The Impact of Nature Exposure on Pro-Environmental Behavior: an Experimental Investigation

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Abstract

Would people behave in more pro-environmentally after simply being exposed to a surrounding that is reminiscent of nature? In order to address this question, we carry out a laboratory experiment where we test participants' likelihood of carrying out two types of Pro-Environmental Behavior (PEB): a monetary effort of donating to an Environmental Non-Governmental Organization (ENGO) that we call an eco-donation, and a non-monetary effort of recycling that we call an eco-action. We construct three different decision-making frameworks through showing participants videos of an urban setting, a nature setting and a "positive emotions" setting (not linked to nature). We find that exposure to nature boosts both eco-donations and eco-actions. Our results highlight that there is no direct link between these PEB in terms of spillover effects. Interestingly, the impact of nature exposure on eco-donation is greater on individuals with a low environmental consciousness score, whereas the impact on eco-action is greater on individuals with a high level of environmental consciousness. Our work provides new avenues for designing environmental protection policies based on behavioral insights.

JEL classification: C91, D91, Q50.

Keywords: Behavioral economics; Charitable giving; Dictator game; Experimental economics; Nature; Pro-Environmental Behavior (PEB); Recycling

1 Introduction

Environmental degradation as a result of climate change and natural resource depletion are current and growing areas of concern worldwide. Modern lifestyles, driven primarily by excessive consumption, contribute to increasing greenhouse gas (GHG) emissions, too much waste generated and the overuse of natural resources. For example, electricity is currently the fastest growing source of energy demand driven by the residential sector (U.S. EIA, 2019). In terms of waste management, the world's cities generated about 2.01 billion tons of solid waste in 2016, amounting to a footprint of 0.74 kilograms per person per day, and this figure is expected to increase by 70% from 2016 levels to reach 3.40 billion tonnes by 2050 (Kaza et al., 2018).

Governments in most countries have been implementing environmental policies to address sustainable development goals. Recent examples are the Grenelle Laws (2009)[1] and the Green Growth and Energy Transition Law (2015)[2] in France, which aim to ensure that society and the economy operate in a sustainable way, or Germany's recently enacted Climate-Protection Law (2019) that aims at meeting the Paris Agreement carbon emissions targets (COP 25). Such policies traditionally seek to constrain (command-and-control through laws and regulations), incentivize (economic instruments) or raise awareness (labels and standards) (OECD, 2007), in order to change citizens' behavior while addressing limits of social acceptability (de Groot and Schuitema, 2012).

To supplement traditional methods employed by environmental policies, "greening" individual behaviors through non-monetary instruments and behavioral insights could be an essential component to mitigate climate change and could also contribute to solving environmental problems caused by humans (Stern et al., 1997; Dietz et al., 2009; Beretti et al., 2013; OECD, 2019). Behavioral based interventions operationalized through nudges as non-binding action could guide individuals in taking decisions (Thaler and Sunstein, 2008), including green nudges (Schubert, 2017), and would encourage individuals to adopt or reinforce so-called Pro-Environmental Behaviors (PEB) (Byerly et al., 2018; Melo et al., 2018).

One of the challenges that remains largely unexplored in the economics literature is how decision-making frameworks relying on nature might help to promote PEB. As individuals would logically be more inclined to protect the environment if they felt they belonged to larger ecosystems (Schultz, 2000; Schultz and Tabanico, 2007), reminding people of the natural world in their daily surroundings or at their workplace could be an effective strategy at a moderate cost.

[1] *Lois Grenelle I et II*; n° 2009-967 of August 3, 2009; n°2010-788, July 12, 2010.
[2] *Loi relative à la Transition Énergétique et à la Croissance Verte*; n°2015-992, August 17, 2015.

Studies show that exposure and connectedness to nature indeed promote health, psychological well-being and happiness (MacKerron and Mourato, 2013), and capitalizing on this phenomenon could be a promising way to enhance PEB. Perhaps not surprisingly 55% of the world's population currently live in urban areas and this figure is expected to reach 68% by 2050, and the percentage of people living in high-income countries in cities was 81.5% in 2018 (UN, 2018). Such lack of contact with the natural world undoubtedly contributes to a physical and psychological disconnect as individuals spend a large part of their time indoors and away from nature due to their jobs and personal activities (MacKerron and Mourato, 2013; Kesebir and Kesebir, 2017). As a consequence, exploring the impact of exposure to nature to enhance people's connectedness with the natural world could have significant potential effects on PEB.

In this paper, we analyze whether exposure to nature has an impact on PEB. In other words, would people behave more pro-environmentally as a result of exposure to a natural setting?

We investigate this question using a laboratory experiment in which we expose participants to various environmental surroundings through video viewing, i.e., a nature surrounding, an urban surrounding, and a positive emotions surrounding (not linked to nature). We consider two types of PEB. First, we look at a monetary donation or "eco-donation" to an Environmental Non-Governmental Organization (ENGO). Second, we look at a recycling action through a green deed or "eco-action".

We show that exposure to nature increases the likelihood that the viewer will behave pro-environmentally. Our results highlight that there is no direct link between these PEB in terms of spillover effects. Interestingly, nature exposure appears to have greater impact on the eco-donation of individuals with a lower level of environmental consciousness, whereas this exposure appears to have greater impact on the eco-action of individuals with a higher level of environmental consciousness. Our work provides new avenues for designing environmental protection policies based on behavioral insights.

The remainder of this paper is organized as follows. In Section 2, we provide a literature review. In Section 3, we state our motivations and present our experimental protocol. In Section 4, we present our results, and finally, we offer a discussion and concluding remarks in Section 5.

2 Literature review

2.1 Pro-environmental behaviors

Since the 1970s, the behavioral sciences literature dedicated to prosocial behaviors has been expanding (Titmuss, 1970; Bénabou and Tirole, 2006; Meier, 2007; Ariely et al., 2009; Bekkers and Wiepking, 2011; Wittek and Bekkers, 2015; Roussel, 2019), which in turn has given rise to contributions in environmental economics and psychology on Pro-Environmental Behaviors (PEB) (Stern, 2000; Kollmuss and Agyeman, 2002; Whitmarsh and O'Neill, 2010; Quimby and Angelique, 2011; Tobler et al., 2012; Ones et al., 2015; Melo et al., 2018).

Prosocial behaviors can be defined as behaviors contributing to the interests of others beyond one's own self-interest such as charitable giving, volunteering, or voting (Frey and Meier, 2004; Roussel, 2019). Research shows that human beings experience greater subjective well-being after engaging in prosocial behaviors (Penner et al., 2005; Weinstein and Ryan, 2010), and Martela and Ryan (2016) demonstrate that it is not only an increased sense of social relatedness to the recipient that improves the giver's well-being but these behaviors in themselves.

