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Environmental Art, Prior Knowledge about Climate Change, and Carbon Offsets

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Using a contingent choice survey of US citizens, we investigate the influence of environmental art on individual willingness to purchase voluntary carbon offsets. In a split-sample experiment, we compare the stated preferences of survey respondents in two different treatment groups to the preferences of a control group. One treatment group is shown photographs that illustrate the impacts of climate change; the other is shown animated images that illustrate wind speeds and patterns for extreme weather events. While individuals seeing the photographs show a higher willingness to purchase voluntary offset than the control group, respondents seeing the animated images seem less willing to buy offsets. This result remains stable when accounting for preference heterogeneity related to prior knowledge about climate change issues. We hypothesize that the differential impacts of the two kinds of artistic images are due to a combination of factors influencing individual choices: emotional affect, cognitive interest, and preferences for the prevention of specific climate change impacts as well as, more generally, internalized and social norms for the mitigation of climate change.

Keywords: *environmental art, climate change, carbon offsetting, knowledge, norms, discrete choice experiment*

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1 Introduction

Debate about the influence of the arts on attitudes and behavior has a long history. One example is the possibility that the arts can shape environmental behavior by connecting people to the natural environment (Reid et al. 2005, p. 3). In this paper we investigate whether artistic images affect a particular kind of behavior: the purchase of voluntary carbon offsets to mitigate global warming.

Global climate change is one of today's most pressing environmental concerns. The Intergovernmental Panel on Climate Change (IPCC) states that, since the 1950s, global mean temperature increase has provoked severe changes in earth systems, including a warming of the earth's atmosphere and oceans, a reduction in global snow and ice cover, and a substantial rise in the global mean sea level (IPCC 2013). There is a strong scientific consensus that anthropogenic greenhouse gas (GHG) emissions, largely due to the combustion of fossil fuels, account for "more than half of the observed increase in global average surface temperature from 1951 to 2010" (IPCC 2013, p.17). The consequences of climate change concern both natural and human systems: ecosystem shifts; species extinction; increased frequency of heat waves, droughts, floods, cyclones, and wildfires; and negative impacts on crop yields, for example (IPCC 2014).

Individuals can mitigate climate change, inter alia, by purchasing carbon offsets on a voluntary basis. Voluntary carbon offsets are financial contributions to GHG emission reduction projects that aim at neutralizing an individual's GHG emissions from consumption. Household consumption is responsible for around 72% of total global greenhouse gas emissions, with housing, mobility and food being the most important consumption categories (Hertwich and Peters 2009). By contributing funds to the financing of projects that reduce GHG emissions, i.e. in which an equivalent amount of emissions is either prevented (e.g. by substituting renewable energy sources for fossil fuels) or sequestered (e.g. through afforestation), an individual's own GHG emissions can be offset and the net contribution of the individual's consumption to climate change can be reduced to zero.

We use a choice experiment to investigate people's willingness to purchase carbon offsets, paying particular attention to the role of internalized and social norms. We investigate the impact of artistic images using a split-sample survey. Subsets of respondents in a choice experiment investigating willingness to buy carbon offsets were shown different artistic images related to climate change. This kind of split-sample survey is frequently used to investigate survey design issues of various kinds, including the amount of information presented to respondents (Schläpfer and Schmitt 2007; Schläpfer et al. 2008; Tonsor and Shupp 2011; Tonsor et al. 2013). The

current study is similar since it investigates whether including artistic images in the survey affects responses.

In the next two subsections of the paper we review the determinants of an individual's willingness to purchase carbon offsets and summarize the pathways by which the arts are thought to affect environmental behavior. After describing our survey instrument and our econometric methods in sections 2 and 3, we discuss and analyze our results in section 4. The paper ends with a discussion in section 5 and a summary and ideas for further research in section 6.

1.1 Determinants of an individual's willingness to purchase carbon offsets

In principle, purchasing voluntary carbon offsets is at odds with economic theory based on rational self-interested agents (Sugden 1982; Dawes and Thaler 1988; Nyborg and Rege 2003). As voluntary offsets are a voluntary contribution to a global public good – climate change mitigation – free-riding would be expected to be the dominant behavior of individuals. However, some individuals make philanthropic donations or other private contributions to public goods, and likewise some people voluntarily offset their emissions from consumption. Recent economic literature provides several explanations for such behavior.

One explanation is that individuals are *purely altruistic* and derive utility from the overall provision of the public good. A purely altruistic individual is willing to contribute as long as the public good is not provided by the government or other agents (Bergstrom et al. 1986; Andreoni 1988). Yet, the observation that voluntary contributions prevail also in large economies or in the case of government provision rather supports the hypothesis that many individuals are *impurely altruistic*. Impure altruists derive utility not only from the aggregate level of the public good but also from their own contribution (Andreoni 1989, 1990). The utility derived from the own contribution is often referred to as 'warm glow' and can be related to psychological concepts, such as self-reward, self-esteem or guilt reduction (Meier 2007). Several 'microfoundations' of 'warm glow' utility can be found in the behavioral economics and social psychology literature. For example, it is assumed that voluntary contributions may be guided by *internalized norms* and the desire for a positive *self-image* (Brekke et al. 2003; Frey and Stutzer 2008; Nyborg et al. 2006). Internalized norms are typically enforced by feelings of guilt or a bad conscience. The activation of internalized norms was found to be conditional on an individual's *awareness* of the negative consequences of own actions as well as the individual's *ascribed responsibility* of these negative consequences (Schwartz 1968, 1970).

Alternatively, voluntary contributions to public goods can be attributed to preferences for social approval which make individuals adhere to *social norms* for making voluntary contributions (Holländer 1990; Rege 2004; Bénabou and Tirole 2006). A further explanation is that individuals may behave as 'conditional cooperators' and make voluntary contributions whenever they observe or expect other individuals to contribute their 'fair share' (Fischbacher et al. 2001; Keser and van Winden 2000; Gächter 2007). When behavioral change is likely to be

costly or subject to strong constraints, theories based on social norms and planned behavior are thought to be more relevant than theories based on activation of personal norms (Steg et al. 2013, p. 192).

Recent economic and psychological literature thus identifies various influencing factors that may enhance individual willingness to purchase voluntary carbon offsets. In the following we discuss whether and how arts may impact an individual's willingness to buy voluntary carbon offsets.

