, we asked participants if it was realistic and if their behavior in the task represented their real investment behavior. In addition, we wanted to understand how they perceived the environmental impact of each strategy post-manipulation if participants understood the trade-off between monetary and environmental effects pertaining to each investment strategy. The responses to these items indicated that most participants understood the key attributes associated with the strategies (for details see Supplementary 1).

2.2.2. Default architecture

For participants in a default condition either the money maximization, exclusion, or inclusion option was preselected, and they were told to actively select another option if they preferred. The participants received the following information: *Money maximization default* - "As a default, we have pre-selected

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Money maximization		
For those seeking to maximize their profit, regardless of its impact on the environment		
If the die rolls a...	*You lose/gain in $*	*You lose/gain in trees*
1	-1	-1
2	4	-1
3	4	-1
4	4	-1
5	4	-1
6	4	-1

Reject forest depletion		
For those aiming to profit while not personally causing harm to the environment by reducing the number of trees planted		
If the die rolls a...	*You lose/gain in $*	*You lose/gain in trees*
1	-1	0
2	2.5	0
3	2.5	0
4	2.5	0
5	2.5	0
6	2.5	1

Support reforestation		
For those aiming to profit while having a chance to significantly help the environment by increasing the number of trees planted		
If the die rolls a...	*You lose/gain in $*	*You lose/gain in trees*
1	-1	-1
2	2.5	-1
3	2.5	-1
4	2.5	0
5	2.5	0
6	2.5	6

Figure 2. *Descriptive financial information presented in the investment task as presented to the participants.*

Note: This descriptive financial information was presented to participants in the investment task. The picture displays the financial information in round 1. "Reject forest depletion" = Exclusion strategy and "Support reforestation" = Inclusion strategy.

to invest your money using the money maximization option, as this investment option will maximize your profits"; *Exclusion default* - "As a default, we have pre-selected to invest your money sustainably using the Reject Forest depletion option, as this investment option guarantees that you will not personally harm the environment by reducing the number of trees planted"; *Inclusion default* - "As a default, we have pre-selected to invest your money sustainably using the Support reforestation option, as this investment option has the greatest chance to significantly help the environment by increasing the number of trees planted".

2.3 Dependent variable

The dependent variable was derived from the investment strategy used by the participants in the ten rounds of the investment task. Thus, the dependent variable represents the average number of times (0–10) the participants choose to use either the money maximization, exclusion, or inclusion investment strategy.

2.3.1 Post-manipulation measures

After completing the investment task, participants in all conditions answered some demographic questions (gender, age, yearly income, investment experience, political affiliation), and rated their affective valence, utilitarianism (Kahane et al., 2018), the importance of moral identity (Aquino and Reed, 2002), and the importance of morality when making financial decisions. The affective valence was measured on a scale from 0 (unpleasant) to 100 (pleasant), and participants answered the question "How do you feel right now?". Utilitarianism was measured as an average of two items (r = 0.434) from the Oxford utilitarianism scale: (1) "It is just as wrong to fail to help someone as it is to actively harm them yourself."; (2) "It is morally wrong to keep money that one does not really need if one can donate it to causes that provide effective help to those who will benefit a great deal" (Kahane et al., 2018), where participants responded on a Likert scale ranging from 1 (Strongly disagree) to 7 (Strongly agree). The self-importance of a moral identity was measured with four items (one example below) ranging from 1 (Strongly disagree) to 7 (Strongly agree): "It would make me feel good to be a person who has these characteristics. . . *Caring, Compassionate, Fair, Friendly, Generous, Helpful, Hardworking, Honest, Kind*" (Aquino and Reed, 2002).