PEB include activities such as limiting energy consumption, avoiding waste, recycling or voting for green political parties (Cazalis and Prévot, 2019). The main barrier that prevents individuals from performing PEB is that such behaviors are costly (Kollmuss and Agyeman, 2002; Quimby and Angelique, 2011; Tobler et al., 2012). For example, switching to organic food implies monetary costs (Onwezen, 2015), whereas selective sorting and recycling require time and thus opportunity costs (De Young, 1985; Kirakozian, 2016). Existing evidence is consistent with the idea that voluntary commitment to PEB can promote well-being (Welsch and Kühling 2010; Venhoeven et al., 2013), and individuals' subjective assessment of the sustainability associated with their behavior is an even stronger predictor of life satisfaction, with regards to the favorable consequences on the environment (Binder and Blankenberg, 2017).

Individual motivations and incentive mechanisms to act in pro-environmentally rely on intrinsic and extrinsic motivations (Deci and Ryan, 1985) as well as social motivations (Ariely et al., 2009), with crowding-in and crowding-out phenomena (Eckel et al., 2005). Ways to improve PEB may be unrelated to monetary means, e.g., through social norms (Kinzig et al., 2013; Farrow et al., 2017) or emotional states (Ibanez et al., 2017). Another way to promote PEB may be emphasizing surroundings in which people do live. For instance, the "Broken window theory" develops the idea that visible signs of disorder (tagging, littering, etc.) create incentives for people to behave anti-socially (Keizer et al., 2008). Applying this theory conversely to PEB through

innovating policies based on enhancing people's natural surroundings might create incentives for increased PEB.

2.2 Nature: connectedness, exposure and pro-environmental behaviors

Exposure to nature has been repeatedly proven to have positive effects on individuals linked to biophilia, and recent contributions in the health studies literature have tried to better understand these benefits, which include increased physiological well-being through stress reduction and lower blood pressure (Bratman et al., 2015; Yin et al., 2018). For example, proximity to parks and other recreational facilities is consistently associated with higher levels of physical activity and healthier weight status among young individuals and adults (Gordon-Larsen et al., 2006). This proximity to nature also impacts psychological well-being through cognitive performance and positive emotions (Mayer et al., 2009; Nisbet and Zelenski, 2011; Yin et al., 2018), impulsivity control (Repke et al., 2018), attention restoration (Stevenson et al., 2019), mindfulness (Huynh and Torquati, 2019) and more broadly mental health (Bratman et al., 2019).

Another strand of literature in conservation biology and psychology focuses on connection with and life experiences of nature that promote environmental concern, in particular towards biodiversity (Clayton et al., 2017; Prévot et al., 2018), and stresses that the exposure to nature is linked to PEB (Cazalis and Prévot, 2019; Whitburn et al., 2019). Using a national study in Metropolitan France, over 16,000 French municipalities analyzed the relationship between the distance to protected areas and performed three PEB, i.e., voting for Green party candidates, joining or donating to biodiversity conservation NGOs and participating in a biodiversity monitoring citizen science program. Cazalis and Prévot (2019) indeed show that the proximity to large protected areas increases these PEB. Whitburn et al. (2019) for their part conducted a meta-analysis over the results from 37 samples (out of 25 peer-reviewed papers and book chapters) and highlight that a stronger connection to nature may result in greater engagement in PEB.

In environmental psychology, various contributions stress that connectedness with nature is significantly associated with PEB, while investigating for example representations of nature linked to anthropomorphism (Liu et al., 2019) or cultural differences among a specific age-class (adolescents) regarding their relationship with nature (Krettenauer et al., 2019). Other contributions identify causal relationships between stated person-environment relationships and stated PEB (Davis et al., 2009) and between exposure to nature and cooperative sustainable behaviors regarding natural resource management (Zelinski et al., 2015). In a meta-analysis, Mackay and Schmitt (2019) show that the robust association (correlational studies) and causality

between connectedness to nature and PEB indicates "that nature connection is a promising avenue for promoting PEB", which requires in particular further experimental manipulations of nature connection.[3]

3 Materials and methods

3.1 Motivations and research questions

Would people behave more pro-environmentally simply as a result of being exposed to a context that is reminiscent of nature?

To answer this question, we use a laboratory experiment with distinct treatments to vary decision-making frameworks in exposing individuals to surrounding environments, including a nature surrounding. We consider two types of PEB following Kollmuss and Agyeman (2002), who distinguish between direct and indirect environmental actions. First, we look at a monetary donation to an Environmental Non-Governmental Organization (ENGO) that we call an eco-donation (indirect PEB). Secondly, we look at a recycling action through a green deed that we call an eco-action (direct PEB). The rationale of considering both decisions is to then separate two types of real-efforts through specific observable tasks, i.e., a monetary effort (monetary donation) and a non-monetary effort (recycling). This allows us to explore observed behaviors and revealed preferences to analyze: first, whether surrounding environments have differentiated impacts on a set of PEB; and second, whether spillover effects do appear in considering these two types of PEB.

More precisely, we consider the following set of research questions: does exposure to nature trigger eco-donation? And / or, does it impact the level of donation? Next, does exposure to nature trigger eco-action? Finally, is there any interplay or spillover effect between these pro-environmental behaviors? Linked to these questions, we wonder if there is an impact of pre-existing environmental preferences on these choices representing a degree of connectedness to nature. Consequently, we also assign a proxy for individual environmental awareness that reflects stated pro-environmental values. We then investigate two hypotheses regarding behavioral insights. Our first hypothesis is that being exposed to a natural surrounding (as opposed to an urban surrounding) would encourage individuals to act pro-environmentally by increasing both eco-donation and eco-action. Our second hypothesis is that individuals with high environmental awareness levels will behave in a more environmentally friendly way through PEB than

[3]Mackay and Schmitt (2019) indeed recorded only 17 experimental studies across 13 papers (divided in 7 published and 6 unpublished manuscripts).

individuals with low environmental awareness levels.

3.2 Experimental strategy and design

Methodologically speaking, our research strategy and experimental design are structured as follows.

First, we measure the stated environmental concern of participants using the New Environmental Paradigm (NEP) scale (Dunlap and Van Liere, 1978; Dunlap et al., 2000; Dunlap, 2008). Our aim is to identify individuals' environmental values and awareness level in order to distinguish individuals according to their level of environmental concern and their apparent connection to the natural environment. More precisely, we use the NEP scale to measure an individual's degree of endorsement (from low to high) of an ecological worldview using a Likert-type 15-item survey with scores for each item ranging between 1 and 5. Respondents are asked to indicate the extent to which they agree (or disagree) with these 15 items. The answers are then used to develop various statistical measures of environmental concerns either by grouping the items into five three-item categories focused on the limits to growth, anti-anthropocentrism, balance of nature, anti-exemptionalism and the current perception of a major ecological crisis; or, by grouping all the items to get overall and average results. Generally speaking, the higher the score, the higher one's concern about the environment. As a result, in the subsequent analysis we distinguish participants with a low level of environmental awareness (*NEP-Low*) from those with a high level of environmental awareness (*NEP-High*).