1.2 Effects of the arts on environmental behavior

The ability of the arts to influence attitudes and behavior in general has been discussed and debated for centuries (Belfiore and Bennett (2007) trace the discussion back to Aristotle and Plato). Regarding the effects of the arts on environmental behavior specifically, David Curtis and his co-authors have developed a theoretical argument based largely on sociological and psychological studies in a series of papers (Reid et al. 2005; Curtis et al. 2007; Curtis 2009; Curtis 2011; Curtis et al. 2012). They list three pathways via which the arts can shape environmental behavior: communicating information, making connections between people and the natural environment, and spurring environmentally sustainable economic development (Reid et al., p. 3). The arts, they argue, can help to shape behavior by affecting values, beliefs, and economic factors (ibid, p. 22). Their arguments contain elements consistent with both the value-belief-norm theory of environmental behavior (Stern et al. 1999) and the theory of planned behavior (Ajzen 1985). As Jackson (2005) points out, human behavior is influenced by both internal and external factors. The model of Curtis (2009) stresses internal factors: art can affect environmental behavior by creating an emotional affinity with nature, developing a cognitive interest in nature, and/or provoking emotional indignation about environmental harm. Steg et al. (2013) do not explicitly discuss art but summarize psychological theories (including the value-belief-norm theory and the theory of planned behavior in addition to other theories) of environmental behavior based on affect, reasoned choice, and social norms, thus including both internal and external factors. The arts can seemingly create both internal and external influences on behavior, by informing people about the consequences of their choices and actions, developing empathy for the natural environment, creating or enhancing moral imperatives, indicating social norms and expectations, and affecting policies and regulations.

The survey reported on in this paper used art works from two sources. Some survey respondents viewed three photographs by Susannah Sayler from the *A History of the Future* collection of the Canary Project (http://www.history-of-the-future.com, accessed on July 3, 2014). The first photograph, labeled "Extreme Weather Events," showed a truck upended by Hurricane Katrina. The second, labeled "Drought and Fires," showed a burning tree in

Washington State. The third, labeled "Rising Sea Levels," showed a waterfront in Venice.[1] Other survey respondents viewed three historical images from the Wind Map: Poetry in Motion project of Fernanda Viégas and Martin Wattenberg. This project is a continually updated animated digital map showing wind speeds and patterns across the U.S., with some historical images archived. Animated images showing Superstorm Sandy, Hurricane Isaac, and Tropical Storm Debby were used in the survey (these images can be found at http://hint.fm/wind/gallery, accessed on July 3, 2014).[2]

The Canary Project photographs used in the survey show dramatically some of the deleterious effects of climate change. They may therefore affect viewers by creating an emotional response to environmental damage. They may also help viewers understand the impact of climate change, though they themselves don't provide any explanation for why carbon emissions would have the effects shown in the photographs. Although many viewers might consider the photographs beautiful, they depict the destruction of nature, not its beauty. So of Curtis's (2009) factors listed earlier, the "emotional indignation" category seems to fit best, possibly along with the "cognitive interest" category; the "emotional affinity" category seems less applicable. Of the theories surveyed by Steg et al. (2013), the Canary Project photographs connect best with the theories that stress affect, though theories based on reasoned choice and social norms may also be relevant. In contrast, the Wind Map Project images connect best with theories stressing cognitive interest and reasoned choice, though emotional affinity and affect may also be relevant if viewers' main reaction to the images is of the beauty of their representation of nature. Viewers certainly have to think more about the Wind Map Project than the Canary Project in order to figure out how the images relate to the dangers of climate change.

Little empirical evidence exists that directly addresses the impact of art on environmental behavior; we are aware of no previous survey-based research connecting exposure to art works with changes in environmental behavior. The 2004 film *The Day After Tomorrow* led to a few studies (Leiserowitz 2004; Reusswig et al. 2004; Lowe et al. 2006) of whether the movie influenced viewers' perceptions of climate change, which might also alter their motivations for behavioral change. Sheppard (2005) discusses the potential impact of visualization and imagery on climate change perceptions, though not on behavior; there is almost no discussion of artistic imagery. Similarly, Leiserowitz (2006) uses survey results to explore the connections between imagery and both risk perception and policy support, but not on direct behavior.

[1] These labels correspond to those used by the Canary Project and also related directly to information given to survey respondents about the likely impacts of global climate change.

[2] On the website for the Wind Map project, historical images are labeled with both the relevant dates and, for dates on which major events occurred, the names of the events. The animations shown to survey respondents, however, showed only the relevant dates.

Many have argued convincingly that landscape painting and landscape photography have affected both environmental awareness and public policy. For example, the photographs of Ansel Adams, William Henry Jackson, Philip Hyde, Eliot Porter, and Robert Glenn Ketchum and the paintings of the Hudson River School, especially Albert Bierstadt and Thomas Moran, are generally acknowledged to have helped create support for American national parks. Curtis (2009, 2011) provides several examples and case studies of how art inspired changed environmental behavior in Australia.

Reeves (2002) reviews evidence about the social impact of the arts. But the studies she reviews are couched in terms of the value of the arts and the effects on personal or social improvements (e.g. personal confidence or social capital), not in terms of identifiable behavioral change. In contrast, our survey directly measures the impact of art on a particular kind of environmental behavior: purchases of voluntary carbon offsets.

2 Description of the survey

Blasch and Farsi (2014) designed a choice experiment to investigate Swiss consumers' preferences and motivations to buy voluntary carbon offsets. We adapted that survey and administered it to 2200 subjects in the U.S., split into a control group and two treatment groups, as described below.

After some initial questions about their own consumption behavior, all respondents were given basic information about greenhouses gases and climate change, as shown in Figure 1. The information stressed aspects that, for the treatment groups, would be illustrated by artistic images. But no respondent knew that the focus of the study was on the effects of those images, nor did any respondent know that some but not all of the subjects were shown images. Immediately following the basic information, the first treatment group was shown three Canary Project photographs while the second treatment group was shown three animated images from the Wind Map Project. The survey then continued for all respondents with information about carbon offsets in general and with explanations of the choice task and the various attributes. To account for the hypothetical nature of the choice experiment, a "cheap talk" script (Cummings and Taylor 1999) preceded the actual choice tasks.[3]

[Figure 1 about here.]

