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Nudging pro-environmental behavior: evidence from a web experiment on priming and WTP



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ABSTRACT

Investigations on state-dependent and endogenous preferences have gained momentum. There is now abundant empirical literature on whether, and how, external stimuli influence or predict people's behavior and appraisals. In recent decades, attempts have been made to enlarge this strand of research to determine whether “nudging” may help in managing environmental problems and boosting social preferences. Following this line of investigation, we describe a web experiment to analyze the impact of priming on environmental and ethical attitudes and willingness to pay (WTP) for environmental protection. We found that while priming does make pro-environmental attitudes more salient, its frame affects the probability of WTP a premium for environment-friendly goods and the size of the premium. Unlike other authors, we used a visual priming technique based on a short video cartoon about a smartphone lifecycle.

Keywords: priming; gain-loss frame; environmental attitudes; willingness to pay

Introduction

Environmental degradation and exploitation of natural resources are impairing the planet's wholeness and its capacity to support life and human development. Environmental management and conservation should be the major concern of any government that has social welfare as a major goal.

Many policies and instruments towards more sustainable growth have been studied and implemented. Most are of the technical type¹ (i.e. fines, taxes, subsidies). Such policies aim to modify firm and consumer behavior and/or to foster environmental technical innovations by changing their economic incentives. Very little attention has been paid to non-technical tools that aim to modify people's behavior by changing their preferences rather than incentives. This depends on the traditional economic view that preferences are molded by a person's idiosyncratic characteristics, which are assumed to be exogenous and given.

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¹“A technical solution may be defined as one that requires a change only in the techniques of the natural sciences, demanding little or nothing in the way of change in human values or ideas of morality” (Hardin, 1968, 1243). Coherently, a non-technical solution occurs only when it generates changes in human values or beliefs.

50 This standard hypothesis seems counterfactual. It contradicts the huge expenditure
51 of firms in advertising and marketing. It also appears unsatisfactory and limiting from
52 a theoretical point of view, since it implies that preferences cannot be influenced by
53 beliefs and external stimuli, while there is now a growing body of literature arguing
54 that preferences can be state-dependent and endogenous (Bowles 2016; Bowles and
55 Polanía-Reyes 2012, among the others). The “psychological properties of preferences”
56 have important economic and social implications (Fehr and Hoff 2011). Indeed, if
57 preferences are at least partially endogenous and editable, innovative economic policies
58 become available.

59 This aspect has been widely investigated by social psychologists and behavioral
60 economists. According to Thaler and Sunstein (2008), people are either “Econs” or
61 “Humans”, i.e. *Homo economicus* (rational people) and *Homo sapiens* (real people).
62 They argue that while the former respond primarily to incentives, the latter are also
63 influenced by nudges. These stimuli affect behavior because people’s judgments and
64 choices are the results of intuitive (System 1) and deliberate (System 2) thought
65 (Kahneman 2011). According to these authors, many of our choices are guided or
66 influenced by System 1, which is based on associative memory, automatically and
67 often unconsciously driving the heuristics of our choices and judgments.

68 Many experiments have investigated whether and how external stimuli influence or
69 predict individual behavior and assessment (Dennis *et al.* 2015). Most of these studies
70 focused on the impact of nudging on individual willingness to pay (WTP) (Koçaş and
71 Dogerlioglu-Demir 2014). In recent decades, increasing awareness of environmental
72 problems has given rise to a strand of research aimed at investigating whether “non-
73 technical” instruments can be useful for promoting more sustainable development. In
74 particular, attention has been dedicated to priming as a way of affecting social prefer-
75 ences, especially the perceived value of a public good (Clarke *et al.* 1999) or WTP for
76 environmental quality (Li *et al.* 2017).

77 Following this line of investigation, we set out to shed new light on how
78 “unconventional” policy instruments can help in pursuing environmental goals.
79 Exploiting the current development and spread of social networks and media, we con-
80 ducted a web experiment to evaluate whether priming affects individual WTP for
81 environmental protection. Unlike most similar studies, it used a visual priming tech-
82 nique based on a short video story. The story is about a smartphone lifecycle.

83 According to UNEP, e-waste is one of the fastest growing waste streams in devel-
84 oped and developing countries. Our experiment tested the effect of priming on WTP for
85 a recyclable smartphone. To design the most effective nudge in terms of environmental
86 attitudes, it conducted a three-sample experiment in which two samples were primed
87 with differently framed visual messages: “degraded” vs. “conserved” environment.²

88 Environmental degradation may be discussed in terms of the positive and negative
89 consequences of undertaking or not undertaking mitigation actions (Spence and
90 Pidgeon 2010). Both frames should modify individual behavior and the likelihood to
91 opt for mitigation, but investigating which information frame is more effective is of
92 interest. According to Prospect Theory, a loss produces higher disutility (discomfort)
93 than the utility yielded by a commensurate gain. While this is normally tested in terms
94

²The three short videos used in our web experiment are available online: control group (https://drive.google.com/file/d/1_6PZsp0DBVJT9KmxDLAUzzaYGVncLwT/view), positive priming (https://drive.google.com/file/d/1-QXop5GhiPeLSwm5pvjuhN_n4iz_Pfww/view), negative priming (https://drive.google.com/file/d/1yATTtuBVAOAVUPhFGzCih2BVQ8c_PfPJ/view).

of WTA and WTP disparity (Sayman and Öncüler 2005), we tried to grasp it by means of WTP alone in order to avoid the bias induced by monetary assessments (pay rather than accept) (Irwin 1994).