Second, we show individuals video of nature – following Zelenski et al. (2015). In the literature, video is a conventional means to exposing individuals to natural settings and investigating their connectedness to nature (Arendt and Matthes, 2016; Soliman et al., 2017). Moreover, nature videos can be directly linked to biodiversity conservation issues and charitable giving (Shreedhar and Mourato, 2019). To ensure that the impact of a natural surrounding is not linked to the conveyed emotions as nature has been shown to induce positive mood and emotional states (Schultz, 2000; Mayer et al., 2009; Bratman et al., 2015; Neill et al., 2019), we control for this dimension by introducing a treatment inducing positive emotions that are not linked to nature (Howell et al., 2011; Joye and Bolderdijk, 2015). Thus, we randomly assigned participants to one of the three treatments (between-subjects). In Treatment T1 ("Urban"), participants viewed a documentary on New York City architecture.[4] The documentary on New York City architecture shows images of the city and plans for building construction. A voice-

[4] An excerpt from the documentary entitled "Walks with an Architect series" from Landmark Media's used in Zelenski et al. (2015).

over explains how, when and why the tallest buildings, mainly on Broadway Avenue, were built. In Treatment T2 ("Nature"), participants viewed a documentary on Yellowstone Park[5] that is made up of images of the park's fauna and flora. The audio includes melodies and a voice-over describing the interactions between species, etc. In Treatment T3 ("Positive emotions"), participants viewed a succession of scenes from four films selected from Uhrig et al. (2016).[6] To avoid priming effects before the real-effort tasks, the nature video excluded "moral" and pro-environmental messages to prevent a clear link between the video exposure and the environmental tasks; moreover, our between-subjects design excludes video content comparison across conditions (Zelenski et al., 2015). The duration of each video was 12-minutes. We provided participants an audio headset with headphone protectors in the form of hygienic headphone fabrics. In order to assess emotional the impact of video viewing participants, we measured the evolution of participants' valence and arousal before and after the viewing of each video using a continuous type measure on the Affective Slider scale (Betella and Verschure, 2016).[7]

With regards to eco-donation, we rely on the dictator game (Kahneman et al., 1986; Engel, 2011). The dictator game is particularly interesting for testing generosity and prosocial behavior because there are no strategic interactions between players. Indeed, the so-called dictator can transfer money to the recipient who is not able to refuse or return this money. Donation behavior can be explained by expected warm-glow (Andreoni, 1990; Benabou and Tirole, 2011; Andreoni and Payne, 2013) and the identity of the recipient (Eckel and Grossman, 1996).[8] In our study, we invited participants to play a modified dictator game where the recipient is an ENGO. As a consequence, we do assess PEB and expect greater donations than in a standard dictator game (Ibanez et al., 2017). Each participant was given a €10 endowment and had to indicate the amount (an integer between €0 and €10) they wanted to donate to an ENGO. To avoid any anchoring effect and to cover international, national and local actions participants could choose among 4 ENGOs: World Wildlife Fund (WWF) (the world's leading nature conservation organization), *Fondation pour la Nature et l'Homme* (a French, non-political organization), *France Nature Environnement* (French Federation of Organizations for the Protection of Nature and the Environment), and *Ouvre-Tête Alternative Sociale et Solidarité Écologique* (a student union

[5]An excerpt from the documentary entitled "Wild Yellowstone" from National Geographic Channel.

[6]The four films are: Bruce Almighty; Sister Act; What Women Want; Wall-E.

[7]The "affective slider" scale is a continuous measurement scale that uses a cursor to be moved on a horizontal axis. On the far left of this axis appears a sad emoji face while on the far right appears a happy smiley face emoji. The individual must move the cursor left or right to express his or her emotional state. This axis is implicitly limited from 0 to 100 without this number being visible to the participants. This scale is used for the measurement of valence as well as for the measurement of emotional arousal.

[8]Eckel and Grossman (1996) have then shown through The American Red Cross example that the donations are higher when the recipient is an NGO rather than an individual.

promoting sustainability created in 2006 at the University of Montpellier).

With regards to eco-action, we design a real green deed in our experiment. Indeed, we offer participants the possibility to recycle a disposable good in a dedicated recycle bin, i.e., a bin with a yellow bag, indicating that only recyclable waste should be disposed of there, as an effective non-monetary effort. As stated above, we provided participants an audio headset with headphone protectors in the form of hygienic headphone fabrics, and provided instructions to dispose of these fabrics in the recycling bin made available at the end of the experiment in the payment room (see instructions in Appendix A.1). We suppose and expect that feeling greener following nature exposure would lead to a higher number of fabrics being recycled.

We divided each individual's payment into two envelopes: one with the individual's earnings (including the show-up fee); the other with the individual's contribution to the chosen ENGO. We asked participants to verify that the amounts in the two envelopes were accurate, and assured them that we would subsequently send the monetary donations to the selected ENGOs.

3.3 Empirical approach

The empirical approach developed in this paper focuses on two types of real-effort observable tasks, i.e., as eco-donation and eco-action. All the statistical and econometric analyses were conducted using STATA software (16.0).

In our framework, we aim to determine which treatments have an effect relative to each other, with a focus on the nature-related impact. We provide traditional statistical analysis in terms of descriptive statistics to compare our between-subjects treatments by using Kruskal-Wallis's equality-of-populations rank test. Turning to the econometric analysis, we use different econometric models linked to our two types of PEB. With regards to eco-donation, as a first step we analyze the amount donated through regression analyses. We use Tobit estimates as the Tobit regression model is a censored regression linked to our choice space and distribution.[9] Successively, we refine our analysis in separating what is at stake in the intensive margin of donating (probability / likelihood) from the extensive margin of donating (amount donated / level of donation). For this purpose, we use a Cragg-Hurdle regression model where the lower bound 0 is considered as observed (Cragg, 1971; Wooldridge, 2010; Engel, 2011; Brañas-Garza et al., 2017; Clark et al., 2017; Shreedhar and Mourato, 2019). This is thus a two-stage decision with the combination of a Probit model explaining the factors at stake in the donation decision and a truncated linear regression on donations. This type of model is preferred to a two-stage

[9]The STATA commands were: *tobit* to run the Tobit regression model and *outreg2* to provide results output.

selection model where the analysis focuses on positive donations in the second stage (Heckman, 1976; 1979). Last, we compute the marginal effects to address the effective monetary impacts as conditional mean estimates from the explanatory variables used in both stages of the Cragg-Hurdle model (Williams, 2012).[10]

With regards to eco-action, we analyze what is at stake in explaining the recycling decision. We use a Probit model to assess the factors playing on the probability of recycling and then identify marginal effects in terms of probability points. The idea is to check for spillover effects towards eco-action from the eco-donation decision.[11]

In terms of control variables, we ask for socio-demographical information in terms of age and gender after the eco-donation part through the dictator game. We use the NEP scale to determine environmental awareness levels based on the stated environmental concern of participants.

