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Postprint

This is the accepted version of a paper published in *Ecological Economics*. This paper has been peer-reviewed but does not include the final publisher proof-corrections or journal pagination.

Citation for the original published paper (version of record):

Farjam, M., Nikolaychuk, O., Bravo, G. (2019)

Experimental evidence of an environmental attitude-behavior gap in high-cost situations

Ecological Economics, 166: 1-12

<https://doi.org/10.1016/j.ecolecon.2019.106434>

Access to the published version may require subscription.

N.B. When citing this work, cite the original published paper.

Permanent link to this version:

<http://urn.kb.se/resolve?urn=urn:nbn:se:lnu:diva-88153>

Experimental evidence of an environmental attitude-behavior gap in high-cost situations

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Abstract

So far, there has been mixed evidence in the literature regarding the relationship between environmental attitudes and actual ‘green’ actions, something known as the attitude-behavior gap. This raises the question of when attitudes can actually work as a lever to promote environmental objectives, such as climate change mitigation, and, conversely, when other factors would be more effective. This paper presents an online experiment with real money at stake and real-world consequences designed to test the effect of environmental attitudes on behavior under various conditions. We found that environmental attitudes affected behavior only in low-cost situations. This finding is consistent with the low-cost hypothesis of environmental behavior postulating that concerned individuals will undertake low-cost actions in order to reduce the cognitive dissonance between their attitudes and rational realization of the environmental impact of their behavior but avoid higher-cost actions despite their greater potential as far as environmental protection. This finding has important consequences for the design of more effective climate policies in a democratic context as it puts limits on what can be achieved by raising environmental concern alone.

Keywords: Climate change mitigation, Low-cost hypothesis, Online experiment, Collective-risk social dilemma

1 Introduction

An established research finding is that environmental attitudes of people only loosely translate into actions able to effectively reduce their environmental impact, something known as the attitude-behavior gap (Carrington et al. 2014; Kollmuss and Agyeman 2002; Hassan et al. 2014; Peattie 2010) or value-action gap (Barr 2006; Babutsidze and Chai 2018). This effect is especially relevant in the context of climate change mitigation, where unsustainable behaviors are maintained in the face of increasing evidence for the necessity of a rapid change (Flynn et al. 2009; Lorenzoni et al. 2007; Whitmarsh 2009) and even policy makers seem unwilling to propose the most effective actions to the public, possibly fearing their unpopularity (Wynes and Nicholas 2017). On the other hand, dissemination of correct information and environmental education are considered key to promote sustainability (Nisbet 2009; Wals et al. 2014; Liefänder and Bogner 2014). This raises the question of when attitudes can actually work as a lever to promote environmental objectives and, conversely, when other factors — e.g., tariff-based policies — could be more effective.

There have been several studies suggesting that the literature on energy-saving behavior, much of which is comprised of conceptual and normative work, would benefit from empirically driven rigorous research able to carefully evaluate the interplay of economic and psychological factors motivating the decisions of people (van den Bergh 2008; Stern et al. 2016). Following this line of

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reasoning, we present a behavioral experiment where the interaction between costs and attitudes is the object of such inquiry. As a means of adding realism, the decision situation was explicitly framed in terms of climate change mitigation and enabled the participants to use their endowments for climate protection initiatives (see Tavoni et al. 2011). We used this setting to test an intuitively simple but still debated concept — the *low-cost hypothesis of environmental behavior* (Diekmann and Preisendörfer 1998, 2003) — according to which environmental attitudes promote ‘green’ actions when the related behavioral costs are low but render irrelevant when people have to bear significant costs or discomfort in order to protect the environment effectively. Worse than that, low-cost actions tend to crowd out more effective enterprises as people often become satisfied with their low-cost mode of conduct and no longer seek alternatives, despite their higher potential. Environmentally concerned individuals are hence more likely to undertake actions that are easy to execute, do not require considerable investments etc. — such as switching off the lights or buying organic foods — but not actions imposing significant behavioral costs in exchange for progressively larger environmental benefits — such as cycling to work or reducing air travel — thus in effect, largely ignoring the efficacy of their behavior.

