The intrinsic drive for knowing boosts pro-environmental choices

Irene Cogliati Dezza

Center for Research in Cognition & Neurosciences, ULB Neuroscience Institute, Université Libre de Bruxelles, Avenue Franklin Roosevelt 50, Belgium

Abstract

The ongoing climate crisis demands massive changes in people's lifestyle. Behavioral economics has highlighted the use of extrinsic incentives (e.g., money) as a powerful tool for changing behavior. However, external incentives come with significant costs, making them feasible primarily for wealthier countries. Here, following recent insights from the field of curiosity and information-seeking, we explore whether internal incentives such as the intrinsic drive for knowing can motivate people to act more pro-environmentally. By developing a novel decision-making task, we showed that the drive for knowing predicts pro-environmental choices. Moreover, participants chose eco-friendly options more when their values were unknown compared to when they were known. Results from this study hold the potential to inform the development of future behavioral interventions, although a replication of its findings is still ongoing.

Keywords: decision-making; information-seeking; pro-environmental behaviors; lab-based behavioral paradigms.

Introduction

The climate crisis is an ongoing global issue that demands massive behavioral changes in people's lifestyles. However, changing behaviors such as integrating new ways of consuming, traveling, and moving around the city, can be challenging for many (ONS, 2023). Understanding how to facilitate such changes has become more critical than ever. Here, by developing a novel sequential decision-making task, we tested whether the intrinsic drive for knowing can motivate people to act more pro-environmentally.

For decades, behavioral economics has highlighted the use of extrinsic incentives (e.g., money) as a powerful tool for changing behavior (Vlaev, King, Darzi, & Dolan, 2019; Medvedev, Davenport, Talhelm, & Li, 2024). Such incentives have also been used to change behaviors in the context of climate actions. For example, a recent meta-analysis of 430 studies found that interventions leveraging financial incentives yielded the most effective outcomes (Bergquist, Thiel, Goldberg, & van der Linden, 2023). Similarly, when participants were exposed to repeated trade-offs between receiving financial bonuses and maintaining carbon neutrality, their choices were influenced by the magnitude of the incentives provided in each trial (Berger & Wyss, 2021).

However, external incentives come with significant costs, making them feasible primarily for wealthier countries. Given the global nature of the crisis, alternative approaches are needed. Recent insights from the fields of curiosity and information-seeking suggest that the desire to know is a powerful driver of human behavior (Gottlieb, Oudeyer, Lopes, & Baranes, 2013; Murayama, 2022; Sharot & Sunstein, 2020), often surpassing extrinsic incentives such as monetary rewards (Wilson, Geana, White, Ludvig, & Cohen, 2014; Cogliati Dezza, Yu, Cleeremans, & Alexander, 2017; Gershman, 2019). However, whether the intrinsic drive for knowing can motivate people to act more pro-environmentally remains unknown.

Here, to fill this gap, we modified a version of a well-known sequential decision-making task (i.e., bandit task) used to elicit both curiosity-driven and reward-driven behaviors in the lab (Wilson et al., 2014; Cogliati Dezza et al., 2017; Cogliati Dezza, Cleeremans, & Alexander, 2022), and where participants have to trade-off the need for satisfying one or the other. In our novel version, each option had also attached an environmental impact. Results from this study will inform the development of future behavioral interventions aimed at prompting pro-environmental behaviors with minimal implementation costs.

Methods

Participants

N = 60 undergraduate students (M_{age} = 18.6, SD_{age} = 2; 5 males) were recruited through the University's SONA system and completed the sequential decision-making task online.

Sequential decision-making task

The behavioral task was a modification of a previous version of the bandit task developed to elicit both curiosity-driven and reward-driven behaviors (Wilson et al., 2014; Cogliati Dezza et al., 2017; Cogliati Dezza et al., 2022) (**Figure 1**). As in the original version of the task, participants played different games (**Figure 1A**) and, on each trial, they had the choice to choose from 3 possible alternatives. Each time that an option was chosen, feedback was given corresponding to the monetary value of the option (ranging between 0 and 100 points; **Figure 1B**). Some options were associated with a low monetary value (drawn from a Gaussian with M = 10, SD = 8), others with a medium (drawn from a Gaussian with M = 40, SD = 8), and a high value (drawn from a Gaussian with

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M = 80, SD = 8). Therefore, the true monetary value could only be learned by repeatedly selecting the option.