People were, therefore, asked to watch a very short video and then to complete a questionnaire. In the authors' opinion, the first and main perception we have of the state of our environment is aesthetic and visual. Unlike value-laden words and scramble games requiring specific expertise to understand (Andersson *et al.* 2017), visual priming makes it possible to convey different types of environmental quality/settings directly and to test the impact of negative and positive frames on individual behavior. Our hypothesis is that a conserved natural environment makes us aware of what we would lose if we do not implement sustainable policy (the hold-paradise option). On the contrary, a contaminated and degraded setting suggests that sustainable policy is needed to improve environmental quality (the escape-hell option). In line with expectations, priming made pro-environmental attitudes more salient and increased the probability of WTP something for environmental protection. Moreover, according to the loss aversion and endowment effect (Kahneman and Tversky 1979), our experiment confirmed that a nudge reminding people what they are losing – the environment and quality of life – is more effective than a nudge focusing on pollution abatement, i.e. recovering the “paradise lost”.

The paper is organized as follows: in the next section, we briefly review the literature on priming and pro-social behavior, focusing on environmental attitudes. The third section presents data, method, and results. The remaining sections are devoted to discussing results and drawing some preliminary conclusions.

Priming and social choice: an essential literature review

In the famous experiment known as the Florida effect, the psychologist John Bargh asked two groups of students to compose four-word sentences from a set of five words. For one of the two groups, the set was composed of words linked to stereotypes of old age. After they had completed the task, participants were asked to move to another office for another experiment. Students primed with words regarding old age walked to the other office significantly more slowly than the others (Bargh *et al.* 1996). Since this pioneering work, priming techniques have been used by social psychologists and behavioral economists to show that preferences can also be shaped by choice architecture and social environment (for the critical survey, see Bargh 2006; Cohn *et al.* 2016; Molden 2014).

Many experiments have been carried out to demonstrate that priming affects people's behavior and choices. The results are statistically significant and robust. Vohs (2015) did a meta-analysis on a number of experiments from 18 countries and showed that people primed with money were less prosocial, eschewed interdependence and behaved more competitively than neutral primes. Albeit in reverse, the priming effect was confirmed by Shariff *et al.* (2016) who analyzed 93 studies and found that religious priming had robust effects on prosocial and various other outcomes. They also found that the effects of religious priming depended on people's religious beliefs, i.e. it did not work with non-religious participants.

Many of these experiments used value-laden words or scramble games to cue or nudge participants (for a review, see Andersson *et al.* 2017). Another frame used in such studies was “watchful eyes”. Haley and Fessler (2005) conducted a Dictator

148 Game and showed that displaying eye-like stimuli on a computer substantially
149 increased the probability of cooperation and the size of donations by participants.
150 Rigdon *et al.* (2009) reached similar results.

151 Such experiments have been replicated with different results, although, in general,
152 the effect of watching-eye experiments modeled in a Dictator Game framework offers
153 robust results. Nettle *et al.* (2013) reported a meta-analysis of seven studies involving
154 887 participants and highlighted that while such cues did not give reliable results in
155 terms of mean donations, they did increase the probability of donating something
156 rather than nothing.

157 Ekström (2012) conducted a natural experiment in a chain of Swedish supermar-
158 kets, testing whether the probability of donating the money obtained from recycling
159 cans and bottles increased when a picture of human eyes appeared on the recycling
160 machines. Controlling for fixed effects (store and day), the picture positively affected
161 the sum donated and the effect was stronger when few people visited the store (reputa-
162 tion effect). Unlike the previous study, Schorn and Maurhart (2009) tested the effect
163 of supraliminal priming on prosocial behavior using the concept of honesty. They used
164 three different priming stimuli mirroring the words “honest”, “dishonest” and a mean-
165 ingless control word. The field experiment was performed among people using a toilet
166 at the motorway service area. They found that people primed with the concept of hon-
167 esty contributed more money than those not primed, while no significant difference
168 emerged between people primed with the word “dishonest” and those primed with the
169 word “honest” or not primed.³

170 Visual priming, using the concept of anchoring, has also been used to appraise the
171 impact on people’s WTP for a private good. For example, Dennis *et al.* (2015) per-
172 formed an experiment to evaluate whether irrelevant and relevant advertisements
173 affected a person’s WTP in an online auction. They found that the bid was higher
174 (lower) when participants were exposed to an advertisement with a high (low) price,
175 irrespective of whether or not the advertisement was relevant to the product. When the
176 auctioned good had a suggested price, advertisements only exerted an effect if they
177 were relevant to the products. Although somewhat different, the experiment conducted
178 by Koçaş and Dogerlioglu-Demir (2014) confirmed these findings. They also found
179 that priming not only affected average WTP but the whole distribution.

