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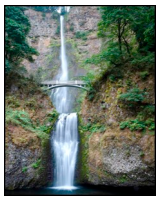

A carbon price by another name may seem sweeter: Consumers prefer upstream offsets to downstream taxes☆

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ABSTRACT

Steps to limit greenhouse gas emissions, including putting a "price" on emissions, can be undertaken in a variety of ways, and these policies are associated with different terminology, including carbon "taxes" or "offsets." Furthermore, in the case of fossil fuels, the emissions can be regulated at different points in the production and usage system: "upstream" regulations are applied to the extraction and importation of fossil fuels, while "downstream" regulations are applied to the usage of products and services. From a conventional economic standpoint, under a range of circumstances, these points of regulation should have effectively equivalent impacts on economic incentives, decisions and resulting carbon emissions. However, the impact of "upstream" vs "downstream" policies on consumer perceptions and preferences is largely unknown. In three studies (two main studies plus one supplemental study) examining consumer preferences in the airline industry, we find that consumers respond significantly more favorably to a description of upstream offsets than to other pricing methods such as downstream taxes. To explain this preference, we find that the upstream offset policy is uniquely perceived to address both the causes and consequences of carbon emissions, which in turn predicts consumer preference and policy support.

1. Introduction

Several years ago, a friend was visiting some monks. As they were eating together, he asked "If you don't believe in killing animals, why do you eat meat?" The answer: "Oh, we don't kill animals, the butcher does that. But everybody hates that guy." Such deflection of responsibility in circumstances where an individual or group benefits from an object or good, in this case meat, that is obtained through an action the individual or group prefers to avoid, in this case, killing of a animal, is not unusual. Many people today have similar attitudes towards products and services that they consume, which are produced through actions that harm the environment. For example, consumers demand energy derived from fossil fuels and other goods and services entailing emissions of carbon dioxide, even as they blame energy companies for their emissions, which contribute to climate change. Yet, in practice, consumers may have fewer choices and their impacts are individually small and dispersed. If a policy solution is to be implemented to reduce these emissions, where would it be more acceptable? At the source (the butcher shop) that is blamed for the problem, or at the point of consumption (the kitchen) where concerned individuals may be nudged to act on their values? To combat carbon emissions,[1] where should a mandatory emissions tax, permit system, or offsetting requirement be applied? "Upstream" on fossil fuel production, or "downstream" on consumers? And how do consumers react to these different policies?

This issue – how consumers respond to different carbon pricing policy descriptions – is directly relevant in the context of policies being developed to reverse climate change or mitigate its effects (Ivanovich, Ocko, Piris-Cabezas, & Petsonk, 2019; Lee, 2018). For example, the International Civil Aviation Organization (International Civil Aviation Organization, 2016) has developed the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), which caps the net carbon dioxide emissions of flights between participating countries at

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[1] In this paper, we follow common usage of the term "carbon" pricing or "carbon" regulation to refer generally to policies addressing carbon dioxide as well as other greenhouse gases. The initial suite of policies to address climate-warming emissions from the international aviation sector focus specifically on carbon dioxide emissions from fuel combustion, the major source of greenhouse gases from international air travel; examination of non-CO_2 impacts is in its early phases.

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the average of 2019–2020 levels, and allows airlines to compensate or "offset" their direct emissions above those levels by paying for emissions reductions achieved from activities outside of the aviation sector. CORSIA is voluntary for countries over its first phases (2021–2026). Many countries are still deciding whether or not to opt-in for these phases and thus impose carbon offsetting requirements on arriving and departing flights. Airlines and their regulators will also have to determine how best to communicate (explicitly or otherwise) the associated carbon costs to their customers. Many countries and airlines are currently looking to make carbon regulation more attractive to consumers, to garner political support for the regulation and to maintain consumer demand in competitive markets.

In this paper, we explore the psychological impact of different carbon emissions control approaches on consumers, depending on whether that extra cost or "price" to consumers is communicated as applied "upstream" on fossil fuel producers and importers, or "downstream" on consumers, as well as whether the extra cost or price is communicated to be a "tax" or an "offset". In the following two sections, we review the academic literatures on these two dimensions.