In our modified version, we told participants they were customers of a supermarket and needed to make repeated choices on what to buy (i.e., which item to select on a given trial). The three options represented three possible items participants could select. Besides a monetary value, each item had also attached its environmental impact, made visible to participants throughout the entire duration of the game (**Figure 1B**). This modification was done to mimic a real-life scenario where environmental labels are usually printed on the package of a product. The impact could be low (drawn from a Gaussian with M = 10, SD = 8), medium (drawn from a Gaussian with M = 40, SD = 8), and high (drawn from a Gaussian with M = 80, SD = 8), and it was organized in such a way that in a given game one option had low impact, the second one had medium impact and the last one had high impact (**Figure 1B**). Participants were told that high numbers meant that the product was very bad for the environment while low numbers meant that the product was eco-friendly. The impact was stable within a game and changed across games.

Participants were told that the manager of the supermarket had decided to help them choose the best product. To do so, in the first part of each game (learning phase) they would be able to see some monetary values attached to their products by just selecting the options highlighted by the manager (**Figure 1A**). At this stage, whatever they selected was not included in their final payoff. Next, in the last part of the game (choice phase), they were free to choose for a certain number of trials (**Figure 1A**). In total participants played 90 games, each with 6 trials of the learning phase and between 1 and 3 trials of the choice phase.

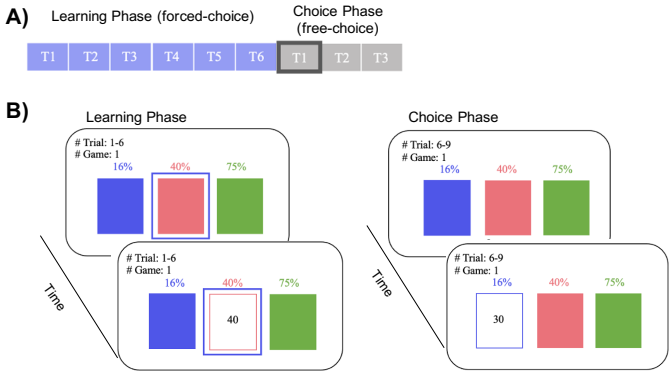

Figure 1: The sequential decision-making task. A) Each game consists of 6 trials of the learning phase and 1 to 3 trials of the choice phase. B) In the learning phase, participants were forced to choose the item pre-selected by the manager (highlighted in blue in the figure). In the choice phase, participants were free to choose the item. In both conditions, feedback was given corresponding to the monetary value of the option, and the environmental impact was displayed above each item for the entire duration of the game.

The learning phase was organized in such a way that in certain games the manager failed to highlight some products, therefore, participants were completely uncertain about their values. For example, after 6 trials of the learning phase participants had experienced the value attached to the first and the second item but the value attached to the third option was still unknown to them. This different organization of trials has already been shown to elicit curiosity-driven behaviors in the first trial of the choice phase in games in which some of the options cannot be selected by participants during the learning phase (Wilson et al., 2014; Cogliati Dezza et al., 2017).

Finally, participants were told that, at the end of the experiment, the manager would randomly select one game and count the number of points obtained in that game as well as how often the most eco-friendly item was chosen. Therefore, both scores would influence their final payoff (that participants were told it would be displayed on the announcement board at the entrance of the university for both winners and losers). This would allow participants to trade off individual monetary gain versus behaving more pro-environmentally as already used in previous lab-based behavioral paradigms for assessing pro-environmental behaviors (Berger & Wyss, 2021).