3.4 Experimental procedure and subject pool

The experiment was conducted at the Laboratory for Experimental Economics in Montpellier (LEEM) in sessions run in December 2017 and December 2018, respectively. One-hundred-seventy-four (174) subjects were recruited randomly from the LEEM database following the ORSEE software procedure, provided that they did not previously participated to any dictator game-type experiment. The single-blind experiment was computed using the Python programming framework for experimental economics.

Out of the 174 participants, 57 subjects each were assigned the urban treatment (T1) and the nature treatment (T2), respectively, and 60 subjects were assigned the positive emotions treatment (T3). The subjects in the three treatments were similar in age (T1: M_{Age} = 22.70 years, SD = 4.14; T2: M_{Age}= 22.74 years, SD = 4.13; T3: M_{Age}= 22.33 years, SD = 4.81). There is rather an overrepresentation of men in both the urban treatment (T1) and the positive emotions treatment (T3) (64.91% and 63.33%, respectively) compared to male participants in the nature treatment (T2) (49.12%).

The experiment lasted about one hour. Payments were made privately at the end of the session with average earnings, including the show-up fee, equal to €12.

[10]The STATA commands used were: *churdle* to run the Cragg-Hurdle regression model; *margins* to derive the marginal effects in terms of conditional means estimates from the significant explanatory variables and *outreg2* to provide results output.

[11]The STATA commands used were: *probit* to run the binomial regression model; *margins* to derive the marginal effects in terms of probability points from the significant explanatory variables and *outreg2* to provide results output.

4 Results

We first gather preliminary results on participants' stated environmental concern through the NEP scale. The three treatments are statistically similar in terms of NEP scale score, as there is indeed no significant difference between the three treatments for each of the categories (*limits to growth* (marked as NEP 1), *anti-anthropocentrism* (marked as NEP 2), *balance of nature* (marked as NEP 3), *anti-exemptionalism* (marked as NEP 4) and the current perception of a *major ecological crisis* (marked as NEP 5)) (Table 1).

We then check for the impact of the three different videos on emotional valence. We use the Multiple Hypothesis Testing (MHT) (List et al., 2019) and show that there is a significant change in subjects' valence after video viewing: participants in the urban treatment felt significantly more unpleasant feelings (negative valence) than participants in both the nature and the positive emotions treatments (Table 2). Results are provided at the 1% (***), 5% (**) and 10% (*) significant levels (p-value), respectively.[12]

[12]Standard deviations (SD) in parentheses.

	NEP 1	NEP 2	NEP 3	NEP 4	NEP 5	Average value of NEP
Urban (T1)	2.92	4.01	4	3.47	4.31	3.74
Nature (T2)	2.78	4.19	4.11	3.68	4.28	3.81
Positive emotions (T3)	2.81	4.01	3.91	3.51	4.23	3.69

Table 1: Scores for stated environmental attitudes (by treatment)

Compared treatments	Differences in mean changes / valence
Urban versus nature (T1 versus T2)	18.75*** (3.55)
Urban versus positive emotions (T1 versus T3)	20.54*** (3.51)
Nature versus positive emotions (T2 versus T3)	1.78 (3.51)

Table 2: Multiple Hypothesis Testing (MHT) of changes in emotional states after video viewing (simultaneous comparison of all treatments)

	Number of obs.	Amount given on average (€)	Subjects – no donation (%)	Recycled hygienic headphone fabrics (%)
Urban (T1)	57	€2.82** (€2.96)	24.56%	45.61%
Nature (T2)	57	€3.53** (€2.43)	19.30%	61.40%
Positive emotions (T3)	60	€2.40** (€2.45)	31.66%	50%
Full sample	174	€2.91 (€2.65)	25.29%	52.3%

Table 3: Eco-donation and eco-action decision description (by treatment)

4.1 Descriptive analysis

Regarding eco-donation and eco-action, firstly we compare per treatment the average amounts donated, the percentage of subjects who do not donate to an ENGO – and then behave as dictators, and the percentage of recycled hygienic headphone fabrics (Table 3). Results are provided using Kruskal-Wallis equality-of-populations rank test, at the 1% (***), 5% (**) and 10% (*) significant levels (p-value), respectively.[13] To supplement this information on the average amounts donated, we display the range of donations out of our choice set by treatment (€0 – 10) (Figure 1).

According to the distributions and with regards to the average amounts given, the subjects exposed to the natural setting donated on average a significantly higher amount (T2, €3.53**) than those exposed to the urban setting (T1, €2.82**) or than those exposed to the positive emotions unrelated to nature (T3, €2.40**) (non-parametric analysis through the Kruskal-Wallis equality-of-populations rank test; $\chi^2(2) = 7.692$, $p = 0.021$). Subjects behaving as dictators (€0) range from 19.3% (T2), 24.56% (T1) to 31.66% (T3), which is lower than figures found in the literature on dictator games (e.g., 36.11% in Engel's (2011) meta-analysis). To supplement this analysis, we have grouped the donators together according to their profile, that we have designated in addition to the dictators (€0) as Low Donators (€1 – 4) and High Donators (€5 – 10). The advantage of focusing on High Donators is that considering at least a €5 split corresponds to a fair sharing between parties, since on the one hand a €5 allocation each out of the €10 endowment leads to a symmetric share, while an amount greater than €5 shows that the donor is particularly generous and altruist. Here we can observe that 38.6% of the subjects exposed to nature (T2) gave €5 or more, which is greater than that donated by those exposed to the urban setting (T1, 26.32%) or the positive emotions setting (T3, 25%). These figures highlight the positive joint impact of our nature exposure setting and the recipient status here as an ENGO towards eco-donation. Turning to the recycling of the hygienic headphone fabrics, we can observe that the highest percentage (61.40%) was recycled by those exposed to the nature setting (T2), Participants exposed to the urban setting (T1) recycled 45.61% and those exposed to the positive emotions video (T3) recycled 50%.

To finely tune our analysis, we provide a similar reading grid in distinguishing participants with a low level of environmental awareness (*NEP-Low*) from those with a high level of environmental awareness (*NEP-High*) (Table 4).