1.1. Upstream vs downstream carbon pricing

In theory, a carbon price may be imposed at different points in the production and usage of fossil fuels and have equivalent impact on carbon emissions; regulation can be applied "upstream" on the extraction and importation of fossil fuels, or more "downstream" on the usage of goods and services such as electricity and air transport (Matthews, 2010). According to conventional economic theory, in the absence of market power, transactions costs, or other distortions, regulation of environmental pollutants is most cost-effective when applied at the point (upstream or downstream) that ensures the greatest flexibility for reducing emissions (see Mansur, 2011). In the case of fossil fuels, which are the largest contributor to global greenhouse gas emissions, the carbon dioxide emissions at the point of combustion are proportional to the carbon content of the fuels, assuming there is no way to scrub out or remove the emissions before they are combusted (or to capture and store them after combustion). As a result, upstream or downstream regulations provide the same chances of reducing emissions, making the two approaches theoretically equivalent from a conventional economics point of view. Entities regulated upstream will tend to raise their prices and thus pass the carbon price through to consumers, transmitting the carbon price downstream. Similarly, if consumers facing a downstream carbon price respond by reducing their demand, producers will then see the same reduction in profits as if they had faced the carbon price upstream.

Given this theoretical equivalence of points of regulation, an upstream point of monitoring and regulation for fossil fuels (for example, requiring permits for the mining and importation of fossil fuel based on its carbon content) has a number of practical advantages relative to more downstream monitoring and regulation (such as a tax levied at the point of sale to consumers). In particular, economists have argued for the value of upstream regulation based on its administrative simplicity (requiring fewer sources to be monitored) and ability to ensure a broader economic coverage of all sources consuming fossil fuels in the economy, improving cost-effectiveness and reducing potential for emissions leakage (e.g., Stavins, 2007).[2]

Despite this practical rationale for an upstream approach, policy makers in most existing and proposed emissions trading systems to date have chosen to regulate fossil fuel emissions at more downstream points, despite significantly higher administrative costs and a reduction of coverage for sources below certain thresholds and sectors such as transportation. These choices may have a behavioral justification (Matthews, 2010). One argument is that downstream regulation increases the salience of the price and has different consequences in terms of managerial attention (Hanemann, 2009). These will induce greater innovation and behavioral change to reduce emissions, reducing the costs of the policy, even as the overall cap or price is still maintained under either type of regulation. These behavioral arguments for downstream regulation are largely "anecdotal" in the context of carbon pricing policies (Aldy & Pizer, 2009), and systematic empirical research on this specific issue of upstream vs downstream carbon prices is lacking. We aim to address this in the current research.

What might be predicted from previous research about the psychological effects of upstream vs downstream pricing on consumers? The implications are mixed. On one hand, studies in the tax arena have shown that consumers are in fact more responsive to taxes that are embedded in a product's price, versus placed on a bill as an-add on to the sticker price (Chetty, Looney, & Kroft, 2009). "Downstream" prices may seem more personally relevant, and therefore more influential on behavior.

On the other hand, motivated reasoning (Kunda, 1990) and self-serving bias (Campbell & Sedikides, 1999) predict that consumers will tend to hold others responsible for problems when possible, and that this is especially likely under self-threat (Campbell & Sedikides, 1999). Climate change is a moral issue for many people, and as such, it is likely that when this moral dimension is made salient, people will seek to hold someone accountable. Furthermore, consumers' self-concept may be threatened if they are engaging in a carbon polluting activity, and therefore motivate them to blame upstream parties for the emissions. Likewise, to the extent that consumers believe they have low self-efficacy to lower carbon emissions, they may make an external attribution of control (Ajzen, 2002) and hold others responsible for the emissions. If consumers do hold others responsible for carbon emissions, they may be more likely to support more "upstream" carbon regulations, as these are perceived to hold the responsible parties accountable for their actions.

In summary, while standard economic theory suggests that consumers would respond equivalently to "upstream" and "downstream" prices, the psychological literature suggests that consumers may respond more strongly to one or the other, and this topic demands empirical study.

1.2. Product attribute framing

Turning to the formulation of a carbon price as a "tax" or an "offset": does it make a difference? Product attribute framing can have a substantial impact on consumers (Levin, Schneider, & Gaeth, 1998). In a classic study, consumers were willing to pay more for a burger labeled as 75% meat than one labeled 25% fat, even after tasting it (Levin & Gaeth, 1988). Similarly, costs labeled as "taxes" are more odious to people than other equivalent financial costs (Ericson & Kessler, 2016; Kessler & Norton, 2016), and this may be particularly true for political conservatives (Hardisty, Johnson, & Weber, 2010; Sussman & Olivola, 2011). However, these tax aversion studies have only been conducted with U.S. participants, and could well be smaller in other countries and cultures around the world where taxes are less stigmatized, such as in Northern Europe.

Why does this carbon "tax" aversion happen? According to Query Theory (Johnson, Haubl, & Keinan, 2007), when people consider a novel choice and "construct" their preference, their first thought has undue influence because it biases subsequent information processing in a confirmatory manner. In the U.S., "tax" is a "dirty word" for consumers (especially for Republicans) that triggers an immediate negative evaluation, in turn leading the overall evaluation of the carbon tax to be negative (Hardisty et al., 2010). In contrast, other terms (such as a carbon "offset") do not trigger the same immediate negative reaction and cascade of negative thoughts.