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Table 2. *Monetary and environmental outcomes split per round in the investment task and investment strategy.*

		Money max		Exclusion		Inclusion	
		Money	Trees	Money	Trees	Money	Trees
Round	**Die roll**						
1	1	−1	−1	−1	0	−1	−1
	2	4	−1	2.5	0	2.5	−1
	3	4	−1	2.5	0	2.5	−1
	4	4	−1	2.5	0	2.5	0
	5	4	−1	2.5	0	2.5	0
	6	4	−1	2.5	1	2.5	6
Expected		3.2	−1.0	1.9	0.2	1.9	0.5
2	1	−2	−2	−2	0	−2	−2
	2	6.5	−2	4	0	4	−2
	3	6.5	−2	4	0	4	−2
	4	6.5	−2	4	0	4	0
	5	6.5	−2	4	0	4	0
	6	6.5	−2	4	2	4	11
Expected		5.1	−2.0	3.0	0.3	3.0	0.8
3	1	−3	−3	−3	0	−3	−3
	2	8.5	−3	5.5	0	5.5	−3
	3	8.5	−3	5.5	0	5.5	−3
	4	8.5	−3	5.5	0	5.5	0
	5	8.5	−3	5.5	0	5.5	0
	6	8.5	−3	5.5	3	5.5	15
Expected		6.6	−3.0	4.1	0.5	4.1	1.0
4	1	−4	−4	−4	0	−4	−4
	2	11.5	−4	7	0	7	−4
	3	11.5	−4	7	0	7	−4
	4	11.5	−4	7	0	7	0
	5	11.5	−4	7	0	7	0
	6	11.5	−4	7	4	7	21
Expected		8.9	−4.0	5.2	0.7	5.2	1.5
5	1	−5	−5	−5	0	−5	−5
	2	14.5	−5	9.5	0	9.5	−5
	3	14.5	−5	9.5	0	9.5	−5
	4	14.5	−5	9.5	0	9.5	0
	5	14.5	−5	9.5	0	9.5	0
	6	14.5	−5	9.5	5	9.5	25
Expected		11.3	−5.0	7.1	0.8	7.1	1.7

(Continued)

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Table 2. *(Continued).*

		Money max		Exclusion		Inclusion	
		Money	Trees	Money	Trees	Money	Trees
6	1	−1	−1	−1	0	−1	−1
	2	−1	−1	−1	0	−1	−1
	3	5	−1	3	0	3	−1
	4	5	−1	3	0	3	0
	5	5	−1	3	0	3	0
	6	5	−1	3	2	3	7
Expected		3.0	−1.0	1.7	0.3	1.7	0.7
7	1	−2	−2	−2	0	−2	−2
	2	−2	−2	−2	0	−2	−2
	3	8	−2	5	0	5	−2
	4	8	−2	5	0	5	0
	5	8	−2	5	0	5	0
	6	8	−2	5	2	5	11
Expected		4.7	−2.0	2.7	0.3	2.7	0.8
8	1	−3	−3	−3	0	−3	−3
	2	−3	−3	−3	0	−3	−3
	3	11	−3	7	0	7	−3
	4	11	−3	7	0	7	0
	5	11	−3	7	0	7	0
	6	11	−3	7	4	7	16
Expected		6.3	−3.0	3.7	0.7	3.7	1.2
9	1	−4	−4	−4	0	−4	−4
	2	−4	−4	−4	0	−4	−4
	3	14.5	−4	9.5	0	9.5	−4
	4	14.5	−4	9.5	0	9.5	0
	5	14.5	−4	9.5	0	9.5	0
	6	14.5	−4	9.5	4	9.5	20
Expected		8.3	−4.0	5.0	0.7	5.0	1.3
10	1	−5	−5	−5	0	−5	−5
	2	−5	−5	−5	0	−5	−5
	3	18.5	−5	12.5	0	12.5	–5
	4	18.5	−5	12.5	0	12.5	0
	5	18.5	−5	12.5	0	12.5	0
	6	18.5	−5	12.5	5	12.5	25
Expected		10.7	−5.0	6.7	0.8	6.7	1.7

Note: Each round had six possible separate monetary and environmental outcomes. The values above are the average of the outcome of each round.

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Further, the participants also answered some questions regarding norms, and several items on metacognitive perceptions of defaults. For the current research, the dependent variables are of main interest, thus, we do not report analyses on all the measures listed. For exact items see OSF.

3. Results

Of the 14220 (1422 × 10 choices) investment decisions made in the experiment, the money maximization strategy was used in 35.51% of the cases, exclusion was used in 36.54%, and the inclusion investment strategy was used in 33.26% of the cases. To further corroborate this pattern of even distribution, we did a within-subject ANOVA for the participants in the control condition, the results reveal no significant difference between the mean use of the strategies in the control condition, $F(2,353) = 1.803$, $p = .166$.