As stated in Sub-section 3.2, the NEP scale allows us to measure an individual's degree of

[13] Standard deviations (SD) in parentheses.

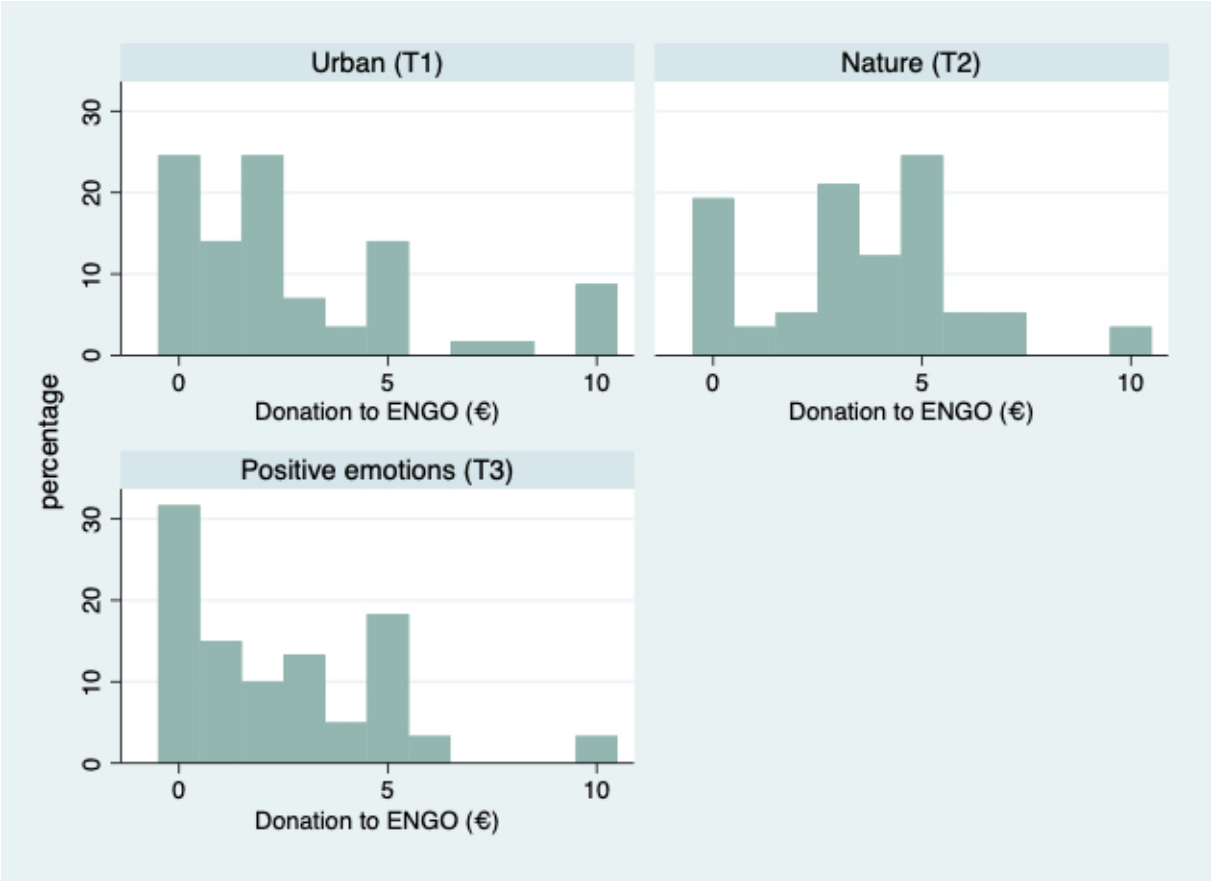

Figure 1: Percentage of eco-donations per amount level (by treatment)

endorsement of an ecological worldview through soliciting information that is likely indicative of the status they give to nature and the surrounding environment. Following Dunlap et al. (2000), we consider that people possess a low environmental awareness level (*NEP-Low*) when they have a score lower than 4, and a high environmental awareness level (*NEP-High*) when they have a score greater than or equal to 4. *NEP-Low* individuals donated on average a significantly higher amount after nature exposure treatment (T2, €3.78**) than after the urban treatment (T1, €2.53**) or after the positive emotions not linked to nature treatment (T3, €2.20**) (non-parametric analysis through the Kruskal-Wallis equality-of-populations rank test; $\chi^2 2(2) = 6.226$, p = 0.0445). In contrast, *NEP-High* individuals contributed less after exposure to the natural setting (T2, €2.94) than after that of the other settings (respectively €3.33 in T1 and €3 in T3), even though this is not statistically significant. Consequently, *NEP-Low* individuals' donations drive our overall results, showing that the impact of nature exposure is more pronounced in individuals with an initially low level of environmental consciousness. If we look at the share of *NEP-Low* subjects behaving as dictators, this percentage is lower in the nature treatment (T2, 15%) than in the urban treatment (T1, 22.22%) and the positive emotions treatment (T3, 31.11%), whereas these percentages are reversed for *NEP-High* subjects and close for those exposed to the nature and urban settings (27.78% (T1) and 29.41% (T2), respectively) although still lower than under positive emotions (T3, 33.33%). Finally, the percentage of recycled hygienic headphone fabrics was more marked (55%) for *NEP-Low* individuals after the nature exposure treatment (T2) than the 51.11% recycled by those exposed to the positive emotions treatment (T3) and significantly higher than the 27.78% recycled by those exposed to the urban setting treatment (T1) at. These figures are high for *NEP-High* individuals exposed to the nature and urban settings (T1 76.19% and T2 76.47%, respectively) compared to 46.67% by those exposed to the positive emotions setting (T3).

NEP-Low (NEP score < 4)	Number of obs.	Amount given on average (€)	Subjects – no donation (%)	Recycled hygienic headphone fabrics (%)
Urban (T1)	36	€2.53** (€2.68)	22.22%	27.78%
Nature (T2)	40	€3.78** (€2.27)	15%	55%
Positive emotions (T3)	45	€2.20** (€2.28)	31.11%	51.11%
Full sample	121	€2.82 (€2.48)	23%	45.45%

NEP-High (NEP score ≥ 4)	Number of obs.	Amount given on average (€)	Subjects – no donation (%)	Recycled hygienic headphone fabrics (%)
Urban (T1)	21	€3.33 (€3.40)	28.57%	76.19%
Nature (T2)	17	€2.94 (€2.75)	29.41%	76.47%
Positive emotions (T3)	15	€3 (€2.90)	33.33%	46.67%
Full sample	53	€3.11 (€3.01)	30%	67.92%

Table 4: Differences in behavior between *NEP-Low* and *NEP-High* subjects

Hence, our descriptive results confirm our first research hypothesis: being exposed to a natural surrounding causes individuals to act in a pro-environmental manner by increasing both eco-donation and eco-action. However, we observe that exposure to nature bolsters PEB towards low environmental awareness level individuals, which is the opposite of our second hypothesis.