180 Building on these results, attention has also been devoted to priming as a way of
181 dealing with environmental problems and especially of boosting prosocial behavior.
182 While a substantial number of studies using contingent valuation have been carried out
183 to elicit people’s WTP and willingness to accept (WTA) in order to preserve an environ-
184 mental feature (e.g. biodiversity) or to estimate economic values for non-market
185 goods, few studies exist on the effect of priming on WTP and WTA.

186 A core question addressed by this new line of investigation is whether priming
187 environmental attitudes influence the perceived value of environmental goods. This is
188 a primary question first pursued by social psychologists. They tried to understand
189 whether and how exposure to different types of information (priming) aimed at activat-
190 ing social representations (e.g. traits, goals) affected representations in social judg-
191 ments and behaviors (Molden 2014). Building on Prospect Theory, another issue this

193 ³The authors argued that a possible explanation could be ambivalent perceptions of the word dishonest,
194 which could lead some people to process the primes *dishonest* and *honest* in similar ways. Using subliminal
195 priming based on value-laden words, Andersson *et al.* (2017) found no significant effect of priming on
196 donation but a positive effect among those with pre-existing pro-social preferences.

197 strand of literature tries to address is the impact of positive vs. negative frames on per-
198 ceived value and prosocial commitments.

199 Prospect Theory, developed by Kahneman and Tversky, argues that *humans*, as
200 opposed to *Econs*, do not always respond rationally to information or act rationally
201 under uncertainty. One of its implications is that the effectiveness of messages may
202 depend on framing. Unlike in standard economic theory, individuals may act differ-
203 ently to identical situations depending on whether the framing is positive (gain) or
204 negative (loss), because people tend to give more weight to loss than to gain.

205 The results are not homogeneous. In fact, while findings on the effect of priming are
206 quite robust, those on the type of message (positive vs. negative) depend on the experi-
207 ment and need additional investigation. In a survey carried out in the USA, participants
208 were asked to self-evaluate whether the information provided made them more or less
209 likely to buy organic food. It turned out that the impact of framing on the self-reported
210 likelihood was positive, but the loss-averse hypothesis was not proved (Gifford and
211 Bernard 2006). Li *et al.* (2017) obtained different results. They tested WTP for five runoff
212 management practices and found that while priming did not affect the likelihood of bid-
213 ding, it positively influenced the WTP of participants who placed bids. However, the dif-
214 ference was only statistically significant for those primed with positive framing.

215 This result somehow confirms the argument of Andreoni (1995), who reported
216 that, contrary to theory, subjects in positive-frame condition were more likely to
217 cooperate than subjects in negative-frame condition. Although incentives were identical
218 in the two frameworks, cooperation in public good provision was perceived to contrib-
219 ute to the well-being of others (positive externality), whereas in the case of a private
220 good with externality, it was perceived to make others worse off (negative externality),
221 i.e. “the warm-glow of creating a positive externality appears to be stronger than the
222 cold-prickle of creating a negative externality” (Andreoni 1995, 2).

223 This is consistent with Clarke *et al.* (1999) who conducted a computer-based
224 experiment among university students. They tested the impact of two contextual fac-
225 tors, i.e. social responsibility and editorial priming. Members of the first group were
226 informed that the outcome for the entire group depended on their individual choice,
227 whereas members of the second group were told that the outcome depended on the
228 choices of all participants. Participants were primed with a neutral or strong editorial
229 prime deriding environmental alarmists or informing about the dangers of pollution.
230 The results showed that environmental goods were valued more in the sole than in the
231 shared responsibility scenario, indicating the effect exerted by perceived social respon-
232 sibility. The assigned value, however, was not affected by priming.

233 The social responsibility scenario was confirmed by Spence and Pidgeon (2010) who
234 studied whether the way communication about climate change was framed could signifi-
235 cantly alter the response of recipients. They framed the same information in terms of gain
236 or loss outcomes and local vs. distant impacts. Other things being equal, they found that
237 gain frames were more effective than loss frames in inducing positive attitudes towards
238 climate change mitigation. Positive responses could also be obtained by focusing on the
239 social impacts of climate change mitigation rather than on personal/private consequences.

240 Following this line of investigation, we conducted an experiment to test the impact
241 of frames on people’s WTP a price premium for a smartphone with a high level of
242 recyclability. Instead of scramble games or imagery processes involving value-laden
243 words, it exploited a visual account of the life of a smartphone and posed the follow-
244 ing hypotheses:
245

246 *H1*: Priming affects people's environmental attitudes and awareness.

247
248 *H2*: When environmental goods are involved, perceived loss (deterioration – hold-
249 paradise option) is assigned more weight than perceived gain (decontamination –
250 recovering the paradise lost option).

253 **Study method and results**

254 ***Participants and procedure***

255
256 A total of 181 subjects (96 men and 85 women) were recruited using Facebook,
257 Instagram, and Twitter and invited to participate in a survey on smartphones and
258 multimedia cartoons by connecting to a web link. The data were collected by an
259 anonymous online survey using Google Forms. Google Forms randomly assigned par-
260 ticipants to three groups. Participants were told that they first had to watch a short
261 video and then fill in a questionnaire.