[2] Also see PMR-ICAP (2016) and PMR (2017) for a fuller discussion of the considerations involved in setting the point of emissions control regulations in the context of an emissions trading and carbon tax system, respectively.

Another psychological factor driving tax aversion could be goal framing (Lindenberg & Steg, 2007; Steg, Lindenberg, & Keizer, 2016); it may be that taxes trigger a personal "gain" frame (in the goal framing context, a "gain" frame means "to guard and improve one's resources", and thus also applies to personal losses, Lindenberg & Steg, 2007), which focuses consumers on the financial cost *they* will pay (rather than the environmental benefit). If this is true, tax framing may influence choices (increasing the decision weight of personal costs) similarly across countries. Likewise, "downstream" frames may induce a "gain" goal frame or "hedonic" goal frame (more focused on personal resources and pain avoidance), whereas "upstream" frames (more distant from the self) may induce a "normative" goal frame, more focused on morally correct behavior. As such, upstream carbon pricing policies may induce more pro-environmental behavior than downstream policies.

A third factor driving acceptance of carbon pricing could be the extent that it focuses consumers on the impact of the policy on climate change. Previous work has found that a climate change frame (vs a financial cost frame or an energy usage frame) increases environmental behavior intentions (Spence, Leygue, Bedwell, & O'Malley, 2014). Carbon "tax" frames may focus consumers on the cost, and therefore be less effective than carbon "offset" frames that draw attention to the environmental impact of the policy.

In short, to the extent these policy descriptions are visible to them, U.S. consumers ought to support paying for an "upstream" carbon offset system more than an equivalent "downstream" tax.

1.3. The present research

We test U.S. consumer perceptions of upstream versus downstream carbon regulation approaches in the aviation industry, along with two different policies: tax and offset. In combination, the two point of regulation frames and two policy frames result in four unique carbon price frames. We compare these four frames with two control conditions: a "no-fee" control in which there is no carbon price, and a "no-information" control in which the amount of the carbon cost is embedded into the price but where this is not broken out or explained to consumers in any way.

In Study 1, we compared these six conditions in an exploratory fashion to determine which combinations were most and least desirable to consumers. In supplemental Study S1 (reported in the Online Supplement), we tested a replication of Study 1 with minor variations in the study procedure. In Study 2, we sought to further replicate the key results, and to uncover the psychological processes driving consumer psychology in this area: specifically, we measured perceptions of environmental impact and accountability. We examined whether consumers believe that certain frames would have a bigger impact on climate change and would ensure that those responsible for carbon emissions would pay to reduce them, in turn predicting flight choices and support for policy.

2. Study 1: material and methods

2.1. Participants

Participants were 588 residents of the United States (60% men; *M* age = 34.82 years [*SD* = 11.29]) who were recruited through Amazon.com's Mechanical Turk (MTurk) website. While MTurk represents a broad, diverse sample of U.S. participants, it is generally younger, more educated, and lower income than the general U.S. population (Paolacci, Chandler, & Ipeirotis, 2010). A sample size target of roughly 600 was set in advance, aiming for 100 participants per experimental cell, to ensure adequate power for all pairwise comparisons. Sample sizes in each experimental cell were as follows: no fee control = 94, no info control = 96, upstream offset = 105, upstream tax = 88, downstream offset = 102, downstream tax = 103.

2.2. Experimental manipulation: proposed carbon regulatory policies

All studies were reviewed and approved by a University ethics board. Participants were randomly assigned to one of six conditions: "upstream offset", "upstream tax", "downstream offset", "downstream tax", "no-information control", or "no-fee control". Participants in the four experimental conditions first read a brief description of the policy (between 35 and 38 words), detailed in Appendix A. Other than varying the stream ("upstream" or "downstream") and frame ("tax" or "offset") of the proposed carbon fee, the content of the regulatory policy in each of the four carbon-fee labelling conditions was identical. Participants in the control conditions did not read about any policy.

2.3. Measure of pro-environmental flight preference

Next, participants were asked to imagine that they were planning a vacation, and were presented with five pairs of similarly priced flights to small island vacation destinations. Flight B always included an additional $14.00 carbon fee which varied in label depending on condition, as seen in Appendix B. For example, "Flight A to the island of Nevis for $322.99" or "Flight B to the island of Bequia for $310.99 plus an additional $14.00 carbon offset [tax] on aviation fuel production and importation [on airplane travel and cargo]". The five flight pairs differed only slightly in price difference (in each case, the price of Flight B differed from that of Flight A by no more than +/− $6). In the "no-information control" condition, the $14.00 carbon fee applied to Flight B was embedded into the price of Flight B with no additional information provided. In the "no-fee control" condition, the $14.00 carbon fee was not applied to Flight B.