To understand why this displacement takes place, it is important to note that the low cost hypothesis has its psychological foundation in the theory of cognitive dissonance, which generally states that people experience discomfort when discovering inconsistencies between their various cognitions as well as between their cognitions and behaviors, and will actively seek ways of relieving the tension (Festinger 1962). In our case, environmentally concerned individuals use low-cost/easy-to-execute actions as a means of reducing the cognitive dissonance between their attitudes and rational realization of the environmental impact of their actions. This has the effect of lowering their cognitive dissonance to a bearable level, which consequently reduces their motivation to take further, potentially more effective steps (Diekmann and Preisendörfer 1998; Fishbach et al. 2006).

It is quite peculiar that within environmental economics and psychology, cognitive dissonance has been studied predominantly as a potential factor *promoting* green behavior. For instance, Kantola et al. (1984) showed in an experimental setting that participants knowledgeable of an inconsistency between their environmental attitudes and actual consumption of electricity saved more electricity than the control group over a period of two weeks. Similarly, a large-scale field experiment on adopting paper-free energy bills found that dissonance-inducing messages increased the overall adoption rate considerably in comparison with the provision of general information about the associated environmental benefits (Gosnell 2018).

Nevertheless, Gosnell (2018) observed that the above increase of the adoption rate was not uniform across all socio-demographic groups and that the messages were actually backfiring as far as highly educated targets, indicating a potential caveat in the utility of cognitive dissonance. More generally, there is a growing body of evidence suggesting that the relationship between attitudes and behaviors is complex and mediated by numerous factors (Keuschnigg and Kratz 2017; Nauges and Wheeler 2017; Stern et al. 2016). This complexity is also reflected in earlier attempts to test the low-cost hypothesis empirically, which often led to contradictory findings. For instance, in their review of survey-based works, Kaiser and Schultz (2009) found a ‘substantial’ relationship between environmental attitudes and pro-environmental behavior. However, this was true for intermediate-cost behavior only. The authors themselves note that virtually everybody undertook very low-cost/easy to execute pro-environmental activities, hence leaving no room for the effect of attitudes. On the other hand, attitudes had virtually no effect on high-cost/difficult to execute activities, which goes in line with the low-cost hypothesis. Now, contrary to the low-cost hypothesis, Kriwy and Mecking (2011) found a relatively weak relationship between environmental attitudes and decisions to purchase organic food, as well as no interaction whatsoever between attitudes and behavioral costs.

The few existing natural experiments and intervention studies, often focusing on recycling behavior, also led to mixed evidence, suggesting that environmental attitudes may only predict behavior in select contexts (Best and Kneip 2011), for specific social groups (Lanzini and Thøgersen 2014), or under limited conditions when interacting with some social norms (Keuschnigg and Kratz 2017).

Despite its current weak empirical status, if carefully tested and rigorously confirmed, the low-cost hypothesis could potentially help explain why educational campaigns and other attempts to increase environmental concern may lead to vastly different outcomes in various situations, and even backfire in some cases (Chang 2012). For instance, Babutsidze and Chai (2018) observed that high environmental concern and significant social pressure can produce heterogeneous behaviors associated with the differences in individual lifestyles. Since differences in lifestyles imply differences in costs associated with the same behavior across the individuals, the low-cost hypothesis would predict that the concerned individuals select those behaviors that incur lower costs for them, not necessarily those that are more effective from the environmental perspective. More generally, the low-cost hypothesis could help better separate those cases where one can expect attitudinal factors to work towards promoting green behavior from those where economic incentives would be more effective (Jackson 2005; Lorenzoni et al. 2007).

2 Design

In order to test the low-cost hypothesis under controlled conditions, we conducted an online experiment with real-world incentives on a sample of adult US residents (identified through their IP address). Among other things, the participants had to trade off individual monetary gains vis-à-vis helping offset actual carbon emissions, which allowed for a proper test of the relationship between attitudes and costs on one side and real behavior on the other. The participants were recruited via Amazon Mechanical Turk (MTurk) and the experiment was programmed using oTree (Chen et al. 2016). The general design was based around an established protocol — the collective-risk social dilemma (CRSD) (Milinski et al. 2008) — that provided several advantages. First, the CRSD has been tested in a number of studies which, among other things, expanded the original design to include such factors as inequality (Tavoni et al. 2011), ambiguous thresholds (Dannenberg et al. 2015) and residual risk (Farjam et al. 2018, 2019). Second, not only does the protocol have a clear frame of climate change mitigation but the participants' actions have an actual positive impact on the environment (in our study, purchasing of carbon offset certificates), all while maintaining a rigorous experimental structure. This enabled the participants with actual environmental concerns to make incentivized decisions with real environmental consequences in a clean setting.

