

Investing into climate change mitigation despite the risk of failure

Supplementary Material

Mike Farjam^{a,b,*}, Olexandr Nikolaychuk^c, Giangiacomo Bravo^{a,b}

^a*Department of Social Studies, Linnaeus University, Växjö, Sweden*

^b*Linnaeus University Centre for Data Intensive Sciences & Applications (DISA@LNU), Växjö, Sweden*

^c*Faculty of Economics and Business Administration, Friedrich Schiller University, Jena, Germany*

Notation

All text presented in the following sections is exactly how it was shown to the participants unless in square brackets [] or curly brackets { }.

The square brackets denote possible parameter values, one for each treatment condition. Only one such value was shown to the participants depending on the actual treatment they were in.

The curly brackets denote our comments aimed to assist the reader of the paper. Their content was not shown to the participants.

MTurk Recruitment Page

Please read this before clicking Accept!

This HIT^{Human Intelligence Task} is an academic experiment on decision making.

It will require you to interact with other workers in real time. Some other workers may have to wait for you to complete a given task before they can proceed so please be mindful of others and complete all tasks in a timely fashion. Conversely, you may have to wait for other workers before you can proceed so please be patient. In addition, most tasks have to be completed within a limited amount of time so please concentrate on the task at hand.

Reward and Bonus Payment Details

In addition to the reward^{1.3 USD}, there is a bonus payment associated with this HIT.

The HIT is comprised of an instruction page that further explains the details of the experiment, seven comprehension questions, the experiment itself, and a short questionnaire about your sociodemographic status.

To receive the reward, you must do both of the following:

- answer at least 3 out of 7 comprehension questions correctly (one attempt per question);
- wait for at least 10 minutes for other participants to join the experiment.

*Corresponding author: Department of Social Studies, Linnaeus University, 35195 Växjö, Sweden

Email addresses: mike.farjam@lnu.se (Mike Farjam), olexandr.nikolaychuk@uni-jena.de (Olexandr Nikolaychuk), giangiacomo.bravo@lnu.se (Giangiacomo Bravo)

That is, if you answer the required number of comprehension questions correctly but there isn't enough participants ready to join, you will be given an opportunity to submit the HIT and claim the reward.

If there is a sufficient number of participants ready to start the experiment before 10 minutes run out or if you decide to keep waiting, the actual experiment will begin eventually.

Your potential bonus payment is associated with what is going to happen in the experiment and is conditional on your own decisions, the decisions of other participants as well as random events under nobody's control.

The maximum bonus payment that can in principle be received is 4 USD and the minimum is 0 USD (that is, nothing). Your actual bonus payment is likely to be anything in-between these amounts, and will only be awarded if you finish the HIT completely (this includes filling out the questionnaire).

Please beware that if you answer the required number of comprehension questions correctly and start the actual experiment but leave it without finishing the HIT completely then you give up your right to receive both the bonus payment and reward.

HIT Duration

The duration of this HIT will depend on how quick you and other workers are at understanding the instructions and answering the comprehension questions as well as how quickly the actual experiment goes.

You will be allowed to take up to 15 minutes to read the instructions, up to 2 minutes to answer each comprehension question and then may have to wait up to 10 minutes for the actual experiment to start.

In our experience, the actual experiment usually takes less than 30 minutes.

Please only accept this HIT if you can commit to completing it and agree with all the conditions above.

Participant Instructions

Instructions

Please read these instructions carefully.

1. General Information

You can earn money in this experiment that will be later converted to your bonus payment for finishing the HIT. All transfers made during the course of the experiment will be denominated in ECU.

10 ECU corresponds to 1 USD

When you are done reading the instructions, click the button below. You will then have to answer a number of comprehension questions. Your answers will be checked by the computer.

2. Climate Change

Below, we will present a game that simulates climate change. The worldwide climate change is a real environmental problem faced by mankind. The majority of climate scientists expect that by the year 2100, the **average temperature** in the world is going to increase by **1.1–6.4 degrees Celsius**. It is also estimated that mankind significantly contributes to climate change by emitting greenhouse gases, carbon dioxide (CO₂) being

a major one. Among other things, CO₂ is produced when burning fossil fuels such as coal, oil and natural gas as part of industrial processes or energy production as well as when using internal combustion engines in automobiles. CO₂ is a global pollutant, that is, it has the same effect on the climate regardless of emission site.

3. Rules of the Game

Altogether, **6 players** participate in the game, that is, 5 other players besides you. The decision situation is the same for each player.