Further, the results show that only a small subset of participants consistently applied the same investment strategy throughout the investment task. Looking at how many percent of participants applied only one strategy, we find that 12.59% of participants consistently applied money maximization, 6.89% applied only exclusion, and 7.03% only applied inclusion. When considering the participants who consistently only used one strategy, they were more likely to use the money maximization strategy compared to both the exclusion strategy ($p < .001$), and inclusion strategy ($p < .001$), the other two strategies did not differ. Further, when looking at the percentages of participants that used one strategy more than half of the time (6–10 times), an interesting pattern emerged, where the exclusion strategy is applied as the favorite strategy to a higher degree than the other two strategies; 25.53% of participants used the money maximization strategy, 31.15% used the exclusion strategy and 22.86% used the inclusion strategy 6–10 times. When using chi-square tests, we find that the exclusion strategy is applied more like a favorite strategy than the money maximization ($p = .001$), and the inclusion strategy ($p < .001$). The two other strategies did not significantly differ from each other ($p = .105$).

3.1. Default effects

Our descriptive results indicate that each default condition slightly increased the use of the corresponding strategy, pointing in the direction of an expected classic default effect. When comparing the use of each investment strategy, we only find an inclusion default effect (see Table 3, and Figure 3). However, all three-default effects have similar effect sizes and p-values approaching significance.[2,3,4]

To assess each default effect, we completed pairwise comparisons between the control condition and each default condition. Using these comparisons, we find that the inclusion default significantly increased the use of the inclusion strategy within the investment paradigm. However, we find no significant effect of the exclusion default on the use of the exclusion strategy. Lastly, we find that the money maximization default increased the use of the money maximization strategy when looking at a one-sided t-test, however, it only approached significance when looking at the two-sided t-test.

Moving to some secondary comparisons, we see that exclusion and money maximization defaults significantly decreased the use of the inclusion strategy. In addition, a one-sided t-test indicates that the inclusion default decreased the use of the exclusion strategy, albeit only approaching significance when looking at the two-sided comparisons.

[2]We completed the same primary pairwise comparison to check only the first three rounds, to see if the small effects might be due to habituation. The analysis shows that both the exclusion and the money maximization default were effective in the first three rounds of the investment task, but not the inclusion default (see Supplementary 3).

[3]We also completed an analysis to see if political affiliation impacted the default effects (see Supplementary 4).

[4]We completed alternative analysis using Multinomial Mixed Model Analysis (see Supplementary 5).

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Table 3. *T-test one (two-sided) comparison for the use of each strategy compared with the control.*

Comparison	Investment strategy	MD	t	df	P	d
Primary						
Control vs inclusion default	Inclusion	0.47	1.97	711[c]	.025 (.050*)	0.15
Control vs exclusion default	Exclusion	0.41	1.60	704	.055 (.111)	0.12
Control vs money maximization default	Money maximization	0.53	1.95	711[c]	.026 (.052)	0.15
Secondary						
Control vs exclusion default	Inclusion	0.46	−2.04	704	.021 (.042)	−0.15
Control vs money maximization default	Inclusion	0.58	−2.51	711	.006 (.012)	−0.19
Control vs inclusion default	Exclusion	0.48	−1.96	711	.025 (.051)	−0.15
Control vs money maximization default	Exclusion	0.05	0.19	711	.422 (.843)	0.02
Control vs inclusion default	Money maximization	0.01	0.3	711	.488 (.975)	<.01
Control vs exclusion default	Money maximization	0.05	0.21	704	.417 (.834)	0.02

Note: Pairwise comparison (t-test) for each investment strategy between control and each default manipulation. *p*-values for one-sided comparison are presented first followed by two-sided comparations in parentheses. Superscript [c] = corrected for violated assumption of equal variance.

3.2 Individual differences

To explore the investment paradigm further, we completed correlation analyses between the use of the three strategies and variables representing individual differences (see Table 4). We report correlations from both the main experiment and from the pilot study (see Supplementary 2).

As suggested in the introduction, theoretically we argue that the inclusion and exclusion strategy is based on different types of moral reasoning. To do preliminary tests of this, we compared the strength of the relationship between strategies, utilitarianism and self-importance of moral identity, using the approach suggested by Lee and Preacher (2013), whose purpose is to test if two dependent correlations (e.g., correlations with one overlapping variable) differ in size.[5] For all correlations see Table 4.