In our CRSD game, six players made individual decisions over the course of 10 rounds about whether or not to contribute to what was called the *climate account* (C). Each player had an initial endowment of 40 experimental currency units (ECU) and in each round, could contribute 0, 2, or 4 ECU to the climate account. The contributions were public, not refundable, and whether or not a group threshold of $C = 120$ ECU was reached by the end of the game affected how the payoffs were determined. In case of success (i.e., $C \geq 120$ ECU), the players received what remained of their endowments. In case of failure (i.e., $C < 120$ ECU), they faced a common risk of losing what remained of their endowments with a predetermined and known probability p . The participants were told that an average individual contribution of 2 ECU per round was needed to reach the group threshold (i.e., a total contribution of half of the individual endowment by the end of the game).

Following the original parametrisation of the CRSD game (Milinski et al. 2008), we considered three levels of risk: $p \in \{0.1, 0.5, 0.9\}$. In addition, we varied the conversion rate between ECU and USD across the treatments: 10:1 and 1:1 in the low-cost and high-cost conditions, re-

spectively. The participants also filled out a post-experiment questionnaire with items assessing their environmental concern and positioning on the left/right-wing political scale. The contributions to the climate account had real-world consequences in that they were used to finance carbon offset initiatives. In total, an equivalent of 4800 USD was contributed to offset 14,500 t of CO₂ via the United Nations platform for voluntary cancellation of certified emission reductions.

As a side effect of relying on the CRSD protocol, the individual endowment, not just the cost of contribution, had to be scaled up in the high-cost conditions. While this could be considered as a technical limitation, we believe that given the context of the decision situation, the participant motivations were not limited to the pecuniary incentives provided by the endowment, and that the benefits of staying within an established paradigm make it worthwhile in the end.

Within the scope of our experimental design, the low-cost hypothesis predicts that, in the low-cost conditions, the participants with a high level of environmental concern should contribute more than those with a low level of environmental concern. In the high-cost conditions, due to the tenfold increase of the contribution cost, one's environmental concern should matter considerably less, if at all. More specifically, the low-cost hypothesis leads to the following predictions in our setup: (i) *positive* main effect of environmental concern on the contribution to the climate account; (ii) *negative* effect on the contribution of the interaction between environmental concern and costs, potentially negating the first effect completely in the high-cost conditions.

As a means of control as well as to rule out the potential use of software bots, the participants were required to provide correct answers to at least 3 out of 7 comprehension questions. The participants received on-screen instructions identical to those in the baseline treatment of Farjam et al. (2019) (except for the ECU to USD conversion rate), which included a brief explanation of the problem of global warming and use of the funds contributed to the climate account. If qualified, they would play 10 periods of the common-risk social dilemma game and finally, would be asked to fill out a short, non-incentivized questionnaire eliciting their political orientation and environmental concern using questions derived from the World Value Survey (World Values Survey Association 2014)¹.

3 Results

A total of 714 people were recruited for the experiment. The game was played only once and all player interaction was anonymized. We excluded 9 groups where some participants left amidst the game or did not fill out the questionnaire from the analysis, which resulted in a total of 660 players in 110 groups. The average individual payment was 3.4 USD in the low-cost conditions and 21.5 USD in the high-cost conditions (including a 'show up' fee of 1.3 USD) for an average duration of 15 minutes. Compared to the usual hourly payment on MTurk of approximately 10 USD, the incentives were substantial, especially in the high-cost conditions.