At the beginning of the experiment, an initial endowment (= **40 ECU**) will be credited to your personal account. Over the course of the experiment, you can choose whether or not to invest the money from your account. In the end, what remains in your account will be converted into your bonus payment.

The decisions you make are anonymous. You will be given a pseudonym for the whole duration of the game. These pseudonyms correspond to the names of moons in our Solar system (Ananke, Telesto, Despina, Japetus, Kallisto or Metis). Once the game starts, your name will be displayed on the screen.

Over the course of this experiment you will play exactly **ten climate rounds**. In these rounds, you can invest in an attempt to protect the climate and lower the probability of climate change. Among other things, dangerous climate change leads to serious economic losses, which is being simulated in this experiment.

In each climate round of the game, all six players will be asked **simultaneously**:

”How much would you like to invest into climate protection?”

The possible answers are 0, 2 or 4 ECU. As soon as every player has made their decision, all six decisions will be displayed simultaneously. After that, all the investments made will be credited to the climate protection account (“climate account”).

At the end of the game (that is, after exactly 10 rounds), the computer will compare the climate account to the predefined amount (= **120 ECU**). This amount must be collected in order to reduce the probability of a dangerous climate change. It would be reached if **each** player invested an **average of 2 ECU** in climate protection **every** round. In that case, there would be 12 ECU invested in the climate account every round.

In case the 120 ECU needed for the climate account is **collected**, each player will receive what remains in their private account (that is, the initial endowment of 40 ECU minus the amount invested by the player in the climate account) with a probability of [**100%**^{ $\pi = 0.0$ }; **90%**^{ $\pi = 0.1$ }; **80%**^{ $\pi = 0.2$ }; **70%**^{ $\pi = 0.3$ }; **60%**^{ $\pi = 0.4$ }] (that is, in [**10**^{ $\pi = 0.0$ }; **9**^{ $\pi = 0.1$ }; **8**^{ $\pi = 0.2$ }; **7**^{ $\pi = 0.3$ }; **6**^{ $\pi = 0.4$ }] out of 10 cases). With the remaining probability of [**0%**^{ $\pi = 0.0$ }; **10%**^{ $\pi = 0.1$ }; **20%**^{ $\pi = 0.2$ }; **30%**^{ $\pi = 0.3$ }; **40%**^{ $\pi = 0.4$ }], the players will lose the amounts in their private accounts.

In case the 120 ECU needed for the climate account is **not collected**, a dangerous climate change, followed by serious economic losses, will happen with a probability of **90%** (that is, in 9 out of 10 cases). With this probability, the players will lose the money remaining in their private accounts. With the remaining probability of **10%**, the players will keep what remains in their private accounts at the end of the game.

Based on the resulting probabilities, a random number generator will determine the final outcome of the game.

All payments will be made anonymously and your identity will be kept secret from the other players.

4. Example

Below, you can see an example of the decisions made by all 6 players in a given round (round 6). The panel on the right (“Investments: Round 6”) shows the investments made

in the current round. Players Ananke, Telesto and Despina invested nothing in the climate account whereas players Japetus, Kallisto and Metis each invested 4 ECU. In total, there was 12 ECU invested in round 6, which was then credited to the climate account.

Investments Rounds 1-6 Total		Investments Round 6	
Ananke	12	Ananke	0
Telesto	12	Telesto	0
Despina	14	Despina	0
Japetus	10	Japetus	4
Kallisto	12	Kallisto	4
Metis	8	Metis	4
Climate Account Total	68	Round 6 Group Total	12

The panel on the left ("Investments: Rounds 1-6 Total") shows the investments made by each player over six rounds. As you can see, players Ananke, Telesto and Kallisto invested 12 ECU in the climate account over six rounds each. Despina invested 14 ECU, Japetus invested 10 ECU and Metis invested 8 ECU over six rounds. As such, there was 68 ECU invested in the climate account over six rounds altogether. This exact information will be given to you after each climate round.

5. Use of Climate Account Funds

In case the 120 ECU needed to reduce the probability of a dangerous climate change is **collected**, we will spend **all** the money from your climate account on the United Nations projects to help offset CO₂ emissions. In case the 120 ECU needed to reduce the probability of a dangerous climate change is **not collected**, we will spend only **half** the money from your climate account to support such projects. The amount transferred by us to the United Nations will be used as a contribution for projects to **fight climate change**. In what follows, we will briefly explain how that works.