If people who preferred the inclusion strategy were more utilitarian, we would expect utilitarianism to correlate to a higher degree with the use of the inclusion strategy than with the use of the exclusion strategy. Furthermore, we would also expect that the use of inclusion would correlate with utilitarianism to a higher degree than moral identity. When comparing the correlation, we found that participants' level of utilitarianism predicted choosing the inclusion strategy better than it predicted choosing the exclusion strategy ($r = 0.231$ vs $r = 0.051$; $z = 4.34$, $p < .001$[< .001]).[6,7] The findings also revealed

[5]Lee and Preacher (2013) software first converted each coefficient into a *z*-score using Fisher's *r*-to-*z* transformation. Second, they calculate the asymptotic covariance that is subsequently used in an asymptotic z-test. Software available at: https://www.quantpsy.org/corrtest/corrtest2.htm.

[6]*p* = One-tailed [two-tailed]

[7]Although the sizes of the correlation coefficients were not significantly different ($r = .193$ vs $r = .149$; $z = 1.19$, $p = .116$[.232]).), the same pattern was found in the pilot study (see Supplementary 2).

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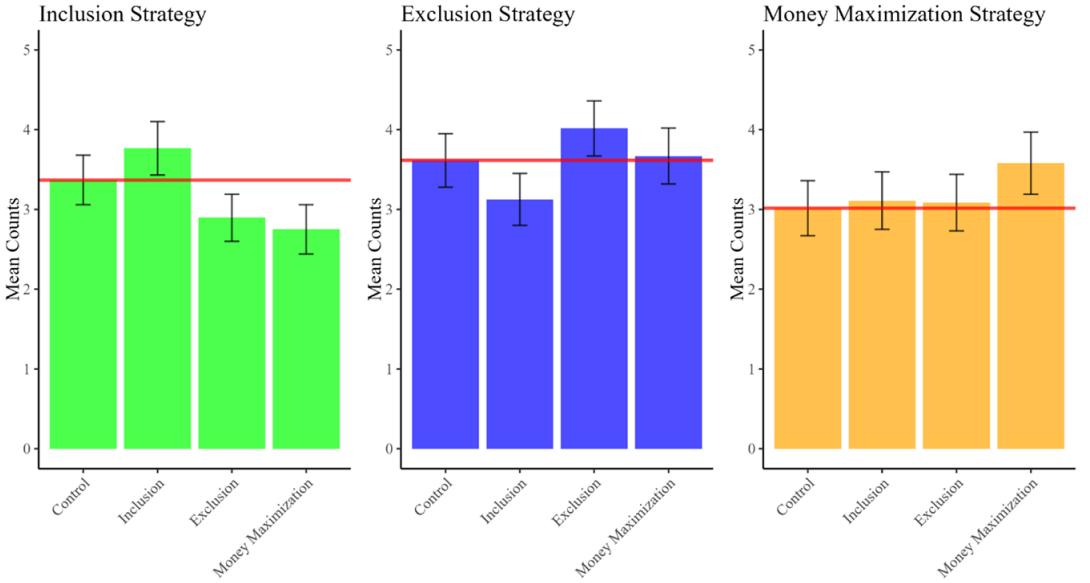

Figure 3. *Mean number of times participants used each investment strategy split per condition.*

Note: The mean number of times (0–10) the participants used each investment strategy in all ten rounds. All participants who were used in the analysis were included ($N = 1422$). Error bars represent the 95% confidence intervals of the mean. The red line represents the control mean for each investment strategy, elongated for easier comparison. Conditions: Control, Inclusion = Inclusion Default, Exclusion = Exclusion Default, Money Maximization = Money Maximization Default.

that the inclusion strategy had a stronger correlation with utilitarianism than with moral identity ($r = 0.231$ vs $r = 0.085$; $z = 4.75$, $p < 0.001$[< .001]).[8]