Figure 1 shows an overview of the general time trends of the contributions over the 10 rounds of the CRSD game. As one can see, the contributions were generally higher and the differences between the various levels of risk were more pronounced in the high-cost conditions. Since the participants had to make decisions repeatedly before the final outcome would be realized, instead of taking the contributions at their face value we followed previous research (Farjam et al. 2018) in considering the cumulative *distance from the reference* contribution as the dependent variable. This distance from the reference was computed for each participant and round as follows:

$$\Delta_i^t = \sum_{\tau=1}^t C_i^\tau - 2t, \quad (1)$$

¹All data and scripts needed to reproduce the analysis can be downloaded from <https://dataverse.harvard.edu/privateurl.xhtml?token=6d7b7275-efac-414e-bd14-7a33f4e941a5>.

where i and t respectively index the participant and round, and $C_i^\tau \in \{0, 2, 4\}$ denotes the contribution of participant i in round τ , $\tau \in \{1, 2, \dots, t-1, t\}$. The number 2 represents the fair reference contribution needed to reach the group-level threshold of 120 by the end of the game. One key advantage of this metric is that it makes it clear if a given participant is 'on track' during the course of the experiment.

Figure 1: Distance (in experimental currency units) of the individual contribution from the reference (see Eq. 1) per treatment. Points represent per-round averages, splines (with 95%-confidence bands) represent smoothed time trends.

Figure 2 shows the average contributions in the low- and high-cost conditions, separately for the participants with low (values smaller or equal to 5 on a 1–10 scale) and high levels of environmental concern. In line with the low-cost hypothesis, the participants with a high level of environmental concern contributed more to the climate account in the low-cost condition, while there was no apparent difference in the high-cost conditions. Note, as indicated by the overlapping of the standard errors, neither the treatment differences between the highly environmentally concerned individuals, nor the differences within the high-cost treatment were significant.

In order to formally test the predictions of the low-cost hypothesis, we used a mixed-effects ordered logit regression model, with the individual contribution to the climate account in each round as the dependent variable. To account for the common (non-linear) time trend, the model included fixed effects for *round* and *round squared*. Since the low-cost hypothesis predicted a negative interaction effect between *environmental concern* and *cost* of supporting climate change mitigation activities, the model included fixed effects for both, as well as for their interaction. As the last set of fixed effects, we added binary variables capturing the various levels of risk faced by the participants. Finally, to account for the possible correlation structure within the data, the model included random effects at the group and participant level. The latent dependent variable was therefore specified as follows:

$$y_{g,i,t}^* = \beta_1 \cdot \text{round}_t + \beta_2 \cdot \text{round}_t^2 + \beta_3 \cdot P5_g + \beta_4 \cdot P9_g + \beta_5 \cdot HC_g + \beta_6 \cdot ENV_{g,i} + \beta_7 \cdot HC \times ENV_{g,i} + v_g + v'_{g,i} + \varepsilon_{g,i,t}, \quad (2)$$

where g , i and t respectively index the group, the participant within the group, and the round; $P5_g$ and $P9_g$ equal one if the group is assigned to the treatment with a moderate ($p = 0.5$) or high

Figure 2: Average individual contribution (in experimental currency units), separately for the participants with low and high levels of environmental concern. Whiskers represent the standard errors.

($p = 0.9$) level of risk and zero otherwise ($p = 0.1$); HC_g equals one if the group is assigned to the high-cost treatment (1 ECU = 1 USD) and zero otherwise (10 ECU = 1 USD); $ENV_{g,i}$ captures the individual environmental concern; and v_g and $v'_{g,i}$ represent the random effect at the group and participant level, respectively.

To fit the data to the model, we adopted the Bayesian framework with vague priors and estimated the posterior distributions of the coefficients using the *brms* package (Bürkner 2017) for the *R* software environment (R Core Team 2018). The results are based on sampling from two independent chains with 5000 + 5000 samples each and presented in Table 1 (Model 1). As indicated by the signs of the coefficient estimates and the associated Bayes factors, we found very strong evidence (Kass and Raftery 1995) in favour of a *positive* effect of environmental attitude on contribution behavior as well as strong evidence in favour of a *negative* interaction effect between environmental attitude and costs, which supports the low-cost hypothesis. In addition, we found positive evidence in favour of a *positive* effect of risk level, which is in line with most replications of the CRSD game (Milinski et al. 2008; Tavoni et al. 2011; Dannenberg et al. 2015; Farjam et al. 2018).