To complete this descriptive part, we now turn to the econometric analysis to refine our results.

4.2 Econometric analysis (1): eco-donation

To implement a more in-depth analysis of the factors leading to monetary donations to ENGOs and the role played by nature exposure, we use a set of econometric models (see Sub-section 3.3) whose purpose is to broadly assess the participation dimension (to be a donor) as well as the amount donated (the effective donation).

Firstly, we perform a censored regression model (Tobit model) to explore the determinants of eco-donation behavior with regards to our choice set (Table 5). Secondly, to supplement the analysis we use the two-stage Cragg's (1971) hurdle model procedure to further explore the impact of surroundings on eco-donation. This procedure combines a participation regression model (*Hurdle 0/1* – i.e., a Probit model; Table 5) to assess the intensive margin of donating (probability / likelihood), with a truncated regression (*Hurdle +*; Table 5) to assess the extensive margin of donating (amount donated / level of donation), conditional of being a donor (Brañas-Garza et al., 2017; Clark et al., 2017; Shreedhar and Mourato, 2019). In other words, we disentangle the participation and quantity dimensions in the monetary donation process within this procedure. To complete the analysis, we compute the marginal effects to address the effective monetary impacts as conditional mean estimates from the significant explanatory variables used in both stages of the Cragg-Hurdle model (Table 6). Results are provided at the 1% (***), 5% (**) and 10% (*) significant levels (p-value), respectively.[14]

[14]Standard deviations (SD) in parentheses.

Variables	Tobit I	Cragg-Hurdle I *Hurdle 0/1 Likelihood*	Cragg-Hurdle I *Hurdle + Regression*
Nature (T2)	1.361*	0.264	1.775**
	(0.760)	(0.349)	(0.882)
Positive emotions (T3)	-0.481	-0.264	-0.107
	(0.750)	(0.311)	(0.944)
Urban (T1)	*Ref.*	*Ref.*	*Ref.*
Gender (Male)	-1.175**	-0.731***	0.118
	(0.528)	(0.242)	(0.599)
NEP-High	0.766	-0.196	2.052**
	(0.916)	(0.381)	(1.061)
*Nature (T2) * NEP-High*	-2.214*	-0.589	-2.399*
	(1.338)	(0.568)	(1.515)
*Positive emotions (T3) * NEP-High*	-0.228	-0.013	-0.071
	(1.368)	(0.555)	(1.594)
*Urban(T1) * NEP-High*	-	-	-
	-	-	-
Constant	2.828***	1.286***	2.211***
	(0.644)	(0.301)	(0.834)
lnsigma, Constant	-	1.008***	1.008***
		(0.999)	(0.999)
/sigma	10.428***	2.741***	2.741***
	(1.375)	(0.272)	(0.272)
LL	-378.295	-371.792	-371.792
LR $Chi^2(6)$	12.87**	23.60***	23.60***
Pseudo R^2	0.017	0.031	0.031
Number of observations	174	174	174

Variables	Tobit II	Cragg-Hurdle II *Hurdle 0/1 Likelihood*	Cragg-Hurdle II *Hurdle + Regression*
Nature (T2)	*Ref.*	*Ref.*	*Ref.*
Positive emotions (T3)	-1.842**	-0.528	-1.882**
	(0.726)	(0.322)	(0.866)
Urban (T1)	-1.361*	-0.264	-1.775**
	(0.760)	(0.349)	(0.882)
Gender (Male)	-1.175**	-0.731***	0.118
	(0.528)	(0.242)	(0.599)
NEP-High	-1.448	-0.786*	-0.348
	(0.973)	(0.422)	(1.076)
*Nature (T2) * NEP-High*	-	-	-
	-	-	-
*Positive emotions (T3) * NEP-High*	1.986	0.576	2.329
	(1.393)	(0.575)	(1.612)
*Urban(T1) * NEP-High*	2.214*	0.589	2.399*
	(1.338)	(0.568)	(1.515)
Constant	4.189***	1.549***	3.986***
	(0.597)	(0.314)	(0.642)
lnsigma, Constant	-	1.008***	1.008***
		(0.999)	(0.999)
/sigma	10.428***	2.741***	2.741***
	(1.375)	(0.272)	(0.272)
LL	-378.295	-371.792	-371.792
LR $Chi^2(6)$	12.87**	23.60***	23.60***
Pseudo R^2	0.017	0.031	0.031
Number of observations	174	174	174

Table 5: Treatments effects, intensive and extensive margins of monetary donation

Variables	Margins I	Margins II
Nature (T2) versus *Urban (T1) (Ref.)*	1.202**	-
	(0.592)	-
Positive emotions (T3) versus *Nature (T2) (Ref.)*	-	-1.557***
	-	(0.556)
Urban (T1) versus *Nature (T2) (Ref.)*	-	-1.202**
	-	(0.592)
Gender (Male)	-0.772**	-0.772**
	(0.391)	(0.391)
NEP-High	0.820	-1.071
	(0.691)	(0.714)

Table 6: Marginal effects / Effective monetary impacts (€)

To highlight the importance of nature exposure in our results, we set successively: the urban surrounding (T1) as the reference in the estimates, provided that the majority of individuals live in urban areas (marked as I in Tables 5 and 6); and the nature surrounding (T2) as the direct reference to get a symmetric analysis with the urban surrounding and to distinguish from the potential effect of the emotional component compared to the emotional setting (T3) (marked as II in Tables 5 and 6).

Considering the urban surrounding (T1) as the reference, censored regression estimates show that exposure to a natural surrounding had a more positive impact on donation levels to ENGOs (*Nature (T2)*, 1.361*) than exposure to an urban surrounding. This was mitigated for individuals with high environmental awareness levels that resulted in the negative impact of the interaction term (*Nature (T2)* times *NEP-High* (-2.214*)). In addition, there was a gender effect, as men contributed less than women (*Gender (Male)*, -1.175**). If we break down the intensive margin from the extensive margin of donating, thanks to the Cragg-Hurdle model we can observe that the gender effect by men plays negatively in the likelihood of donating, i.e., the intensive margin (*Gender (Male)*, -0.731***), whereas the impact of nature exposure (compared to urban exposure) is positive on donation levels, i.e., the extensive margin (*Nature (T2)*, 1.775**; *NEP-High*, 2.052**); this latter result is mitigated through the interaction term including individuals with high environmental awareness levels (*Nature (T2)* times *NEP-High*, -2.399*). Estimating the marginal effects of the significant variables from the Cragg-Hurdle model in terms of effective monetary impact allows us to conclude that nature exposure resulted on average in a donation of €1.202 greater than urban exposure (*Nature (T2)*, 1.202), with €0.772 less on average than women did (*Gender (Male)*, -0.772**). We found no statistically significant impact of having a high level of environmental concern.