If people who preferred the exclusion strategy showed more concern for moral identity, we would expect to find that moral identity would have a stronger correlation with the use of the exclusion strategy than with the use of the inclusion strategy. In addition, we would expect that the use of exclusion would correlate more strongly with moral identity than with utilitarianism. When comparing the correlations between moral identity and the two pro-environmental strategies the pattern was as expected, but we failed to find a significant difference ($r = 0.142$ vs $r = 0.085$; $z = 1.36$, $p = .087$[.174]).[9] Still, the findings revealed that the exclusion strategy had a stronger correlation with moral identity than utilitarianism ($r = 0.051$ vs $r = .142$; $z = 2.74$, $p = .003$[.006]).[10]

Lastly, we aimed to determine whether the negative relationship between money maximization and the two moral constructs could better predict participants' investment patterns. When comparing the strength of the relationship between utilitarianism and the use of the money maximization strategy to its relationship with the inclusion strategy, we found no significant difference ($r = -0.226$ vs. $r = 0.231$; $z = -0.12$, $p = .425$). However, when comparing the relationship between moral identity and money maximization to its relationship with the exclusion strategy, we observed that the correlation with money maximization was stronger ($r = -0.244$ vs. $r = 0.142$; $z = 4.27$, $p < .001$). This indicates

[8]The same pattern was found in the pilot study, and there the size of the correlation coefficient was significantly different ($r = .193$ vs $r = .020$; $z = 5.68$, $p < .001$[< .001]) (see Supplementary 2).

[9]The same pattern was found in the pilot study, and there the size of the correlation coefficient was significantly different ($r = .168$ vs $r = .020$; $z = 3.96$, $p < .001$[< .001]) (see Supplementary 2).

[10]Although the sizes of the correlation coefficients were not significantly different ($r = .149$ vs $r = .168$; $z = -0.63$, $p = .265$ [.531]), the same pattern was found in the pilot study (see Supplementary 2).

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Table 4. *Spearman correlations between the use of investment strategies, utilitarianism, moral identity, positive mood, age, and gender.*

Experiment 2	Money maximization	Exclusion	Inclusion	Utilitarianism	Moral identity	Positive mood afterward	Age	Female gender
Money maximization	-	−.575***	−.463***	−.226***	−.244***	−.058*	−0.082**	−.124***
Exclusion		-	−.272***	.051	.142***	−.021	0.041	.101***
Inclusion			-	.231***	.085***	.098***	0.042	.046
Utilitarianism				-	.202***	.124***	0.048	.074**
Moral identity					-	.178***	0.085**	.172***
Affective valence						-	0.182***	−.045
Age							-	−.069*

Note: The main study described above, $N = 1422$ (1399, Gender/). * = 0.05, ** <.01, *** <.001.

that a lower concern for moral identity is a stronger predictor of more selfish investment behavior compared to the relationship between moral identity and the use of the exclusion strategy.

4. Discussion

The investment of financial assets can either help reduce or further increase the negative consequences of climate change, therefore changing investment decisions to be more environmentally impactful could help mitigate climate change (IPCC, 2022). Our experiment suggests that the use of the inclusion investment strategy, a strategy that arguably has high climate change mitigation potential, can be increased by using a default choice architecture. Furthermore, the individual level of utilitarianism seems to be related to the use of the inclusion strategy, conversely, moral identity is a better predictor of the exclusion strategy.

The positive but small effect of the inclusion default found suggests that a simple manipulation, including short information highlighting how you can invest in an environmentally impactful way, and then subsequently pre-selecting that strategy in a default architecture, can increase the number of times people want to invest using the inclusion strategy. This effect is in line with previous results showing a positive default effect in the pro-environmental domain outside of financial investments (Sunstein and Reisch, 2021; for a review on pro-environmental nudging see Byerly et al., 2018). This could help increase the use of the inclusion investment strategy from the low level seen currently (1–5%) in the global financial markets (GSIA, 2022). This finding helps us move forward toward not only a global financial market that considers sustainability but that particularly considers potential climate change mitigation. Future research should explore under what conditions concerning gains, losses, mitigation potential, harm, and risk, this inclusion investment default intervention is effective. For example, a future study could include baseline conditions where all investment strategies had the same probability distributions and expected values or test a separate evaluation structure.

A limitation of the study, motivating future research is the higher risk associated with the inclusion strategy compared to the exclusion strategy. Consequently, more risk-averse individuals might have used the inclusion strategy less frequently. However, evidence indicates that newer and smaller companies are affected by capital allocation from investors to a larger extent (for a review, see Kölbel et al., 2020). Therefore, ventures with a direct positive impact but a riskier profile (i.e. newer and/or smaller) have the greatest potential to lead to mitigation, albeit with higher associated risks. The inclusion strategy used in the current study was modeled with this in mind.