Questionnaires

Participants were also asked to fill in some questionnaires. In particular, they were asked to report demographic information such as age, ethnicity, income, and gender. Next, They were asked to report their current environmental engagement by rating how often they engaged in the following environmentally significant behaviors in the last month on a 5-point Likert scale from “Never”(1) to “Always”(5) (Stern, 2002):

1) Choose a vegetarian meal over a beef/fish dish
2) Sorting out garbage
3) Buy products with less packaging
4) Donate to an environmental organization
5) Sing a petition about an environmental issue or participate in a local environmental group
6) Change the way of transportation
7) Purchase clothing from second-hand stores
8) Limiting water use
9) Buy local and seasonal products
10) Re-use of bags and packing to avoid waste

Finally, a measure of the strength of their belief about climate crisis was taken (Heath & Gifford, 2006) and this included three distinct scores. First, participants were asked “How likely do you think global warming is happening” and they gave their answers on a 5-point Likert scale from “Very unlikely”(1) to “Very likely”(5). Next, they were presented with an extract of a journal article about the North Pole melting and they were asked to choose among the following statements as a response to the article.

1) It is an obvious sign that global warming is actually occurring
2) I think this probably indicates that global warming is occurring
3) I am unsure what to make of it
4) I am still not convinced that global warming is occurring
5) This article is an exaggeration; it does not prove at all that global warming is occurring

Lastly, they were asked to report how strongly they agreed with 26 statements about the climate crisis including "I plan to take some actions to stop global warming" or "Global warming is mainly due to natural causes, not human activity".

Analysis

To test whether the intrinsic drive for knowing can motivate people to act more pro-environmentally, we first ran a linear mixed-effects model with random intercept and slope predicting pro-environmental choices (i.e., the level of environmental impact of the choice chosen on the first trial of the choice phase, from low to high) with the level of knowledge in the option (whether it was pre-selected in the learning phase – known – or not – unknown) and its monetary value (low, medium, high) as predictors. We focus on the first trial of the choice phase as previous research shows that it is in this trial that participants' intrinsic drive for knowing is elicited (Wilson et al., 2014; Cogliati Dezza et al., 2017). We particularly focused on the trials (total number = 59) in which there was an unknown option in the learning phase. We also included in the model the monetary value as usually knowledge and rewards are correlated in these types of tasks (Cogliati Dezza et al., 2022). We then repeated the same analysis at the individual level by constructing a linear model for each participant predicting pro-environmental choices from the level of knowledge and monetary value.

Next, answers to the questionnaires were entered as covariates into the above analyses. In particular, we obtained a score for each demographic information, participants' environmental engagement (by taking the sum of the answers provided to the ten questions), and the three measures about participants' beliefs about the climate crisis (for the third measure the sum of participants responses to the statements was taken). As we had a score for each participant, we only entered the covariates at the individual level by computing the correlations between the betas of the two independent variables (level of knowledge and monetary value) and each covariate and correcting each correlation using FDR correction.

Finally, we zoomed into choices toward the most eco-friendly item (i.e., Gaussian with M = 10) and asked whether participants would choose this option more when unknown (not selected in the learning phase) compared to when it was known (selected during the learning phase) using a paired sample T-test. Then, we ran a similar analysis to investigate whether even choosing the high environmental impact option (i.e., Gaussian mean of 80) could be affected by the drive for knowing. Finally, we asked whether participants would choose the most eco-friendly item more when it was associated with high rewards compared to low rewards using again a paired sample T-test.

Results

The drive for knowing predicts pro-environmental choices

We first investigated whether the drive for knowing could predict participants' pro-environmental choices by running the mixed-effects model in trials in which one of the items remained unknown to participants during the learning phase. In particular, the model was constructed such that the level of knowledge in the item (Known, Unknown) and the monetary value (Low, Medium, High) were the predictors, and the level of environmental impact of the choice chosen on the first trial of the choice phase (low, medium, high) was the dependent variable. Results showed that participants behaved more pro-environmentally when the option was more unknown to them (beta coefficient = - 0.266 ± 0.038 (SE), t = - 6.99, $p < 10^{-6}$). However, the monetary value did not predict choices at the group level (beta coefficient = 0.028 ± 0.026 (SE), t = 1.08, $p = 0.282$). These results were replicated with a linear regression model fit to each participant individually, and then the betas were tested across participants against zero (level of knowledge: mean beta = - 0.263, t (58) = - 7, $p < 10^{-6}$ – in one participant the model did not converge; monetary value: mean beta = 0.015, t (59) = 0.513, $p = 0.609$; **Figure 2**).