Turning to the natural surrounding exposure (T2) as the reference, we get symmetric behavioral results in comparison with the urban surrounding (T1), and similar impacts on donation behavior according to gender and high levels of environmental awareness.[15] More interestingly, we can distinguish the potential influence of nature compared to solely positive emotions. In the censored regression analysis, we found exposure to the positive emotions (*Positive emotions (T3)*, -1.842**) had a negative impact on donation levels compared to exposure to nature. Yet again, breaking down the intensive margin from the extensive margin of donating displays a negative impact of being exposed to positive emotions compared to nature within the truncated regression (*Positive emotions (T3)*, -1.882**). Lastly, the effective monetary impact shows that exposure to the positive emotions video resulted in an average donation of €1.557 lower than donations by those exposed to the nature settings (*Positive emotions (T3)*, -1.557***). In other words, nature exposure strengthened monetary eco-donations in comparison to exposure to other surroundings, even though this exposure does not trigger the donation process.

Consequently, our econometric analysis on eco-donation confirms our first research hypothesis: exposure to a natural setting leads individuals to act in a pro-environmental manner by increasing eco-donation. However, our second hypothesis only partly holds: individuals with a high level of ecological concern would be willing to donate higher amounts, but this is mitigated when combined with nature exposure. This finding suggests that policies aiming to increase PEB using exposure to nature would be most effective when targeted at individuals with a low level of environmental awareness or exposure.

4.3 Econometric analysis (2): eco-action

With regards to eco-action, we analyze what is at stake in explaining the recycling decision (Tables 7 and 8). We use a Probit model to assess the factors playing on the probability of recycling and then to identify marginal effects in terms of probability points. The idea is in particular to check for spillover effects towards eco-action from the eco-donation decision. As in Sub-section 4.2, we successively set the urban (T1) and nature (T2) surroundings as references in the estimates (marked as I and II in Tables 7 and 8, respectively). Results are provided at

[15] Regarding urban exposure compared to nature exposure: in the censored regression (*Urban (T1)*, -1.361*; *Urban (T1)* times *NEP-High*, 2.214*), in the Cragg-Hurdle model (*Urban (T1)*, -1.775**; *Urban (T1)* times *NEP-High*, 2.399*) and the associated marginal effect (*Urban (T1)*, -1.202**), i.e., an average donation of €1.202 less under urban exposure than under nature exposure. The gender effects are still the same: in the censored regression (*Gender (Male)*, -1.775**), in the Cragg-Hurdle model (*Gender (Male)*, -0.731***) and in the associated marginal effect €0.772 less by men than by women. In the intensive margin of donating, having a high level of environmental awareness plays negatively on the likelihood of donating (*NEP-High*, -0.786*), although there is no significant overall impact through marginal effects.

Variables	Probit I *Likelihood*	Probit II *Likelihood*
Nature (T2)	0.723***	*Ref.*
	(0.300)	
Positive emotions (T3)	0.609**	-0.114
	(0.291)	(0.276)
Urban (T1)	*Ref.*	-0.723**
		(0.300)
Donation (Yes)	-0.152	-0.152
	(0.235)	(0.235)
Gender (Male)	-0.075	-0.075
	(0.211)	(0.211)
NEP-High	1.298***	0.551
	(0.374)	(0.395)
*Nature (T2) * NEP-High*	-0.746	-
	(0.544)	-
*Positive emotions (T3) * NEP-High*	-1.429***	-0.683
	(0.532)	(0.541)
*Urban(T1) * NEP-High*	-	0.746
	-	(0.544)
Constant	-0.425	0.298
	(0.334)	(0.325)
LL	-110.908	-110.908
LR $Chi^2(7)$	19.03	19.03
Pseudo R^2	0.079	0.079
Number of observations	174	174

Table 7: Binomial regression estimates

the 1% (***), 5% (**) and 10% (*) significant levels (p-value), respectively.[16]

First of all, we note that there is no direct spillover effect. Starting with the urban setting as the reference (T1), we observe that donating to an ENGO does not have a significant impact on recycling behavior (*Donation (Yes)*, -0.152).[17] By contrast, we observe that participants exposed to the natural setting (*Nature (T2)*, 0.723**) and the positive emotions (*Positive emotions (T3)*, 0.609**) setting were more likely to recycle than those exposed to the urban setting (T1). This is reflected if we now turn to the marginal effects in terms of probability points: the probability of performing a green deed grows under nature exposure (*Nature (T2)*, 0.264***) and positive emotions exposure (*Positive emotions (T3)*, 0.222**) compared to urban exposure. If we now investigate the influence of high levels of environmental awareness, we can observe that participants were more likely to recycle than those with low levels, both regarding the likelihood

[16]Standard deviations (SD) in parentheses.

[17]Note that even though this is not significant, the sign is negative and would suggest a self-licensing phenomenon (Clot et al., 2016).

Variables	Margins I	Margins II
Nature (T2) versus *Urban (T1) (Ref.)*	0.264***	-
	(0.104)	-
Positive emotions (T3) versus *Urban (T1) (Ref.)*	0.222**	-
	(0.102)	-
Urban (T1) versus *Nature (T2) (Ref.)*	-	-0.264**
	-	(0.104)
NEP-High	0.473***	-
	(0.122)	-

Table 8: Marginal effects

of recycling (*NEP-High*, 1.298***) and the probability of performing it in terms of probability points (*NEP-High*, 0.473***). This effect decreases if we consider the interaction term joining high environmental awareness individuals exposed to depictions of positive emotions (*Positive emotions (T3)* times *NEP-High*, -1.429***).

Using the natural setting (T2) as the reference provides reciprocal results with the urban setting (T1) (respectively *Urban (T1)*, -0.723**; and, *Urban (T1)*, -0.264*** in terms of probability points), but it does not allow us to draw a significant distinction between the impact of nature itself and the impact of positive emotional content (T3).

As a consequence, our econometric analysis on eco-action once again confirms our first research hypothesis: being exposed to a natural surrounding leads individuals to act in a pro-environmental manner by increasing the likelihood of their performing a green deed as eco-action. We can now observe that individuals with a high level of environmental concern showed an increased likelihood of recycling, which validates our second hypothesis. These two results are reflected in probability points.