In many countries around the world, and especially so in the US, political affiliations and environmental attitudes tend to correlate, resulting in a growing polarization on such topics as climate change and environmental protection (McCright et al. 2014; Dunlap and McCright 2008; Hornsey et al. 2018). This was also the case in our sample, where the environmental attitude of the participants was correlated with their self-assessment on the political left/right-wing scale (Spearman's $\rho = -0.44$). Since it is quite plausible that the same latent factor underlies the two measures, we aggregated them into one index, dubbed left-wing environmentalism (LWE). By doing so, we hoped to better capture the signal underlying the two individual measures through a reduction of the measurement noise. Model 2 in Table 1 presents the coefficient estimates when using this aggregated index. They are qualitatively similar to the ones found by the first model but provide even stronger evidence as far as the interaction effect.

	Model 1			Model 2		
	Estimate	[CI ₉₅]	Bayes factor	Estimate	[CI ₉₅]	Bayes factor
p = 0.5	0.15	[-0.14; 0.47]	1:5	0.16	[-0.15; 0.48]	1:5
p = 0.9	0.18	[-0.11; 0.48]	1:7	0.19	[-0.11; 0.52]	1:8
high-cost	0.03	[-0.23; 0.31]	1:1	0.05	[-0.22; 0.33]	1:2
env.	0.38	[0.24; 0.53]	1:10000			
high-cost × env.	-0.28	[-0.54; -0.01]	47:1			
LWE				0.34	[0.20; 0.49]	1:10000
high-cost × LWE				-0.42	[-0.69; -0.13]	624:1
round	0.24	[0.16; 0.32]	1:10000	0.24	[0.16; 0.32]	1:10000
round ²	-0.03	[-0.04; -0.03]	10000:1	-0.03	[-0.04; -0.03]	10000:1

Table 1: Coefficient estimates for the mixed-effects ordered logit regression model of the individual contribution to the climate account. The Bayes factors correspond to the posterior probabilities of the estimates being larger than zero. For comparability, the coefficients for *env.* and *LWE* were standardized. Sampling was done on two independent chains with 5000 + 5000 samples each.

4 Discussion

Our experiment showed that the effect of environmental attitude on contributions, while positive in principle, depends on the cost of such behavior, which is in line with the prediction of the low-cost hypothesis. In contrast to earlier works presenting mixed evidence on the issue, by conducting a controlled experiment with monetary incentives and real-world consequences we were able to account for potential confounds and investigate the causal link between costs and contributions to climate change mitigation. An additional degree of realism was warranted by the fact that the study was conducted on a sample of adult US residents.

The main limitation of our work lies in the domain of external validity due to the duration of the experiment and the relative abstractness of contribution behavior. The actual climate ‘game’ is being played on a considerably larger time and spatial scale and presupposes real physical (inter)actions. In addition, the amounts available to the participants in our experiment were extremely low compared to the investments needed as part of the global scale mitigation initiatives able to reduce the risks of climate change significantly. Nevertheless, even though our model of individual behavior in the context of collective action for climate is somewhat abstract, the practical relevance of insights provided by the CRSD protocol that has been repeatedly shown both in the economic and environmental research literature (Milinski et al. 2008; Tavoni et al. 2011; Dannenberg et al. 2015; Farjam et al. 2018, 2019).

It is also worth noting that CRSD players not only face individual risk but also have to solve a collective action problem as joint effort is required to reach the necessary threshold (see the analysis by Milinski et al. 2008; Farjam et al. 2018). This is in line with the argument made by Paavola (2001) regarding sustainable consumption, according to which the interdependence of actions among the agents makes collective interventions a more effective means of reaching sustainability than simply increasing environmental concern as heterogeneity of said concern can still lead to sub-optimal environmental outcomes.

Our findings put forward the idea that reinforcing environmental concern through communication and education is only going to have a meaningful effect in basic, low-cost situations while considerably stronger incentives (e.g., electric car subsidies) and/or structural changes able to lower the cost of the most effective actions (e.g., investment into infrastructure such as fast recharge networks) are required otherwise. That said, raising concern may still have indirect positive effects, for instance by increasing support for more ambitious environmental policies (Diekmann

and Preisendörfer 1998; Stehr 2015).