262 In order to be consistent with the title of the survey, the first part of the question-
263 naire included some questions on multimedia cartoons that had no relation to the goal
264 of our research. The second section was on smartphones and individual attitudes.
265 Respondents were asked to score various factors influencing their decision when buy-
266 ing a smartphone. Scores were on a 5-point scale, ranging from 1 (*not at all*) to 5
267 (*very important*). Respondents were also asked, other things being equal, whether they
268 were willing to pay a higher price for an ecological smartphone (highly recyclable)
269 and if so, how much. The third part concerned socioeconomic characteristics. Finally,
270 following Bargh and Chartrand (2014), we asked respondents whether they had noticed
271 anything specific during the survey and whether they thought the video influenced
272 their answers. The purpose of this question was to exclude any conscious or intentional
273 strategies, i.e. subjects who were aware of the stimulus.

274 While the questionnaire was the same for all participants, the videos were not.
275 They consisted of a sequence of black and white cartoons telling the lifecycle of a
276 smartphone. Two groups were primed. Priming consisted of an additional color cartoon
277 in both cases reproducing a person taking a picture with a smartphone. In one case
278 (nature priming), the cartoon had an uncontaminated landscape in the background, in
279 the other (urban priming), a congested road and some chimneys. In the first case, the
280 video ended with a cartoon showing a recycled smartphone in a shop window, whereas
281 in the second, it showed a smartphone in a dump. In the neutral video, these two car-
282 toons did not appear.

283 According to Prospect Theory, people's behavior is sensitive to information and
284 the way it is framed. It argues that they value gains less than losses and are therefore
285 less willing to take risks when considering gains than when avoiding losses. In other
286 words, people are risk-averse when considering the potential gain offered by a deci-
287 sion, and risk-seeking when considering the possible loss caused by a decision. Loss
288 frames are therefore more effective when behaviors considered risky are concerned,
289 whereas gain frames are preferred with behaviors considered safe (Banks *et al.* 1995;
290 Edwards *et al.* 2001).⁴

293 ⁴In health psychology, empirical evidence indicates that loss frames are more effective for encouraging
294 detection behavior and gain frames for encouraging prevention behavior (Rothman *et al.*, 2006).

Our hypothesis was that environmental protection may be better pursued within a loss frame. In our experiment, the natural environment setting is compatible with the prevention option because pro-environment behavior seeks to prevent future degradation or to ensure conservation (avoid a loss). On the contrary, the degraded environment setting is compatible with the cure option, since pro-environmental action may improve environmental quality (obtain a gain), i.e. recover the paradise lost.

Besides avoiding misunderstandings based on the comprehension of words or individual differences in scrambling ability, our experiment also avoided the problem of defining personal perspectives on risk and safety. By testing both frames in terms of WTP, it avoided bias due to monetary assessments (pay rather than accept) (Irwin 1994).

Before starting the experiment, a pre-test was conducted among university students. Several students were invited to take part in an off-line experiment. The pre-test did not reveal any particular difficulties and nobody noted a relationship between the video and the questionnaire. This confirmed that none of the students was aware of the stimulus.

Descriptive statistics and method

In view of the aim of the study, two distinct analyses were carried out. We first performed a descriptive investigation of the three samples. We then did an independent test for significant differences between groups. Due to sample characteristics and the type of variables (categorical or ordinal) the χ^2 or Kruskal–Wallis tests were used. Finally, logit and ordered logit models were developed to identify any correlation between priming frames and self-reported environmental attitude and WTP, which were treated as response variables. In order to test the robustness of the results and the role of other factors that are normally considered to affect individual attitudes, we also included other relevant determinants in the models. The data were analyzed using STATA software.

The total sample consisted of 181 individuals; 47% were females and 53% males; aged 18 to 54 years ($M=28.3$ $SD=9.5$). The youth of the participants was due to the type of experiment, a web-survey. Individuals were randomly assigned to three groups, two of which were primed. No systematic differences were detected in the structural characteristics of the groups (samples) (see Table 1).⁵ All participants declared that they had a smartphone. The groups did not show any significant dissimilarity in terms of spending habits: primed and non-primed subjects normally changed their phone every 3 years (median) and, on average, paid a similar price for it.

The effect of priming

In order to test the impact of priming, we analyzed differences in response variables between groups. Besides testing for differences in pro-environment attitude variables, we also investigated other aspects that may influence individual choices but that, in the authors' opinion, had no relationship with the frame. Table 2 shows the results.

⁵The only significant difference emerged for income. However, these data have to be taken with caution because 39% of participants did not answer the question. Data may also be non-homogeneous because the question could refer to own or family monthly income.

Table 1. Main sample characteristics (descriptive statistics).

Variables	Groups			Test <i>p</i> -value
	Neutral (<i>n</i> = 60)	Urban (<i>n</i> = 60)	Nature (<i>n</i> = 61)	
Gender				
Male	48.3%	58.3%	52.4%	0.544
Female	51.7%	41.7%	47.5%	
Age (mean)	29.8 (<i>SD</i> = 10.38)	27.3 (<i>SD</i> = 8.14)	27.8 (<i>SD</i> = 9.06)	0.3013
How often changed phone? (median, years)	3	3	3	0.3603
Price (mean, euros)	365 (<i>SD</i> = 107.5)	342 (<i>SD</i> = 129.2)	329 (<i>SD</i> = 100.6)	0.2070
Education				
Lower secondary	8.3%	10	4.92	0.77
Upper secondary	50%	50%	47.5%	
University (Bachelor)	28.3%	31.7%	39.3%	
Master	13.3%	8.33	8.2	
Work status				
Student	53.3%	55%	63.9%	0.434
Employed	40%	41.7%	27.9%	
Not employed	6.7%	3.3%	8.2%	

Table 2. Between-group analysis: descriptive statistics (sample, *n* = 181).