5 Discussion and conclusion

Behavioral economics views human beings as decision-makers motivated by psychological, social, cognitive and emotional factors. In this article, we analyze to what extent the surroundings in which we live influence our behavior towards the environment. Specifically, we examine whether nature exposure can lead to more sustainable behaviors measuring two types of real efforts, i.e., a monetary effort as eco-donation and a non-monetary effort as eco-action.

Our results mainly indicate that individuals are responsive to nature exposure both in terms of eco-donation and eco-action. In addition, we control for the emotional component and show that nature has a particular impact apart from a generally positive one. Furthermore, it appears that

there is not a direct link between eco-donation and eco-action behaviors as respectively indirect and direct PEB (Kollmuss and Agyeman, 2002) that could be considered separately. Our results are consistent with previous studies in the literature (Grinde and Patil, 2009; Corral-Verdugo et al., 2011; Capaldi et al., 2014), and are in line with research on short-term consequences of nature exposure, which suggests that nature can promote sustainability and cooperative behaviors in the context of commons dilemmas (Mayer et al., 2009; Nisbet and Zelenski, 2011; Zelenski et al., 2015). A main issue raised in our study concerns the heterogeneousness of behavioral changes in reaction to exposure to nature. An important driver appears to be the level of an individual's environmental consciousness. As a consequence, an individual's subjective connectedness with and exposure to nature may consistently predict pro-environmental attitudes and behaviors. To our knowledge, the literature has not yet focused on explaining why behavioral insights do work (or not) on differentiated populations with regards to their environmental consciousness levels.

This finding opens the door to designing policies that aim to connect people to nature or natural environments (e.g., by implementing urban and peri-urban horticulture to build greener cities; Salbitano et al., 2016). More precisely, individuals with a low level of environmental consciousness should be firstly targeted through nature exposure when the aim is to increase monetary efforts, whereas individuals with high level of environmental consciousness should be targeted when physical efforts to protect the environment are desired. Hence, integrating exposure to nature to improve PEB in the form of behavioral insights could be operationalized by green nudge designs (Schubert, 2017), that are straightforward, low-cost and non-binding actions. Modern lifestyles indeed contribute to disconnecting people from nature. Thus, exposure to natural landscapes, environmentally friendly ways of life, greening working conditions at the workplace, controlling for the degree of municipalities' natural surroundings through public policies could improve PEB. However, our results confirm the importance of separating the various types of PEB (Melo et al., 2018). As a matter of fact, undertaking behavioral insights will depend on the field of application (e.g., energy saving at the household scale, personal transportation, recycling behavior, etc.) (Byerly et al., 2018), and the associated efforts required to achieve PEB. Taking into account behavioral insights leads to investigate the effective relationship between visual cues and pro-environmental behaviors (Abrahamse et al., 2005; Wu et al., 2016).

Wondering about the external validity and implementation of green nudges that rely on natural features raises issues about the persistence of behavioral insights and potential waning effects, especially with regards to experienced individuals who are getting used to these decision-making frameworks. A one-shot exposure to nature will probably not permanently change a

person's behavior, and it is possible that momentary feelings of connectedness with nature do not lead to sustainable choices in the same way that more consistent exposure might, or could even generate negative spillover effects (Ghesla et al., 2019). One should study this potential basis for future decisions and hence strengthens the original cause for the pro-environmental behavior, and this would allow measuring cost-effectiveness and behavioral change over time (Byerly et al., 2018).

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Supplementary materials

Appendix A.1. Laboratory experiment instructions

Good morning / Good afternoon,

The experiment you are about to participate in is intended for the study of decision-making. We ask you to read the instructions carefully. Once each of you has read the instructions, an experimenter will read them aloud.

All your answers will be treated anonymously. You will indicate your choices using the computer you are sitting in front of.

The experiment is composed of 2 parts. For each part, messages on the screen will tell you when you can complete the set of associated tasks or if it is appropriate to wait. Waiting intervals are sometimes introduced so that all people participating in the experiment can progress at the same pace.

Your remuneration will be paid at the end of the experiment. Your remuneration will be the sum of your possible gain in Part 2 of the experiment and the lump sum of €5 which corresponds to the transport expenses. This sum will be given to you in cash at the end of the experiment, in Room C217 and on presentation of your identity card.

We ask you to remain totally silent during the entire experiment and not to give any signs that could influence your neighbors. Your cell phones must be turned off. You should not consult any documents other than those that have been distributed to you or that are presented to you on the computer screen.

If you have any questions, raise your hand and an experimenter will come and answer you in private.

Part 1. Instructions

The first part is composed of 3 tasks.

- Task 1: We ask you to rate your level of satisfaction (from "not satisfied" to "very satisfied") and your state of arousal (from "very calm" to "very awake"). To do this, you have a cursor to move horizontally to express how you feel.
- Task 2: You will be associated with an Environmental Non-Governmental Organization (ENGO) for the duration of the experiment. You can choose one of the following four ENGOs:

- WWF (World Wildlife Fund) (the world's leading nature conservation organization);
- *Fondation pour la Nature et l'Homme* (French, non-political organization);
- *France Nature Environnement* (French federation of organizations for the protection of nature and the environment);
- *Ouvre-Tête Alternative Sociale et Solidarité Écologique* (a student union created in 2006 at the University of Montpellier). If needed, you will find at the end of these instructions a short presentation of these ENGOs.

- Task 3: We will present you with 15 statements about the relationship between people and the environment. For each statement, we ask you to indicate whether you "Totally agree", "Agree", "Neither agree or disagree", "Not agree" or "Not agree at all". Please answer as sincerely way as possible. We are interested in your opinion. There are no right or wrong answers.

Part 2. Instructions

The second part is composed of 3 tasks.

- Task 1: A video will be presented to you. We ask you to look at it carefully. For this purpose, an audio headset is available with headphone protectors in the form of hygienic headphone fabrics. We will ask you to throw them away at the end of the experiment; a dedicated bin will be available at the time of payment.

- Task 2: We ask you to rate your level of satisfaction (from "not satisfied" to "very satisfied") and your state of arousal (from "very calm" to "very awake"). To do this, you have a cursor to move horizontally to express how you feel.

- Task 3: During this task, you have an endowment of €10. You are asked to make a decision regarding this endowment. We give you the opportunity to give a part of this endowment to the ENGO you previously selected. You can choose to give any amount as an integer number between €0 and €10; you will keep the rest of the endowment to yourself.

  The game will be played only once.

Important: the experimenters undertake on their honor to forward all the donations generated by this experiment to the chosen ENGOs.

Post-experimental situation

Following the two parts of our experimental setting, we ask socio-demographic questions to record individual information.

At the end of the experiment, the subjects are invited one after the other to go to Room C217 to collect their earnings in private. During the payment process, subjects had the opportunity to recycle the headphone fabrics in a dedicated bin.

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