Within the framework of the United Nations, one can choose developmental projects at offset.climateneutralnow.org. Financing a project like that allows for buying energy efficient appliances for example. For every dollar donated, the website shows how many tonnes of CO₂ can be spared by realizing a given project. Currently, the most efficient project is estimated at 0.5 USD per tonne of CO₂. At the end of December, we will invest the climate account funds into the most efficient project to offset CO₂ emissions.

In summary, if the players invest, for example, 120 ECU (12 USD) in the climate account then approximately 24 tonnes of CO₂ will be neutralized (as of this writing). This corresponds to approximately 7 return flights from New York to Berlin worth of emissions per passenger.

If you wish, you can **leave your e-mail address** with us at the end of the experiment and we will send you a copy of the UN certificate for the use of the climate account funds.

Control Questions

{one by one; single attempt; no skipping allowed}

1. In order to reduce the probability of climate change, how much does each player have to invest in the climate account over 10 rounds in total?

- 12 ECU; • 20 ECU; • 40 ECU; • 120 ECU.
2. Suppose that the amount of 120 ECU necessary to reduce the probability of climate change has been collected and that you have invested 16 ECU over 10 rounds in total. How large is your final income in ECU?
- 24 ECU with certainty;
 - 24 ECU with a probability of 90% or 0 ECU with a probability of 10%;
 - 24 ECU with a probability of 80% or 0 ECU with a probability of 20%;
 - 24 ECU with a probability of 70% or 0 ECU with a probability of 30%;
 - 24 ECU with a probability of 60% or 0 ECU with a probability of 40%;
 - 24 ECU with a probability of 90% or 16 ECU with a probability of 10%;
 - 24 ECU with a probability of 80% or 16 ECU with a probability of 20%;
 - 24 ECU with a probability of 70% or 16 ECU with a probability of 30%;
 - 24 ECU with a probability of 60% or 16 ECU with a probability of 40%.
 - 16 ECU with certainty.
3. Over how many rounds can the players freely decide upon their investments in climate protection?
- 3 rounds; • 5 rounds; • 7 rounds; • 10 rounds.
4. Take a look at the numerical example below^{Table 1}. How large is the amount in Despinas private account after round 6?

Investments Rounds 1-6 Total			Investments Round 6	
Ananke	12		Ananke	0
Telesto	12		Telesto	0
Despina	14		Despina	0
Japetus	10		Japetus	4
Kallisto	12		Kallisto	4
Metis	8		Metis	4
Climate Account Total	68		Round 6 Group Total	12

Table 1: Numerical example used in questions 4–6.

- {any value between 0 and 100 in increments of 1}.
5. Take a look at the numerical example below^{Table 1}. How large is the amount in Metis' private account after round 6?
- {any value between 0 and 100 in increments of 1}.
6. Take a look at the numerical example below^{Table 1}. How much would the group as a whole have to invest in the climate account over the next 4 rounds in order to reduce the probability of climate change?

- 12 ECU; • 52 ECU; • 68 ECU; • 120 ECU.
7. Suppose that the amount of 120 ECU necessary to reduce the probability of climate change has not been collected. What is the probability of you losing the money remaining in your private account?
- 10%; • 30%; • 50%; • 70%; • 90%; • 100%.

Sociodemographic Questionnaire

1. How old are you?
 - {any value between 0 and 100 in increments of 1}.
2. What is your gender?
 - female; • male; • other.
3. What is your employment status?
 - employee; • self-employed; • student; • not working.
4. What is your highest degree attained to date?
 - primary education; • college degree;
 - high school; • graduate degree.
5. How much experience do you have with economic experiments?
 - it is my first time;
 - little experience (three times or less);
 - a lot of experience (four times or more).
6. In politics people commonly talk of 'left' and 'right'. Where would you place yourself on that scale?
 - left ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ right
7. Generally speaking, how concerned are you about environmental issues?
 - not at all concerned ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ very concerned

How much do you agree or disagree with each of the following statements?

8. We believe too often in science, and not enough in feelings and faith
 - agree strongly ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ disagree strongly
9. Overall, modern science does more harm than good
 - agree strongly ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ disagree strongly
10. We worry too much about the future of the environment and not enough about prices and jobs today
 - agree strongly ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ disagree strongly
11. People worry too much about human progress harming the environment

- agree strongly ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ disagree strongly

12. Please enter your email if you would like to receive an overview of projects supported with the help of this experiment

- {text entry field}.