[3] The cheap talk script included the following text: "Before going through the eight decision situations, please consider the following important instructions! Consider the situations to be real purchase situations: Choose your answers as if you really had to pay the respective amounts and take your monthly income into account when making the decisions." There is empirical evidence that a cheap talk script can reduce the hypothetical bias in choice experiments, see e.g. Cummings and Taylor (1999) or Carlsson et al. (2005).

The experimental design was identical to that used in Blasch and Farsi (2014), to which readers are referred for details. Blasch and Farsi used the software program Ngene to create a Bayesian D-efficient design of 48 choice sets divided into six blocks. This design was adopted in our survey and each respondent was shown one of these blocks of eight choice sets. Each choice set comprised three alternative scenarios representing purchases of offsets with varying attributes plus a *status quo* (no-buy) option. Figure 2 shows a representative choice set. As in Blasch and Farsi (2014), after each choice task, respondents were asked how sure they were that they would make the same choices in actual purchase situations,[4] and unless a respondent said she or he was rather sure, quite sure, or very sure (the top three choices on a six-point Likert scale) that an offset would be purchased, the choice was treated as if no offset were purchased. By considering uncertain positive choices as if no offset was purchased, the risk of an overestimation of the probability of buying an offset is reduced. This approach is similar to that suggested by Champ et al. (1997) for contingent valuation studies, which can be adapted to choice experiments (Lundhede et al. 2009); other approaches are possible as well (Lundhede et al. 2009; Martinez-Espineira 2012).

[Figure 2 about here.]

Brookmark Research Services administered the internet survey to a nationwide sample. In all, 2200 subjects, divided equally among the three subsamples (the control group plus the Canary Project and Wind Map Project groups), responded to the survey. Approximately 25% of each group always chose the status quo, no-buy option.[5] These choices may represent "pure" preferences for the status quo (that is, a reluctance to purchase offsets) or they may represent status quo bias (Samuelson and Zeckhauser 1988): a tendency for people in choice situations to stick with the status quo, no matter what it is. These respondents can be considered a class of their own with limited interest in offsetting. They are removed from the statistical analysis since, within each group, explanatory variables clearly do not affect these individuals' decision of whether to purchase offsets; this segment of the population is considered, however, when the statistical results are interpreted. Of the remaining respondents, some chose not to provide some of their personal characteristics; the final sample included nearly 500 respondents for each subsample. Descriptive statistics for individual characteristics used in the analysis, overall and for the three subsamples, are shown in Table 1.

[Table 1 about here.]

[4] All scenarios in the present study represent hypothetical situations: respondents were not asked to actually purchase offsets. Blasch and Farsi (2014) find, however, a high congruency between stated preference responses and actual purchase behavior by the respondents to their survey.

[5] The percentage in the control group (28%) was slightly higher than in the two treatment groups (24% for the Canary Project group, 23% for the Wind Map Project group). The corresponding percentage in Blasch and Farsi (2014) is 15%.

About 40% of subjects in each group said (in response to a question asked before any information about climate change was provided) that they were knowledgeable about climate change issues. Age and income are measured in intervals; because the main interest here is in comparisons across subsamples, Table 1 simply reports data for the interval codes.[6] The other three variables shown correspond to variables created by Blasch and Farsi (2014). They created a scale, based on the answers to two survey questions regarding respondents' beliefs about whether their family and friends expect them to buy offsets, thus accounting for adherence to social norms; a scale, based on the answers to three survey questions about respondents' beliefs about the importance of individuals taking actions in response to climate change, for ascribed responsibility; and a survey question about respondents' expectations about the percentage of the nationwide population who purchase offsets, which Blasch and Farsi call an index of expected cooperation. The same scales were created from responses to the current survey (see Table 5 in the Appendix). Even though respondents were assigned arbitrarily to the control and treatment groups, there are some differences across subsamples. Ages were quite similar, but the Canary Project group had somewhat higher incomes than the other two groups. Expectations about others' offset purchases were similar across groups, but the control group was less likely to believe individuals are responsible for taking actions in response to climate change while respondents in the Canary Project group were more likely to believe in individual responsibility and more likely to believe that their friends and family expect them to purchase offsets; respondents in the Wind Map Project group were the least likely to believe that friends and family expect them to purchase offsets.[7]

3 Econometric methods

In order to be able to classify our respondents according to their preferences for voluntary carbon offsets and specific offset attributes, we analyzed the data with a latent class model (McCutcheon 1987; Boxall and Adamowicz 2002). We did this in the framework of discrete choice modeling. Discrete choice models are based on random utility theory (Marschak 1960; McFadden 1974) and the consumer theory of Lancaster (1966), which postulates that individuals derive utility from single product characteristics or attributes rather than from a consumer good per se. In the framework of discrete choice analysis, it is thus assumed that an individual's valuation of a product or service depends on the individual's preferences for single attributes of this good or service. By observing individual choices among a number of *J* alternatives, preferences for specific attributes can be elicited (Hensher et al. 2005; Louviere et al. 2000).

[6] The median age interval is 36 – 45; the median income interval is $35,000 – 49,999 per year. Both are comparable to statistics for the U.S. population.

[7] These differences might be treatment effects, since questions about individual responsibility and family and friends' expectations were asked after the treatment groups saw images. This would imply that differences in the estimated coefficients on the status quo dummy variable would not correctly measure the total effects of treatment. But our main measure of treatment effects, the difference in average derivatives with respect to the status quo (see later discussion and tables) incorporates these differences as well as differences in the estimated coefficients on the status quo dummy variable.