As far as practical policy making goes, relying on soft ‘nudges’ such as using green energy schemes as the default as opposed to more to-the-point interventions such as carbon taxation (perhaps, to avoid upsetting the public) can actually backfire in the long run. In a recent vignette study, Hagmann et al. (2019) show that introducing nudges to purchase green energy crowds out the participants’ support for carbon taxes. From this perspective, it is especially unfortunate that current decision makers tend to propose simple but barely effective ways of fighting climate change in public reports and even schoolbooks while at the same time, avoid discussing more controversial but vastly superior ways (Wynes and Nicholas 2017). While this hesitation is understandable in light of the recent opposition to raising the cost of fossil fuels in several countries (Carattini et al. 2019), one must be aware that low-scale low-cost interventions are almost certainly insufficient to prevent climate change (IPCC 2018; Rogelj et al. 2018).

A side question is whether or not the low-cost hypothesis could be extended to other domains. Indeed, it seems quite plausible to end up with the same result if the cognitive dissonance between one’s beliefs and behavior is reducible through low-cost low-effect actions regardless of the context. To this effect, Akhondan et al. (2015) and Kriwy and Mecking (2011) report a strong association between one’s health consciousness and consumption of organic food, a relatively low-cost behavior, while Newsom et al. (2005) find a significantly weaker association between one’s health consciousness and more demanding activities such as refraining from smoking or exercising regularly. Similarly, many Germans supported, among other things financially, the inflow of migrants during the refugee crisis of 2015. Their willingness to pay for such programs, however, appears to be negatively related to the number of immigrants in their close proximity, possibly due to an increase in the associated costs for the local welfare systems (Schmidt-Catran and Spies 2016). These examples suggest that the low cost-hypothesis could be applied to a wide variety of phenomena and is worth exploring in further experiments.

5 Conclusion

Due to the complexity and diversity of factors affecting human behavior it is difficult if at all possible to draw any clear conclusion as far as the low-cost hypothesis of environmental behavior from the existing literature. As a clean test of the interplay between environmental attitudes and actual behavior under various cost conditions, we implemented an online experiment with a large and representative sample of US residents, real money at stake and the possibility for the participants to invest in climate change mitigation initiatives (in the form of carbon offset credits). By considering participants varying in their level of environmental concern, we found that such attitudes have a positive behavioral effect only in case the associated costs are low.

To the best of our knowledge, this represents the first experimental confirmation of the low-cost hypothesis of environmental behavior based on a large sample of residents of one of the most polluting countries in the world as far as greenhouse gas emissions. Consequently, it implies rather important prescriptions for the design of effective climate policies. First, in line with the recent results of Hagmann et al. (2019), our finding suggests that running generic information campaigns or ‘nudging’ the public towards lower-impact actions may not just fail to reduce emissions down to the level sufficient to keep the temperature rise within 2°C of pre-industrial levels (IPCC 2018) but can actually backfire by preventing the adoption of more incisive measures. More comprehensive and carefully designed policies, taking into account the complexity of human motivations, would be better suited for this purpose (Hagmann et al. 2019; Stern et al. 2016).

Second, the complex interplay of economic and psychological factors highlighted by our experiment as well as by previous research (van den Bergh 2008; Stern et al. 2016), calls for a more serious discussion of how to promote efficient environmental policies in a democratic context

(Lorenzoni et al. 2007; Stehr 2015). Our general point is that, instead of proclaiming the desired effects of tentative policies or deriving rational predictions under simplistic modeling assumptions, it is important to actually test the potential effects of tentative policies under strict conditions (Oullier 2013). This way, efficacy and acceptance of climate and energy saving measures can be greatly enhanced while errors and counter-reactions potentially undermining any positive effects if not completely backfiring — as illustrated by the 2018 events in France, where public opposition to a new carbon tax on transportation fuels forced the government to rethink its strategy (Carattini et al. 2019) — may be prevented (Oullier 2013; Allcott and Mullainathan 2010).

Acknowledgements. The research presented in this article was supported by the Linnaeus University Center for Data Intensive Sciences and Applications, DISA (<http://lnu.se/disa>). This paper has profited from comments by Marc Keuschnigg and two anonymous referees.

Author contributions. M.F., O.N. and G.B. planned the research, discussed the results and wrote the paper. M.F. and O.N. coded and conducted the experiment and analyzed the data.

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