Related to each strategy's characteristics, we proposed that the strategies examined in our investment paradigm correspond to three distinct moral motives. The inclusion strategy aligned with a consequentialist morality, prioritizing overall positive outcomes. In contrast, the exclusion strategy is rooted in deontological morality, emphasizing adherence to moral principles, such as avoiding harm (Sandberg and Nilsson, 2015). In partial support of these theoretical underpinnings, utilitarianism

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was more strongly related to the inclusion strategy than to the exclusion strategy. Furthermore, the inclusion strategy was more closely related to utilitarianism than moral identity, whereas the exclusion strategy was more strongly associated with moral identity than utilitarianism. These results should be considered preliminary evidence that different types of moral constructs can predict the use of specific pro-environmental investment strategies. A clear limitation of these findings, however, is the measurement methods used. It is possible that the specific two items from the Oxford utilitarianism scale and the four from the Self-importance of Moral Identity Scale, rather than the underlying moral constructs, drive these relationships (Aquino and Reed, 2002; Kahane et al., 2018). In the present study, utilitarianism was represented by the beliefs that failing to help is as wrong as causing direct harm, and that it is morally wrong to keep unnecessary money when it could be donated to those in greater need. The self-importance of moral identity was represented by the value put on possessing certain moral traits, feeling good about having them and desiring them as a key part of one's self-concept. Future research should aim to use the full scale for measuring moral reasoning, further potentially splitting utilitarianism into instrumental harm, measured with sacrificial dilemmas, and impartial beneficence, aiming to capture tendencies to maximize well-being for all (Everett and Kahane, 2020). This would enable clearer predictions about what specific moral constructs underpin the use of each strategy.

Why do we find these individual differences? We suggest that beyond the deontological vs consequentialist distinction, strategy preferences are likely related to differences between perspective/prospective morality, risk tolerance (passive/active risk taking), and behavioral patterns (avoidance/approach). Prescriptive morality is approach-driven, suggesting a preference for acting morally, or – "what we should do" (Janoff-Bulman and Carnes, 2013; Sonnentag et al., 2023). Therefore, prescriptive morality is associated with behavioral preference for action. This preference for doing what one *should do* indeed increases the attractiveness of applying inclusion investment. Future research should test how intervention focused on increasing actionability (i.e., relevance, feasibility, and motivational impact of behavioral recommendations) could utilize this action preference or potentially leverage an action bias (Albarracín et al., 2018; Sunderrajan and Albarracín, 2021).

Conversely, proscriptive morality is avoidance-driven, with a preference for inhibiting immoral acts, or – avoiding "what we should not do" (Janoff-Bulman and Carnes, 2013; Sonnentag et al., 2023). This avoidance of *what we should not* do indeed seems conceptually closer to excluding companies that cause direct environmental harm from investment portfolios. This type of inaction goal has been shown to be perceived as less positive, and less intentional, but also less effortful (Albarracín et al., 2008; Ireland et al., 2015; Sunderrajan and Albarracín, 2021). However, is this perception of inaction the same for moral judgments? Meta-analytic evidence suggests that moral judgments are subject to an omission bias (Yeung et al., 2022). Omission bias is the inclination to not act when there is a risk of causing harm, although the overall outcome would be more positive if acting (Baron and Ritov, 2009). Thus, in a sense, people might be applying a "do no harm" heuristic (Baron, 2012). Baron (1995) found that although participants logically had deemed the overall consequences of an action to be more positive, they were reluctant to do it if it entailed causing any harm, even if the overall benefit would be greater. This type of avoidance of harm has been repeatedly found concerning moral dilemmas (Feldman et al., 2020). Thus, the risk of harm associated with the inclusion strategy makes it a less viable option for individuals with these preferences. This idea also theoretically relates to the concepts of passive (i.e., "foregoing an opportunity to act") and active (i.e., impulsively act) risk takers (Keinan and Bereby-Meyer, 2012). Passive risk-taking has been linked to behaviors such as procrastination and avoidance. Extending these findings, one could argue that individuals who, when faced with a trade-off between money and the environment, select the latter, might be individuals who prefer to handle problems (i.e., climate change) through procrastination.