Factors influencing choice of smartphone (1 = <i>not at all</i> ; 5 = <i>very important</i>)				Kruskal–Wallis
Single items (median value)	Neutral	Urban	Natural	<i>p</i> -value
Price	3	3	4	0.1048
Advice from friends	2	2	2	0.1433
Advertising	1	1	2	0.3562
Ethical and environmental characteristics	2	2	3	0.0001
WTP				χ^2
Other things being equal, would you pay a higher price for an eco-friendly smartphone?				
No	33.3%	23.3%	9.8%	0.008
Yes	66.7%	76.7%	90.2%	
Reserve price				Kruskal–Wallis
What is the maximum difference you would be WTP? (median value)	10%	10%	10%	0.0099

The first part of Table 2 indicates the importance, on a 5-point scale, that respondents assigned to certain factors when purchasing a smartphone. Significant differences only emerged with respect to the ethical and environmental characteristics of the smartphone ($p = 0.0001$), which was one of the variables we used to test respondents' pro-environment attitudes. The other variables were WTP a higher price for an eco-friendly smartphone and the maximum premium one would be willing to pay for an eco-friendly smartphone. For both variables, significant differences emerged between groups ($p = 0.008$ and 0.0099 , respectively). With respect to the reserve price, although all groups had the same median value, we detected dissimilarities in the distribution (Table 3).

393 These results confirm that priming affected individual response. However, on
394 closer examination, the results were not so straightforward: there were differences
395 between loss and gain frames. This was shown by the differences between pairs of
396 groups (Table 4). Regarding the influence of ethical and environmental values on pur-
397 chase choice, the results confirm that priming did affect the subjects' environmental
398 consciousness. On the contrary, with regard to WTP and reserve price, i.e. maximum
399 premium, it emerged that significant differences only arose with respect to natural pri-
400 ming (loss adverse), compared to control (neutral) and urban-primed groups.

401 Having detected these differences in the responses, we tested for the type of impact
402 that priming had on our three variables, i.e. we tested whether priming boosted a pro-
403 environmental attitude, and in particular, whether loss frames were more effective
404 when dealing with behaviors considered risky. This we did by logit and ologit ana-
405 lysis. The results are shown in Tables 5–7.

406 In these models, the reference variables are those indicating a pro-environmental
407 attitude, i.e. the importance given to ethical and environmental aspects when buying a
408 smartphone (Table 5), WTP a higher price for an eco-friendly smartphone (Table 6)
409 and the maximum premium (as a percentage) respondents were willing to pay for such
410 a smartphone (Table 7). The covariate coefficient indicates the expected change in the
411 response variable implied by a unit increase in the predictor (i.e. moving from one
412 level to another of the variable) (odds ratio). Specifically, a coefficient greater (less)
413 than 1 means that a unit change in the independent variable increases (decreases) the
414 likelihood of obtaining a higher score for the dependent variable, quantified by the
415 coefficient (Long and Freese 2006).

416 For each reference variable, we show four estimates testing the link between pri-
417 ming and pro-environmental attitude. We started with a simple regression of the effects
418 of priming frames on reference variables. In the first case, we observed an effect of
419 priming on environmental attitude, both for gain (urban) and loss frames (nature),
420 though stronger in the latter case. The significant positive association did not seem
421 driven by other factors. In fact, the results did not change substantially when other
422 important control variables were added (models 2, 3 and 4). The positive effect of pri-
423 ming increased from model 1 to model 4, especially for nature priming, and the terms
424 remained robust in all specifications. Model 4 highlighted that gender and a high level
425 of education also have a positive impact, while the impact of smartphone price is
426 almost zero, though highly significant in all estimates.⁶ These results are in line with
427 those of other studies (Clarke *et al.* 1999).

428 As expected, the second and third estimates (Tables 6 and 7) gave slightly different
429 results. While confirming the irrelevance of a number of variables, the robustness of
430 estimates and the same behavior of the coefficients in the different models, they
431 showed that only the nature framing had an effect on WTP. The loss (nature) frame
432 considerably boosted the probability of WTP something for an eco-friendly smart-
433 phone. It also affected the percentage premium on the price that individuals were will-
434 ing to pay. Among those willing to pay something, the probability of offering a higher
435 price more than doubled. In both models, gender and smartphone price turned out to
436 be significant. However, as before, the impact of the latter was almost zero.

439 ⁶We venture to say that smartphone price could be a proxy for purchasing power. We did not consider
440 income because as stated earlier, 39% of participants did not answer this question and it is a sensitive
441 variable that can give rise to untruthful responses.

Table 3. Between-group analysis: max difference subjects were WTP (frequencies).