The individual's utility from consuming a specific good or service is specified by a linear index that depends on attributes of the available alternatives x_j and parameters that may differ across individuals:

$$U_{ij}\left(x_j\right) = x_j'\beta_i + \varepsilon_{ij}$$

with *i* denoting the individual and *j* denoting the alternatives among which to choose. The error term ε_{ij} captures the unobserved heterogeneity among individuals. Different choice models can be derived depending on how the density of the error term is specified. The most widely used model is the logit model, which is based on the assumption that the error term ε_{ij} is i.i.d. Extreme value distributed (Train 2003). The probability that decision maker *i* chooses alternative *j* in choice situation *t* is thus defined as

$$P_{it}\left(j\right) = \frac{\exp\left(x_{jt}'\beta_i\right)}{\sum_j \exp\left(x_{jt}'\beta_i\right)}.$$

In the latent class model, it is further assumed that individuals can be differentiated according to their preferences and assigned to a discrete number of *K* different classes. All individuals in a particular latent class have the same set of parameters β_k but these vectors of parameters differ across latent classes. Thus, a latent class model is particularly useful to capture unobserved heterogeneity among respondents. The prior probability of decision maker *i* to be affiliated to latent class *k* depends on individual characteristics z_i and is estimated as a model parameter, together with the class-specific utility parameters β_k and θ_k. Class affiliation is specified as a multinomial logit function of the observed variables (Hensher and Greene 2003):

$$H_{ik} = \frac{\exp\left(z_i'\theta_k\right)}{\sum_k \exp\left(z_i'\theta_k\right)}.$$

This leads to the following probability that decision maker *i* chooses alternative *j* in choice situation *t*:

$$P_{itk}\left(j\right) = \sum_k H_{ik} \frac{\exp\left(x_{jt}'\beta_k\right)}{\sum_j \exp\left(x_{jt}'\beta_k\right)}.$$

A latent class analysis thus allows us to identify a predefined number of latent classes of respondents with specific preferences for specific attributes of voluntary carbon offsets. Carrying out a latent class analysis both for the treatment groups and the control group enables us to identify potential treatment effects.

4 Results

The first column of results in Table 2 shows the latent class analysis estimates for the control group, which did not see any artistic images. In the context of this survey, the status quo represents the decision not to purchase an offset, so the alternative-specific constant (ASC) for the status quo option shows the general tendency to *not buy* offsets. Since our main interest is in the effects of explanatory variables on the decision to *buy* offsets, i.e. not choose the no-buy option, the ASC is reported with reverse coding so that it represents (for each latent class) the tendency to purchase offsets, holding constant the various offset attributes.

[Table 2 about here.]

The latent class analysis identified two classes. The first class, comprising a little over 40 percent of the sample, had low values of expected cooperation, ascribed responsibility, and adherence to social norms; these respondents were, on average, older than those in the other class. Based on the status quo ASC these respondents tend to be unwilling to purchase offsets. The cost variable was significant (and negative, as expected) only in the air travel and home heating contexts (i.e. those contexts associated with higher amounts of GHG emissions and thus higher overall offsetting costs). These respondents dislike buying offsets from for-profit providers. They are happier buying offsets certified by the EPA, and they dislike offsets certified by the UN. The second latent class, comprising almost 60 percent of the sample, was more willing to buy offsets. These respondents were sensitive to cost in only the heating and hotel contexts; they were less likely to purchase offsets certified by NGOs.

The latent class analysis identified two latent classes for each of the treatment groups, similar to the control group. But the pattern of coefficients in those latent classes was different in some ways for the two treatment groups, compared both to each other and to the control group. Results are shown in the second and third columns of estimates in Table 2. The first latent class for the Canary Project treatment group, made up of 38 percent of the sample, is reluctant to buy offsets. These respondents were responsive to cost in all contexts except for air travel; they were also less likely to purchase offsets when larger amounts of emissions were being offset. This class of respondents, similar to the control group, does not like offsets from for-profit organizations. The second latent class, comprising 62 percent of the sample, is in some ways like the second latent class for the control group: respondents in this class were younger, had high values of expected cooperation, ascribed responsibility, believed that their friends and family expect them to purchase offsets, and were willing to buy offsets. But more offset characteristics matter to them than was the case for the control group. They were sensitive to cost in the home heating and hotel contexts, more willing to buy renewable-energy offsets, and more likely to buy offsets certified by the EPA. In addition, they were less likely to buy offsets from for-profit organizations and less likely to buy methane-capture offsets.

The second treatment group saw the Wind Map Project images. Like in the Canary project group and the control group, those respondents who saw the Wind Map Project images were divided into two latent classes, one of which was reluctant to buy offsets and the other of which was more willing. Similar to the control and Canary Project groups, the respondents more willing to buy offsets were younger with higher values of the three variables reflecting internalized and social norms as well as expected cooperation. But for the first latent class—about 41 percent of those who saw the Wind Map Project image—the only offset characteristic that mattered was cost in the air travel context. The second latent class—close to 60 percent of the sample—was sensitive to cost in all contexts except for car rental. They preferred offsets certified by the EPA and the UN but disliked offsets certified by NGOs. But no other offset characteristics mattered to this group.

4.1 The effects of art on willingness to buy offsets

The effect of the artistic images on respondents' stated willingness to purchase offsets can be partly inferred from the differences in the status quo ASCs between the control group and the two treatment groups. The value of the coefficients on the (reverse coded) status quo ASC in the Canary Project treatment group are algebraically higher than the corresponding coefficients in the control group while the status quo ASCs for the first latent class (the class generally unwilling to purchase offsets) in the Wind Map Project treatment group are algebraically lower. This suggests that the willingness to buy carbon offsets is also larger for those respondents who saw the Canary Project photos, while the Wind Map Project images seem, if anything, to have reduced the willingness to buy carbon offsets. But the willingness to buy offsets is not determined solely by the status quo ASCs. In conditional logit models, which include latent class analysis, the effect of a particular explanatory variable x_m on the probability of choosing a particular option (in this case, the no-purchase option) depends on all of the estimated coefficients as well as on values of all of the explanatory variables. Hence the effect is different for each observation**:**

$$\frac{\partial P_{itk}(j)}{\partial x_{m,jt}} = \frac{\partial\left(\sum_k H_{ik}\frac{\exp\left(x'_{jt}\beta_k\right)}{\sum_j \exp\left(x'_{jt}\beta_k\right)}\right)}{\partial x_{m,jt}}.$$

The impacts of the Canary Project and Wind Map Project on the overall willingness to purchase offsets can be estimated by calculating for each group the average (over all observations) of the derivative[8] of the probability of choosing the no-purchase option with respect to the (reverse coded) status quo ASC and then comparing the average derivatives for the treatment groups to the average derivative from the control group. (In latent class analysis these

[8] This is not literally a derivative since the explanatory variable in question is a dummy variable. So the "derivative" is calculated as the difference between the predicted values of the probability when the dummy variable equals one and when it equals zero.

derivatives take into account the probability that a particular observation belongs to each latent class.) For the control group, the average derivative is -.0455; for the Canary Project treatment group, it is .0069; for the Wind Map Project treatment group, the average derivative is -.0846. These values are each statistically significantly different than zero and they are also significantly different from each other. So, in addition to the other changes reported above, the treatments did affect the overall willingness to buy carbon offsets: seeing the Canary Project photos increased the overall willingness to buy offsets (that is, they decreased the overall *un*willingness to buy offsets) while seeing the Wind Map Project images decreased the overall willingness to buy offsets.