Building on dual-process theories, different moral reasoning types have been proposed to vary between deliberative and intuitive processes. Consequentialism has often been linked to cold, deliberative reasoning, while deontology has been associated with intuitive judgments (Greene et al., 2008; Guzmán et al., 2022; Persson and Tinghög, 2023). However, evidence also suggests that consequentialist moral reasoning can occur intuitively (Białek and Neys, 2017). Moreover, Baron

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(2011, 2021) challenges the strict association of utilitarianism with emotional coldness, arguing that utilitarian judgments can be emotionally driven, while non-utilitarian decisions, often guided by biases like omission bias, may still involve deliberative processes. Beyond the individual differences in the moral constructs and behavioral tendencies noted above, future research could use this experimental investment task to see how the three strategies are related to other variables, such as specific pro-environmental behaviors, or using the carbon emission task (Berger and Wyss, 2021) or the Recurring Pro-environmental Behavior Scale (Brick et al., 2017).

The central contribution of the current research is the development of an experimental investment paradigm. This investment paradigm will allow researchers to learn what predictors are related to specific investment patterns, and how these predictors can be used to develop interventions to alter problematic investment patterns (i.e., negative mitigation potential). Further research could also manipulate private vs. public, intuitive vs. deliberative, or self vs. other, within the paradigm to explore how investment patterns are altered. While our current experiment showed a relatively even distribution among the three strategies, this is not reflective of the real global financial markets (GSIA, 2022). The even distribution between strategies is advantageous for future research, as it leaves room to manipulate the use of all three strategies in both directions. However, our findings still reveal that the exclusion strategy is used as more of a favorite strategy than the other two strategies. When considering the potential real-world impact of sustainable investments and to what extent the exclusion- and inclusion investment strategies are employed, a paradoxical picture emerges, in which the less impactful strategy is used to a much larger extent than the strategy with higher mitigation potential (GSIA, 2022). This inverse relationship between the proportion of use and climate change mitigation motivates the need for research altering these investment patterns.

Throughout this paper, we have argued that the current global pattern of sustainable investments is not only inadequate but also paradoxical, as the exclusion strategy, with limited mitigation potential, is strongly preferred over the inclusion strategy, which has a higher potential to help mitigate climate change (Sandberg, 2008). However, quantifying the real-world impact of these strategies, such as their contribution to reducing/increasing greenhouse gas emissions, is still accompanied by uncertainty. The assessment of tangible effects associated with different investment strategies is complex, and empirical evidence for various impact metrics is scarce. Investors often bear the responsibility for evaluating real-world impact, and existing tools face limitations. Popescu et al. (2021) evaluated 37 impact tools, concluding that there is currently no state-of-the-art tool for a comprehensive assessment, particularly noting a lack of a life-cycle perspective. While recent attempts have explored machine learning to enhance metrics, the field is still evolving (Kumar et al., 2022). Hellweg et al. (2023) suggest a way to quantify life-cycle sustainable finance metrics but acknowledge limitations put on these metrics due to low data availability from companies. At its core, our investment paradigm simplifies the trade-off between profit, avoiding personal harm, and maximizing impact. While this helps experimentally explore interventions, it does not comprehensively reflect the current state of investment strategies used in today's global financial markets.

5. Conclusions

In this study, we introduced a new experimental investment paradigm to compare the use of different investment strategies based on both monetary profit and climate change mitigation potential. We examined three strategies – maximizing profits, exclusion, and inclusion – and studied how default settings can alter the use of the three strategies within the paradigm. We obtained evidence validating the hypothesis that providing participants with information about the monetary profits and climate change mitigation potential associated with each strategy and setting the inclusion strategy as the default, resulted in an increased adoption of the inclusion strategy. Future research should develop stronger interventions aimed at increasing sustainable investments and shifting the paradoxical investment patterns seen between inclusion and exclusion, potentially leveraging individual differences in moral reasoning.

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Data availability statement. Registration: The study was preregistered; the registration can be found at Pilot study 1, https://osf.io/84uj3; Main experiment, https://osf.io/nsxgp

The data that support the findings of this study are openly available at: https://osf.io/3p69w/

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