Group	Neutral	Urban	Nature
5%	40%	39.1%	18.2%
10%	35.5%	39.1%	34.6%
15%	12.5%	10.9%	25.4%
20%	7.5%	8.7%	16.4%
Over 20%	5%	2.2%	5.4%

Table 4. Between-group analysis (Wilcoxon–Mann–Whitney).

Items (<i>p</i> -value)	Neutral vs. Urban	Neutral vs. Natural	Urban vs. Natural
Ethical and environmental characteristics	0.0003	0.0000	0.0587
WTP ^a	0.2242	0.0017	0.0457
Reserve price	0.8938	0.0130	0.0044

^aTwo-sample test of proportions.

Discussion

Our findings confirmed both our hypotheses (*H1* and *H2*), namely that priming makes pro-environmental attitudes more salient and frame affects the probability of WTP for environmental protection and the size of the price one is willing to pay.

The mechanism of priming is well known: exposing people to stimuli activates associative memory and can make a particular attitude (in this case, a pro-environmental attitude) more salient and therefore more relevant to the decision to be made (Akerlof and Kranton 2000). In our case, the respondents were subject to two pairs of visual unconscious stimuli: an uncontaminated landscape and a happy recycled phone in the shop window in the natural frame; a degraded landscape and a sad phone in a dump in the urban frame. The control group received no stimuli.

When choosing a phone, consumers evaluate different items (e.g. price, technical characteristics and the intrinsic attractiveness of the brand, which are signals of phone quality and also reflect some form of social pressure). If consumers are not totally self-ish and have social preferences, they also consider the ecological footprint of the phone. Our results show that when primed, people tend to ascribe more importance to the ecological content of the good (Table 4). Our results, therefore, confirm that a significant number of people would be willing to take environmental problems into account when buying a mobile phone if stimulated to do so.

The regression results confirmed that exposure to priming significantly increased the probability of an ethical and pro-environmental attitude (Table 5): the coefficients also maintained their size and significance when some relevant control variables were added to the regression. The effect, therefore, appears quite robust. However, only the loss frame (nature priming) modified the probability of paying an ethical premium when buying a phone (Table 6) and the size of the premium (Table 7). As discussed below, the frame of the priming was not neutral.

It is no surprise that few control variables in the regressions were significant: the price paid for the last phone bought, and gender, were the most interesting. The first

Table 5. Ethical and environmental awareness: ologit regression (odds ratio).

Variables	(1)	(2)	(3)	(4)
Urban priming	3.546*** (1.236)	3.105*** (1.099)	3.340*** (1.194)	3.884*** (1.424)
Nature priming	6.652*** (2.382)	6.000*** (2.172)	6.664*** (2.446)	7.624*** (2.846)
Smartphone price		0.994*** (0.00136)	0.994*** (0.00140)	0.994*** (0.00140)
Upper secondary			0.864 (0.474)	1.043 (0.604)
University degree			1.359 (0.757)	1.693 (1.001)
Master degree			4.380** (2.973)	6.501*** (4.611)
Age				1.017 (0.0166)
Female				2.133*** (0.618)
Constant cut1	0.960 (0.238)	0.109*** (0.0621)	0.113*** (0.0828)	0.327 (0.316)
Constant cut2	5.075*** (1.435)	0.653 (0.359)	0.736 (0.526)	2.268 (2.197)
Constant cut3	23.14*** (7.898)	3.285** (1.830)	3.920* (2.812)	12.95*** (12.66)
Constant cut4	79.65*** (35.88)	11.97*** (7.410)	14.57*** (11.20)	50.59*** (51.65)
Observations	181	181	181	181
Pseudo R^2	0.0600	0.0965	0.119	0.136
LR χ^2	30.88	49.65	61.04	69.70

SE values in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

was always significant, although slightly different from one.⁷ This implies that the higher the price paid for the last phone purchased, the lower the probability of a pro-environmental attitude. If we consider phone price as an indicator of attention to mainstream phone features (high technical characteristics or fashionable brand), this result suggests a trade-off between private and social preferences: the higher the interest for private characteristics the lower the attention for social aspects. However, as we have said, although this effect was statistically significant, it was almost zero.

Unlike the previous variable, in all regressions, the gender effect was significant and not negligible in size. This is consistent with the results of other studies showing that women have relatively stronger environmental concerns and behavior than men (Dietz *et al.* 2002; Vicente-Molina *et al.* 2018). Being a female significantly increased the probability of having a pro-environmental attitude, WTP an ethical premium, and the size of the premium. It also indicated that the effect of priming was stronger.

⁷These are odds ratios: a coefficient greater (less) than 1 means a higher (lower) probability of obtaining a higher (lower) score for the dependent variable, quantified by the coefficient. This means that a value close to 1 implies no impact.

Table 6. WTP a higher price for an eco-friendly smartphone: logit regression (odds ratio).