4.2 The effects of knowledge about climate change issues

The latent class analysis presented so far allows for a substantial amount of heterogeneity in individuals' preferences. But another sort of heterogeneity seems likely, too: preferences about offsets, and in particular the effect of the experimental treatments investigated here, might well be different depending on how knowledgeable one is about climate change issues. This is explored by splitting each group of respondents (the control group and the two treatment groups) into those who said they were knowledgeable about climate change issues and those who said they were not. (This question was asked before respondents in the treatment groups were shown artistic images.) After splitting the samples this way, in each case the latent class analysis once again identified two latent classes, one of which had a positive and statistically significant status quo ASC and the other of which had a negative and statistically significant status quo ASC.

[Table 3 about here]

Table 3 shows the results for knowledgeable respondents. The first latent class in each sample of respondents, to which a large majority of the relevant respondents belonged, was the one most willing to purchase carbon offsets, based on the status quo ASCs. In the control group sample, these respondents—65 percent of the sample—had high values of the three variables representing internalized and social norms as well as conditional cooperation, though the coefficient on adherence to social norms was not statistically significant. These respondents were less happy (holding constant overall cost) offsetting large amounts of emissions and they were sensitive to cost only in the hotel context; no other offset characteristics were statistically significant. The corresponding latent class in the Canary Project treatment group—comprising over three-quarters of these respondents—had high values of expected cooperation and the social norms variable but otherwise there were no statistically significant individual characteristics. They were sensitive to cost in the home heating and hotel contexts, liked renewable-energy offsets and disliked methane-based offsets, and disliked purchasing offsets from for-profit organizations. The corresponding latent class in the Wind Map Project treatment group—over two-thirds of the sample—were younger and had high values of ascribed responsibility and the social norms variable. They were sensitive to cost in the hotel context only and disliked buying offsets certified by NGOs while they preferred offsets certified by the EPA.

The estimated (reverse coded) status quo ASCs were less positive in both treatment groups than in the control group for the first latent class. The second latent class in each group had a negative and statistically significant (reverse coded) status quo ASC, with the point estimate slightly larger in magnitude in the Canary Project group than in the control group and the point estimate considerably larger in magnitude in the Wind Map Project group. Few offset characteristics were statistically significant: in the control group, only cost in the home heating context and the for-profit dummy variable; in the Canary Project group, nothing except the total amount of emissions being offset; in the Wind Map Project group, only the methane-capture dummy. But despite the ASCs, exposure to the Canary Project images seems to have increased the willingness to buy offsets (average derivative with respect to the (reverse coded) status quo ASC is .038 instead of -.019) and exposure to the Wind Map Project images seems to have decreased the willingness to buy offsets (-.038 instead of -.019). Exposure to the Canary Project photographs led to a much higher percentage of respondents in the latent class most willing to buy offsets; exposure to the Wind Map Project images led to a similar, but much smaller, effect.

[Table 4 about here]

The situation is quite different, in the sense that more offset characteristics matter to respondents, for the subset of respondents who said they were not knowledgeable about climate change issues. Table 4 shows the results. Again there were two latent classes identified for each group, one of which had a positive and statistically significant status quo ASC and one of which had a negative and statistically significant status quo ASC. But in general these respondents were more sensitive to cost than were the respondents who were knowledgeable about climate change issues and more other offset characteristics were statistically significant. In the Canary Project group, respondents who were generally unwilling to buy offsets had low values of ascribed responsibility, like the control group, but no other individual characteristics were statistically significant. In the Wind Map Project group, respondents who were generally unwilling to buy offsets had low values of ascribed responsibility and were generally older. In all three groups there were more respondents in the latent class interested in buying offsets. Taking everything into account, once again exposure to the Canary Project photos seems to have increased the willingness to buy offsets (the average derivative was -.0123 instead of -.0645 in the control group) and exposure to the Wind Map Project images seems to have decreased the willingness to buy offsets (the average derivative was -.1133 instead of -.0645).

5 Discussion

One of the main conclusions of the empirical analysis is that there is a lot of heterogeneity in the ways people decide whether to buy voluntary carbon offsets. In addition to there being a group that never buys offsets under any circumstances, around 60 percent of other respondents are much more willing to buy offsets than the rest of the respondents. For respondents knowledgeable about climate change issues, this rises to two-thirds or three-fourths. The knowledgeable group is also different than the rest of the sample in that fewer offset

characteristics seem to matter and that they seem to be less cost sensitive (with cost attributes being largely insignificant, compared to those who stated that they were not knowledgeable) . In addition to prior knowledge, age affects respondents' preferences about offsets and offset characteristics, as do all three variables capturing internalized and social norms as well as conditional cooperation, though which variables matter differs across subsets of the sample. Out of all individual characteristics included in our analysis, the effect of ascribed responsibility on the propensity to buy offsets seems to be the most robust, as it is significant in 8 out of 9 class membership models.

Regarding characteristics of offset projects, the responsiveness of respondents to costs varies a lot, both with respect to context and across latent classes. Other offset characteristics matter sometimes but not often; the most consistent are whether the offset providers are for-profit organizations and whether the EPA is certifying the offset project. The individuals' responsiveness to these characteristics indicates that trust strongly matters in the market for voluntary carbon offsets. As voluntary offsets are highly intangible products and the buyers cannot observe whether the certified emission reductions are actually provided, it is even more important for the consumers to purchase voluntary offsets only from trustworthy sources. Non-profit providers certified by the EPA seem to be a particularly trustable choice from the point of view of the consumers. Compared to the reliability of the providers and certifying agents, the other attributes such as project type and location seem to be much less relevant.

Another stable observation is that offset characteristics matter more for respondents who are more interested in offsetting. This is plausible, as these individuals probably made a higher cognitive effort to compare the different alternatives.