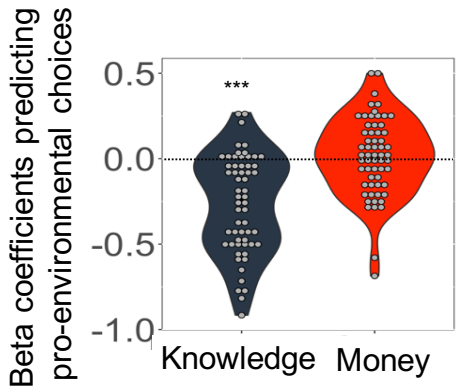

Figure 2: The level of knowledge in the items predicts pro-environmental choices. In other words, the less participants knew about the least impact option the more they were selecting that option. (The negative value is because pro-environmental choices are coded 1 for low environmental impact, and therefore more pro-environmental choices, and 2 and 3 for medium and high environmental impact)

Covariates do not correlate with individual betas

We correlated each covariate with the betas obtained from the model fit at the individual level. No significant correlations

were observed between the covariates and the betas for the level of knowledge and the monetary value (**Figure 3**).

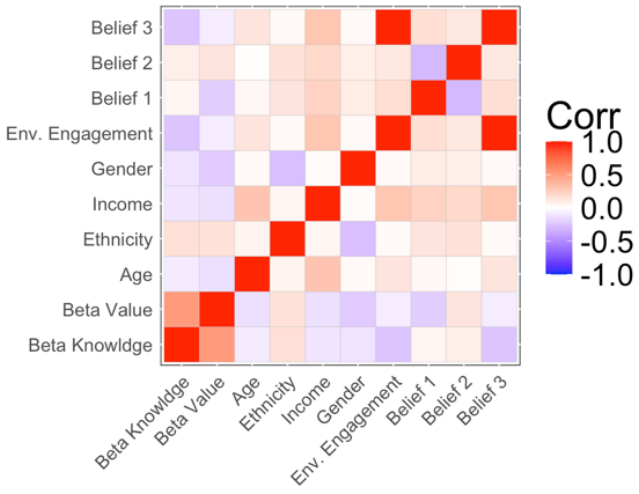

Figure 3: Correlation matrix. No correlation was found between the betas obtained by fitting the linear model to each participant individually and the covariates.

Not knowing the most eco-friendly item increases the chance of selecting it

We then looked at the choices made toward the most eco-friendly item (i.e., the option associated with low environmental impact) and see whether not knowing the option could increase these choices. Results showed that this was the case as we observed that the frequency of selecting the most eco-friendly item was smaller when participants knew the option (M = 0.467, SD = 0.12) compared to when they were ignorant about its possible value (M = 0.533, SD = 0.12, t (59) = - 2.1, p = 0.038; **Figure 4A**). Next, we checked whether the above effect was specific to choosing the most eco-friendly item. We observed this was the case by comparing the choices towards the high environmental impact item when it was unknown (M = 0.532, SD = 0.27) and when it was known (M = 0.468, SD = 0.27) and found no differences (t (59) = 0.3841, p = 0.348).

Finally, we investigated whether the monetary value of the option could also influence choosing the most eco-friendly item. And this is what we found with participants choosing the most eco-friendly item more when it was also associated with a high monetary value (M = 0.764, SD = 0.169) compared to a low monetary value (M = 0.236, SD= 0.169, t (59) = 12.2, $p < 10^{-6}$; **Figure 4B**).