Variables	(1)	(2)	(3)	(4)
Urban priming	1.643 (0.674)	1.572 (0.652)	1.652 (0.698)	1.887 (0.821)
Nature priming	4.583*** (2.336)	4.217*** (2.168)	4.269*** (2.222)	4.854*** (2.591)
Smartphone price		0.997* (0.00160)	0.997* (0.00168)	0.997 (0.00170)
Upper secondary			1.631 (1.043)	1.737 (1.209)
University degree			2.406 (1.648)	2.811 (2.087)
Master degree			5.714* (5.571)	7.207* (7.324)
Age				1.020 (0.0220)
Female				2.049* (0.823)
Constant	2.000** (0.548)	5.595*** (3.697)	3.049 (2.606)	0.990 (1.178)
Observations	181	181	181	181
Pseudo R^2	0.0544	0.0702	0.0940	0.117
LR χ^2	10.40	13.42	17.98	22.46

SE values in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Our findings also confirmed the second hypothesis ($H2$), showing that nature (loss) frame was much more effective than the urban (gain) frame. The two priming schemes produced different effects. Table 4 shows that while both increased the importance that agents attributed to the ethical and environmental characteristics of the phone, only the natural framework had a significant effect on WTP and on the size of the ethical premium consumers were willing to pay. The agents seemed to behave differently according to the type of stimulus they received. Priming was therefore effective, but the way it was designed also mattered a lot. We could say that both priming stimuli changed the attention paid to environmental problems, but only positive-framed (nature) priming had an effect on WTP. In economic terms, while the urban frame contributed to making “externalities” potentially relevant, the nature frame made them Pareto-relevant.⁸

The regression results support this conclusion. In considering WTP and the amount of the ethical premium, being primed with a positive stimulus (nature priming) significantly increased the probability of paying an ethical premium (Table 6) and of paying a higher premium (Table 7). The results were relatively unaffected by the introduction of the control variables, whereas the effect of urban priming (negatively framed), though positive, was less than that of nature priming and never statistically significant. Urban priming was, therefore, unable to increase the probability of paying an ethical premium when buying a smartphone.

Our results suggest that while both priming mechanisms reminded consumers of the importance of the environmental content of the phone choice, only the positive

⁸For a distinction between relevant and Pareto-relevant externalities, see Buchanan and Stubblebine (1962).

Table 7. Maximum price premium for an eco-friendly smartphone: ologit regression (odds ratio).

Variables	(1)	(2)	(3)	(4)
Urban priming	0.946 (0.379)	0.815 (0.332)	0.936 (0.384)	1.047 (0.434)
Nature priming	2.687** (1.044)	2.272** (0.889)	2.822** (1.149)	3.082*** (1.264)
Smartphone price		0.996** (0.00145)	0.996** (0.00149)	0.996*** (0.00151)
Upper secondary			0.391 (0.257)	0.675 (0.499)
University degree			0.457 (0.305)	0.778 (0.585)
Master degree			1.295 (1.005)	2.852 (2.480)
Age				1.029 (0.0206)
Female				1.982** (0.643)
Constant cut1	0.625 (0.191)	0.161*** (0.102)	0.0832*** (0.0699)	0.421 (0.512)
Constant cut2	3.147*** (1.012)	0.856 (0.525)	0.472 (0.384)	2.545 (3.084)
Constant cut3	8.640*** (3.128)	2.451 (1.513)	1.383 (1.114)	7.734* (9.401)
Constant cut4	36.72*** (18.52)	10.68*** (7.486)	6.101** (5.298)	35.66*** (45.25)
Observations	141	141	141	141
Pseudo R^2	0.0259	0.0412	0.0573	0.0755
LR χ^2	10.31	16.42	22.85	30.12

SE values in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

framework produced a change in their intentions by increasing their WTP. As stated before, this result is consistent with the loss aversion and endowment effect and is in line with a similar result obtained by Spence and Pidgeon (2010).

Another tentative explanation may be based on the conditional cooperation hypothesis of Fischbacher *et al.* (2001), who showed that in an experimental situation in which a public good has to be financed and people have the chance to free ride, people behave differently according to personality traits and beliefs. They observed three groups of people: unconditional co-operators, who tended to finance the public good irrespective of others' contributions; selfish people, who did not contribute irrespective of others' behavior; conditional co-operators (the most numerous), whose contribution to the public good was positively correlated with their beliefs about the contributions of other people (Chaudhuri 2011).

In our framework, reducing e-waste is a public good that can be financed by paying an ethical premium when acquiring a sustainable phone. If we reasonably assume that among our subjects there are conditional cooperators, we can conclude that they are conditioned differently by the two priming settings. The negative framework – the degraded environment and the sad phone discarded in a dump – conveys the belief

638 that other people are not contributing; otherwise, the situation would be better. This
639 can be expected to reduce conditional cooperators' willingness to contribute. On the
640 other hand, the positive framework – a natural environment and a happy recycled
641 phone in the shop window – implies a situation in which most people are considering
642 environmental problems and behaving virtuously, and it increases conditional cooper-
643 ators' willingness to contribute.

644 The idea is very simple. Priming makes two different attitudes more salient: envir-
645 onmental awareness and conditional cooperation. In the case of a positive framework,
646 both stimuli go in the same direction and produce the same results, increasing the
647 importance ascribed to phone ethical features and WTP something (an ethical pre-
648 mium) to contribute to the solution. In the case of a negative framework, they go in
649 opposite directions, partially offsetting each other, at least for subjects who are aware
650 of the environmental problem but are only conditional cooperators.