Compared to the results of the same choice experiment conducted in Switzerland, reported in Blasch and Farsi (2014), we find many similarities. Individuals in Switzerland also revealed strong preferences for non-profit providers and government certification. The average share of those who are generally willing to purchase offsets was around 70% of the sample, i.e. similar to the share observed in the knowledgeable subsample. The propensity to offset was also higher for younger individuals with strong values in the three variables capturing internalized and social norms as well as conditional cooperation. The most significant difference between the results of the survey presented in this paper and the Swiss survey is that Swiss respondents had clear preferences for project types and project locations: throughout, afforestation and renewable energy projects were preferred to energy efficiency and methane captures projects. Projects in developing countries were clearly preferred at least by a subsample of respondents (Blasch and Farsi 2014).

The most important finding with respect to the analysis presented in this paper is that exposure to the Canary Project photographs makes respondents generally more willing to buy offsets and increases the percentage of respondents in the latent class that is more willing to buy offsets. It also changes to some extent which other explanatory variables are statistically

significant. Exposure to the Wind Map Project images, however, seems to reduce respondents' willingness to buy offsets overall, although once again the percentage of respondents in the latent class more willing to buy offsets increases. There are some effects on other explanatory variables' statistical significance, although overall these effects are smaller than those caused by exposure to the Canary Project photographs.

Results are robust to whether information was added about how important respondents felt each attribute was. There were some differences regarding cost sensitivity and significance of total carbon dioxide emissions being offset and also some differences in latent class probabilities but otherwise the results were very similar.[9]

The different impacts of the Canary Project and Wind Map Project images may be due to the different avenues via which they are likely to affect behavior. As argued earlier, The Canary Project photographs are more likely to create an emotional affect in addition to educating viewers about the likely impacts of climate change; in particular, they are likely to invoke what Curtis (2009) calls emotional indignation. The Wind Map Project images are harder for viewers to connect to climate change issues and are more likely to work solely through cognitive interest and reasoned choice. Also, viewers can more easily link the Canary Project photographs than the Wind Map Project images to the impacts of climate change. Further, the Canary Project photographs used in the study illustrate three different impacts of climate change, whereas all of the Wind Map Project images used refer to extreme weather events.

In addition, it may be that survey respondents don't care as much about the impact of climate change on extreme weather events than they do about rising water levels and forest fires. Seeing pictures of drought, forest fires and rising sea levels also might have more strongly affected respondents' feelings of responsibility, which we found to be an important factor influencing individual willingness to buy offsets. However, none of these hypotheses provides an explanation for why the Wind Map Project images seem to make respondents less likely to buy offsets than the control group. These hypotheses, as well as other aspects of the relationship between art and environmental behavior, could be investigated with additional survey-based research, whether based on choice experiments or on simpler surveys about past or planned future behavior. All of the images used in this study are quite explicitly about climate change and all can be viewed as warnings about the impacts of climate change whereas much art work that historically has been said to influence environmental attitudes or behavior has been more in what art critic Vicki Goldberg (1991) calls a pastoral eulogy category, which corresponds to Curtis's (2009) pathway of creating emotional affinity for nature. Contrasting the effects of exposure to these different kinds of art would help identify whether emotional affinity or emotional indignation had a larger effect on behavior. It would also be interesting to explore the effects of different kinds of art works, including not just visual images but other formats. Other interesting

[9] The main conclusions were also unchanged when a mixed logit model was used instead of a latent class analysis or when offset prices were used as variables rather than the total costs of purchasing offsets.

extensions would be to investigate whether abstract art has similar effects to more documentary art, whether prolonged or repeated exposure leads to greater behavioral change, and whether impacts of art on behavior are lasting or fleeting.

6 Summary

Results of our contingent choice survey suggest that people's preferences about buying voluntary carbon offsets are very heterogeneous. Prior knowledge about climate change, age, and all three variables capturing internalized and social norms as well as conditional cooperation affect preferences. In addition, characteristics of offsets matter more for those who are more interested in buying offsets. Results from this survey of US citizens are quite similar to results from a previous survey conducted in Switzerland.

Our split-sample experiment indicates that respondents who were shown photographs by the Canary Project that illustrate the impacts of climate change were more likely to purchase carbon offsets than were respondents in a control group. This is even though the respondents saw these images only briefly: typically for less than a minute. Not all artistic images have this effect, though: respondents who saw animated images from the Wind Map Project that illustrate wind speeds and patterns for extreme weather events were usually less willing to buy offsets than the control group. This result remains stable when accounting for preference heterogeneity related to prior knowledge about climate change issues.

We hypothesize that the differential impacts of the two kinds of artistic images used in this study are due to a combination of factors influencing individual choices. These factors involve emotional affect, cognitive interest, preferences for the prevention of specific climate change impacts as well as, more generally, internalized and social norms for the mitigation of climate change.

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Table 1 Summary statistics for individual characteristics of the entire sample, the control group, and the two treatment groups: mean (standard deviations in parentheses)

Variable	Entire Sample	Control Group	Canary Project Group	Wind Project Group
Age (interval data) **Median = 4**	3.93 (1.59)	3.88 (1.53)	3.99 (1.64)	3.90 (1.59)
Income (interval data) **Median = 3**	3.42 (1.92)	3.35 (1.95)	3.55 (1.93)	3.34 (1.88)
Adherence to social norms **Median = -0.118**	0.219 (0.861)	0.229 (0.885)	0.275 (0.873)	0.154 (0.822)
Ascribed responsibility **Median = 0.144**	0.220 (0.714)	0.150 (0.737)	0.276 (0.698)	0.230 (0.702)
Expected cooperation **Median = 4**	4.15 (2.21)	4.18 (2.31)	4.15 (2.22)	4.13 (2.10)
Knowledgeable about climate change	0.387 (0.487)	0.370 (0.483)	0.420 (0.494)	0.369 (0.483)
Number of respondents with non-missing data	1459	465	498	496

Table 2 Results of latent class analysis: estimates for the control group as well as the two treatment groups (coefficients for Latent Classes 1 and 2, followed by the coefficients of the class probability models)