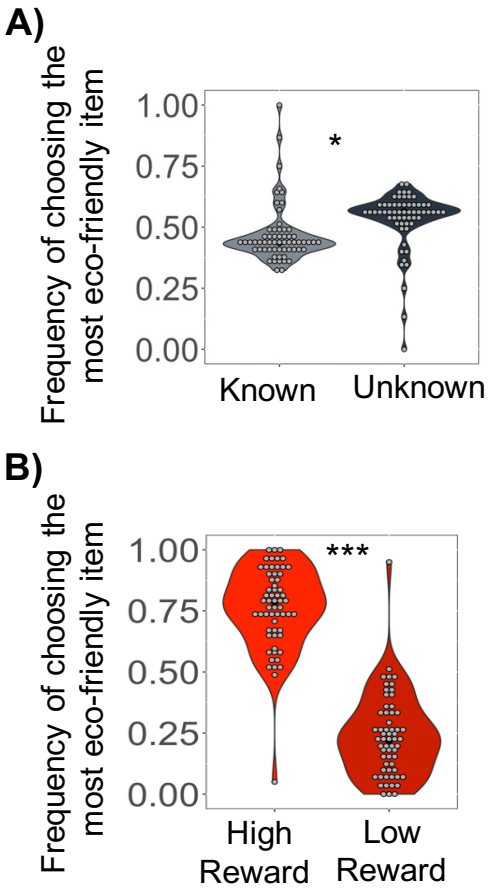

Figure 4: A) Participants chose the most eco-friendly item more when it was unknown compared to when it was known. B) Participants chose the most eco-friendly item more when it was associated with high reward compared to low reward.

Discussion

Here, we show that the drive for knowing can motivate people to act more pro-environmentally. In particular, the level of knowledge associated to an item predicts participants' pro-environmental choices. Moreover, participants chose the most eco-friendly item more when its value was unknown compared to when it was known. However, this was not the case for the high environmental impact option. These results suggest that the intrinsic drive for knowing can be included in behavioral interventions to prompt pro-environmental behaviors.

Participants in our task were exposed to repeated choices among three items each with an environmental impact (made visible to participants throughout the entire duration of the game) and a monetary value (learned by repeatedly selecting an option). Our results show that the level of knowledge in the item (whether the item was pre-selected in the learning phase or not) predicted participants' pro-environmental choices. In particular, the more participants ignored the value of the least environmental impact item the more they chose

such an option. This result is in line with recent work from the field of curiosity and information-seeking that shows that the desire to know is a powerful driver of human behavior (Gottlieb et al., 2013; Murayama, 2022; Sharot & Sunstein, 2020), and here we show that it can also motivate pro-environmental behaviors.

Our analysis did not highlight the predicted value of the monetary payoff associated with each item. To note, the above analyses were conducted in trials in which the items were pre-selected unequally during the learning phase. In such trials, the drive for knowing is usually higher than the tendency to maximize rewards (Wilson et al., 2014; Cogliati Dezza et al., 2017; Cogliati Dezza et al., 2022). This difference in number of choices toward unknown vs. highly rewarded options might be the reason for the above results.

Next, participants' choices towards the most eco-friendly item were higher when they were ignorant about its value compared to when they had experienced it in the learning phase. This effect was restricted to the most eco-friendly item as we did not observe any difference in the frequency of choosing the high environmental impact item when it was unknown compared to when it was known. These results strengthen even more the claim of this paper regarding the importance of the intrinsic drive for knowing in motivating pro-environmental behaviors.

Finally, we did observe a higher frequency of choosing the pro-environmental item when it was associated with high rewards compared to low rewards. This result is in line with the extensive literature in behavioral economics on the use of extrinsic incentives to motivate behaviors (Halpern, Service, Thaler, & Team, 2015; Vlaev et al., 2019; Bergquist, 2023; Medvedev et al., 2024), and it replicates previous findings on the importance of using financial bonuses to enhance pro-environmental behaviors in lab-based behavioral paradigms (Berger & Wyss, 2021).

While the results of this study point towards the potential use of the intrinsic drive for knowing to motivate pro-environmental behaviors, they still lack replication in a larger and more heterogeneous sample (compared to undergraduate students). Additionally, whether the results of this study will generalize to different pro-environmental choices is something to be explored in future research.

Taking together, by developing a novel lab-based behavioral paradigm this study shows the importance of the intrinsic drive for knowing to motivate pro-environmental choices. The results of this study, if replicated, will provide useful knowledge for the development of future behavioral interventions aimed at prompting pro-environmental behaviors with minimal implementation costs.

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