651 It is not surprising that while there was no significant difference in the importance
652 attributed to environmental features in the two frameworks (first row of [Table 4](#)),
653 major differences emerged for WTP (second and third rows of [Table 4](#)). WTP and its
654 size are a measure of the contribution that an individual makes to production of the
655 public good. In the urban framework, conditional cooperators do not contribute, since
656 the priming received suggests that others are not contributing. Obviously, this second
657 explanation does not exclude the previously mentioned loss aversion and endowment
658 effects, which can coexist and operate simultaneously.

660 **Concluding remarks**

661 The present study addressed the intriguing issue of whether beliefs and external stimuli
662 affect people's preferences (Bowles [2016](#); Bowles and Polanía-Reyes [2012](#)). It demon-
663 strated that, in the case of a smartphone purchase, people's behavior and appraisal of
664 the phone's private and social characteristics were affected by priming and frames.
665 Consistently, it argued that non-technical tools may help in pursuing sustainable
666 development.

667 Unlike other studies, it was based on a web survey of a video cartoon story, i.e. it
668 used a visual priming technique. This avoided problems due to a misunderstanding of
669 words or differences in individual capacity. Participants had to watch a video and then
670 answer a questionnaire aimed at testing their environmental attitude and WTP. Besides
671 testing for a priming effect, the study also aimed at verifying loss aversion and endow-
672 ment effect (Kahneman and Tversky [1979](#)). It tested all frames in terms of WTP so as
673 to avoid bias induced by monetary assessments implied by the WTP and WTA frame-
674 work (Irwin [1994](#)).

675 The results showed that priming and its frame were the main variables determining
676 differences between groups. In particular, they highlighted that while priming increased
677 the likelihood of attention to the ethical and environmental characteristics of a good
678 (smartphone), frames affected WTP a price premium for a smartphone with a higher
679 level of recyclability. In other words, among people with pro-social traits, priming
680 increased the probability that externalities became potentially relevant while framing
681 raised the probability of making externalities Pareto-relevant. This finding is in line
682 with those of other studies (e.g. Spence and Pidgeon [2010](#)). Moreover, if one accepts
683 our interpretation of urban and natural settings, it confirms the loss aversion and
684
685
686

687 endowment effect. It is also consistent with the conditional cooperation hypothesis
688 (Chaudhuri 2011; Fischbacher *et al.* 2001).

689 Our results have interesting policy implications. They show that people's aware-
690 ness of the severity of environmental problems may be boosted by nudges. If appropri-
691 ately primed, nudges also increase their willingness to help solve the problem. We
692 can, therefore, expect a proper information campaign, based on non-technical tools, to
693 complement other policies for developing more environmental consciousness in con-
694 sumers and sustainable development.

695 However, our results suggest that nudging is effective when it occurs during the
696 decision process. A tentative example of a policy measure exploiting this idea could
697 be the introduction of a (compulsory) visual label on the shelves, indicating an environ-
698 mental rating. When choosing a new item, such as a smartphone, the consumer
699 receives many different stimuli (advertisements, fashion and social pressure, advice
700 from friends, etc.). The label is an additional stimulus, reminding potential buyers of
701 the ecological value of the good. In the sense of Thaler and Sunstein, this nudge
702 (implicitly) enriches the consumer's information set and "forces" those with pro-social
703 preferences to adjust their choice in order to maximize their utility. The label would
704 reinforce consumers in their pro-environmental attitude and produce a double dividend:
705 higher private utility and improved social welfare (better environmental quality).

706 These results are confirmed by the gender and education effect. Many studies have
707 shown that women have more pro-social preferences, while education has been widely
708 considered a determinant of individual environmental awareness. Our experiment con-
709 firmed both these aspects since gender and higher education reinforced the prim-
710 ing effect.

711 Our results also suggest that a positively framed stimulus is far more effective than
712 a negatively framed one. This means that any public campaign should not just stress
713 the negative features of a polluted world. Our results indicate that it is more effective
714 to stress and emphasize what people risk losing if they do not change their behavior,
715 presenting the problem in a positive frame. Such campaigns should also emphasize
716 that many people are working to solve environmental problems and that good practices
717 are happening in society: in this way, they do not discourage conditional cooperators
718 from making their contribution.

719 Although interesting, our study is not without its limitations, some common to
720 other such studies. The first is the representativeness of the sample obtained by a web
721 survey. Our average subject was young, educated, willing and able to use social media,
722 and therefore not the average Italian citizen. It would, however, be unfair to say that
723 our results have no value. They can be seen as a step in a new direction.

724 Another aspect worth noting concerns the survey technique. The experiment used a
725 stated preference approach. As we know, differences may arise between stated and
726 actual behavior (revealed preferences). Stated preference is a survey-based technique
727 often used for establishing valuations (contingent valuation). It may give rise to prob-
728 lems, such as the respondent being deliberately misleading for reputational effect
729 (wanting to appear in a positive light); as well, people often have a poor understanding
730 of what they are asked to value. In our opinion, however, our method avoided both
731 these problems, because the survey was anonymous and participants were "hidden" by
732 the web. The nature of the visual stimulus was also very simple for people of any age
733 and educational level to understand. Revealed preference techniques would naturally
734 shed new light on the issue and ensure sounder results. The analysis in greater depth,
735

involving a larger and more representative sample, would make it possible to infer more general results.

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