	Control Group	Canary Project Group	Wind Map Project Group
Number of respondents	465	498	496
Latent Class 1 average class probabilities	.415	.383	.412
ASC-status quo (reverse coding)	-1.12599***	-.77224***	-1.56516***
CO_2 emissions offset	.04983	-.16722**	.06889
Cost in air travel context	-.00550**	.00127	-.00516**
Cost in home heating context	-.01465***	-.01419***	-.00544
Cost in hotel stays context	-.02265	-.07748***	-.02754
Cost in automobile travel context	-.01454	-.07521***	-.00026
Type: afforestation	.01517	.07573	-.05436
Type: renewable energy	.01143	.03733	.11403
Type: methane	-.06358	-.04141	.06279
Developing country location	-.01026	.04040	.10837
For-profit provider	-.35575***	-.28840***	-.01357
Certifier: EPA	.19902***	.08187	.06932
Certifier: UN	-.13974*	-.02905	.01621
Certifier: NGO	.03112	-.10336	-.01066
Latent Class 2 average class probabilities	.585	.617	.588
ASC-status quo (reverse coding)	1.68315***	1.98018***	1.69232***
CO_2 emissions offset	-.08819	-.13647*	-.05738
Cost in air travel context	-.00011	-.00155	-.00238*
Cost in home heating context	-.00511*	-.01130***	-.00587**
Cost in hotel stays context	-.04356**	-.04942***	-.05113***
Cost in automobile travel context	-.00325	-.01143	-.01151
Type: afforestation	.04831	.00152	-.00446
Type: renewable energy	.06718	.10175**	.05914
Type: methane	.00808	-.09291**	-.00968
Developing country location	.04425	.00632	.05941
For-profit provider	-.08489	-.18596***	-.07070
Certifier: EPA	.05694	.11829***	.13274***
Certifier: UN	.01099	-.02288	.08463**
Certifier: NGO	-.10271**	.00025	-.19242***
Effects on membership in Latent Class 1			
Intercept	.49976*	.32691	.16013
Income	-.00166	-.02642	-.01087
Age	.13956*	.14756**	.25855***
Ascribed responsibility	-1.02910***	-.70672***	-.72910***
Social norms	-.66804***	-.39426**	-.30907**
Expected cooperation	-.18202***	-.15978***	-.09989*
Average derivative with respect to (reverse coded) status quo ASC	**-0.0454*** **	**0.0069*** **	**-.0846*** **
*****, **, * statistically significant at 1%, 5%, and 10% levels**			

Table 3 Results of latent class analysis for subsample of knowledgeable respondents: estimates for the control group as well as the two treatment groups (coefficients for Latent Classes 1 and 2, followed by the coefficients of the class probability models)

	Control Group	Canary Project Group	Wind Map Project Group
Number of respondents	172	209	183
Latent Class 1 average class probabilities	.646	.776	.696
ASC-status quo (reverse coding)	3.39470***	2.15334***	2.04064***
CO_2 emissions offset	-.51572**	-.13852	-.00777
Cost in air travel context	.00247	.00057	-.00215
Cost in home heating context	-.00456	-.01361***	-.00482
Cost in hotel stays context	-.05765**	-.05507**	-.05609**
Cost in automobile travel context	.00519	-.01575	-.01230
Type: afforestation	.02277	-.00327	-.01112
Type: renewable energy	.04913	.13389**	-.00541
Type: methane	.02686	-.14810***	.00224
Developing country location	.02864	-.03735	.06292
For-profit provider	-.00774	-.19222***	.01486
Certifier: EPA	-.03008	.05838	.10348*
Certifier: UN	.02569	-.00326	.02960
Certifier: NGO	-.10831	.03154	-.18902***
Latent Class 2 average class probabilities	.354	.224	.304
ASC-status quo (reverse coding)	-.91859***	-1.05161***	-1.33834***
CO_2 emissions offset	.14880	-.29605*	.04012
Cost in air travel context	-.00472	.00375	-.00215
Cost in home heating context	-.02181***	-.00785	-.00145
Cost in hotel stays context	-.01130	-.06640	.00157
Cost in automobile travel context	.01359	-.04266	.01427
Type: afforestation	.01932	.24887	-.14001
Type: renewable energy	.14425	-.01588	.23129
Type: methane	-.01273	.04654	.06029*
Developing country location	.11381	.30654	.12236
For-profit provider	-.29946**	-.02149	-.04992
Certifier: EPA	.09229	-.01393	.19720
Certifier: UN	-.03431	-.02668	-.02796
Certifier: NGO	-.03841	-.27801	-.04278
Effects on membership in Latent Class 1			
Intercept	-1.40077***	-.63639	.10757
Income	.12723	-.00782	.07546
Age	-.12749	-.25066	-.37650**
Ascribed responsibility	.76033*	.08786	.85887*
Social norms	.40666	.46936*	.59039*
Expected cooperation	.37179***	.39239***	.01442
Average derivative with respect to (reverse coded) status quo ASC	**-0.0193*** **	**0.0378*** **	**-0.0378*** **
*****, **, * statistically significant at 1%, 5%, and 10% levels**			

Table 4 Results of latent class analysis for subsample of not knowledgeable respondents: estimates for the control group as well as the two treatment groups (coefficients for Latent Classes 1 and 2, followed by the coefficients of the class probability models)

	Control Group	Canary Project Group	Wind Map Project Group
Number of respondents	293	289	313
Latent Class 1 average class probabilities	.450	.468	.470
ASC-status quo (reverse coding)	-1.19988***	-.74620***	-1.69445***
CO_2 emissions offset	-.00058	-.12832	.09472
Cost in air travel context	-.00546*	.00079	-.00707**
Cost in home heating context	-.01208**	-.01742***	-.00865*
Cost in hotel stays context	-.01932	-.08068**	-.04197
Cost in automobile travel context	-.03291	-.09310***	-.01419
Type: afforestation	.07062	-.00320	-.05022
Type: renewable energy	-.08290	.07386	.07843
Type: methane	-.08833	-.06189	.05282
Developing country location	-.07440	-.06029	.14959
For-profit provider	-.36606***	-.37889***	.05637
Certifier: EPA	.21484**	.10113	-.00621
Certifier: UN	-.15042	-.06047	.01770
Certifier: NGO	.05498	-.04050	.00236
Latent Class 2 average class probabilities	.550	.532	.530
ASC-status quo (reverse coding)	1.09052***	1.63362***	1.47199***
CO_2 emissions offset	.02804	-.12258	-.09201
Cost in air travel context	-.00233	-.00381**	-.00250
Cost in home heating context	-.00513	-.00847**	-.00602*
Cost in hotel stays context	-.04074*	-.04535**	-.04906**
Cost in automobile travel context	-.00202	-.00630	-.00801
Type: afforestation	.03967	.02107	.01418
Type: renewable energy	.08687	.06362	.10570*
Type: methane	-.00800	-.03801	-.01184
Developing country location	.04951	.07685	.04543
For-profit provider	-.13617*	-.18398**	-.15267***
Certifier: EPA	.13577**	.18711***	.16489***
Certifier: UN	-.02247	-.03048	.13518**
Certifier: NGO	-.09017	-.04432	-.19922***
Effects on membership in Latent Class 1			
Intercept	.06698	-.07392	.26413
Income	.02553	-.00079	.09196
Age	.10938	.03381	.21937***
Ascribed responsibility	-1.03173***	-.82644***	-.63444***
Social norms	-.81348***	-.35194	-.08704
Expected cooperation	-.08431	-.01358	-.12020
Average derivative with respect to (reverse coded) status quo ASC	**-0.0645*** **	**-0.0123*** **	**-0.1133*** **

Table 5 Scales and items used in the analysis

Ascribed responsibility (scale)
How strongly do you agree with the following statements? *(strongly disagree/disagree/neutral/agree/strongly agree)* Every single citizen has to take responsibility towards the climate. I feel morally obliged to protect the climate. In my opinion, every single contribution to climate protection is effective.
Perceived social norm in peer group (scale)
Do you think that your family expects that you make voluntary payments to offset some of your CO_2 emissions from consumption? *(do not expect it at all/rather do not expect it/maybe expect it/rather expect it/clearly expect it)* Do you think that your friends expect that you make voluntary payments to offset some of your CO_2 emissions from consumption? *(do not expect it at all/rather do not expect it/maybe expect it/rather expect it/clearly expect it)*
Expected cooperation
In your opinion, approximately what share of US citizens is generally willing to voluntarily offset part of their CO_2 emissions from consumption? *(< 5 / 5 / 10 / 20 / 30 / 40 / 50 / 60 / 70 / > 70 percent)*

Climate Change Information

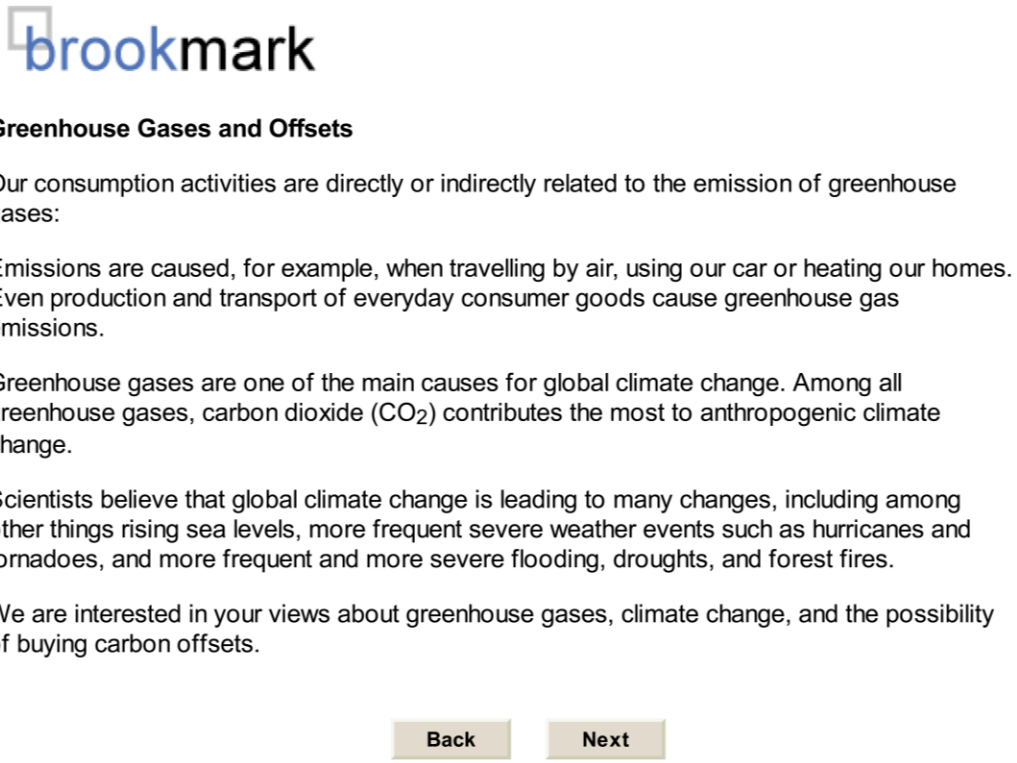

Fig 1. Screen informing survey participants about climate change and consumption-related CO_2 emissions

Representative Choice Set

brookmark

Imagine you have booked a long-distance flight, e.g. from New York to Cairo (Egypt) or Buenos Aires (Argentina). The ticket costs you $1,200 (economy class/round-trip). While booking your flight you get the information that your flight causes some 3.6 tons of CO_2 emissions per passenger. You are given a choice to offset the CO_2 emissions from your trip.

Which option would you choose among the four listed below:

Screen: 1 out of 8

	Option A full offset	Option B full offset	Option C full offset	Option D no offset
Type of project	Energy efficiency	Renewable energy	(Re-)/Afforestation	I would choose not to offset emissions in this situation under the given circumstances.
Project host country	Newly industrializing country (e.g. China, India, Brazil)	Developing country (e.g. Bangladesh, Burkina Faso, Haiti)	Developing country (e.g. Bangladesh, Burkina Faso, Haiti)	
Type of offset provider	Non-profit provider	Non-profit provider	For-profit provider	
Third-party certification	by the U.S. Environmental Protection Agency (EPA)	by the United Nations (UN)	by a non-governmental organization (NGO)	
Amount payable	$18.00 ($5/tCO_2)	$126.00 ($35/tCO_2)	$82.80 ($23/tCO_2)	
Which option would you choose in this situation?	☐	☐	☐	☐

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Fig. 2 Example of a choice set in the air travel context: description of the consumption context, three offset options and status-quo option