Our main dependent variable of interest was how likely participants would be to buy Flight B instead of Flight A on a 7-point scale (from "1-Definitely Not" to "7- Definitely"), averaged across the five flight pair items. [3] Finally, all participants provided demographic information.

3. Study 1: results

Data is publicly available for download at https://tinyurl.com/y75k6hkm. To test whether experimental condition affected pro-environmental flight preferences (i.e., preference for flights which included a carbon fee), we conducted an ANOVA on continuous preference for Flight B (collapsed across all flight pair choices), with condition as the independent variable. Results revealed a significant main effect of experimental condition, F (5,582) = 6.07, $\eta^2 = 0.05$, $p < .001$. Fig. 1 shows that the "upstream offset" condition was most effective at eliciting pro-environmental flight preferences.

We followed up the ANOVA with a series of pairwise comparisons; as this was an exploratory study, we corrected for family-wise error by using Tukey's HSD. Preference for flights carrying a $14.00 carbon fee in the "upstream offset" condition was significantly greater when compared to the "no information" control, $\text{mean}_{\text{upoff-noinfo}} = 0.88$, $p < .001$, CI_{95} [0.39,1.36], and when compared to the "downstream tax" $\text{mean}_{\text{upoff-downtax}} = 0.55$, $p = .01$, CI_{95} [0.07,1.02]. Also, the "no fee" control was preferred to the "no information" control, $\text{mean}_{\text{upoff-downtax}} = 0.63$, $p < .01$, CI_{95} [0.14,1.13]. No other pairwise comparisons were statistically significant.

We also ran an additional replication Study S1 (reported in the Online Supplement), which found the same pattern of results: preference for the "upstream offset" was greater than preference for the

[3] For each flight pair in both Studies 1 and 2, participants also indicated their preferred flight as dichotomous choice ("Which of these two flights would you prefer to buy, Flight A or Flight B?"). Results from analyses on this dichotomous choice variable are reported in the Online Supplement, Appendix H. The patterns of results do not differ from those of the continuous choice measure in either study, and the results are often stronger.

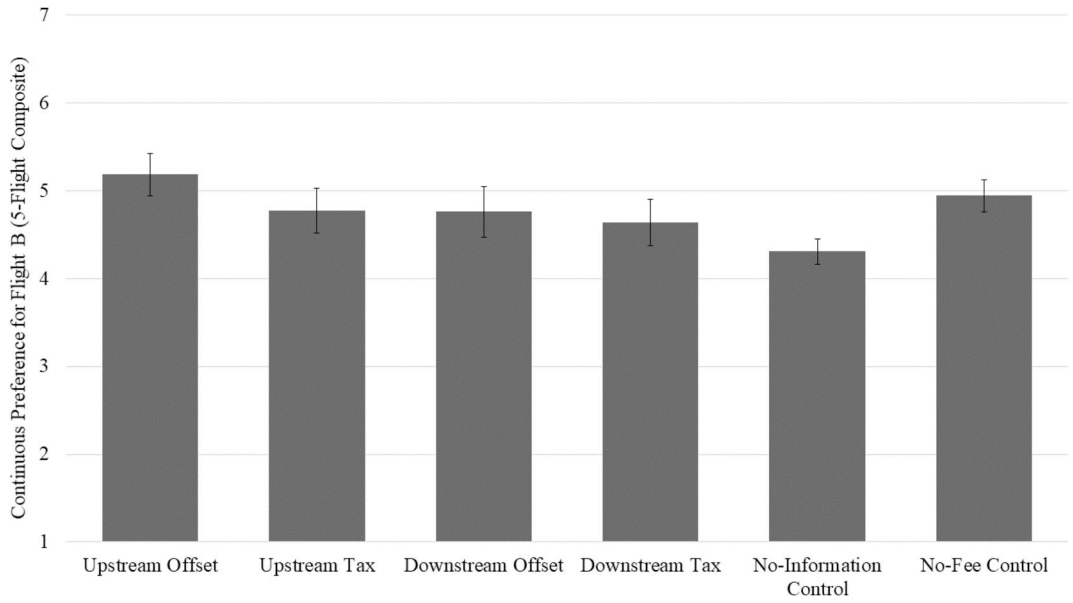

Fig. 1. Mean preference for flights carrying a $14.00 carbon fee within each condition in Study 1. Error bars indicate 95% confidence intervals.

"downstream offset", "upstream tax", and "downstream tax" conditions.

As political affiliation of U.S. consumers has previously found to be a significant moderator of environmental policy support (with stronger framing effects found for Republicans than Democrats; Hardisty et al., 2010; Hart & Feldman, 2018), we also analyzed political affiliation and found that it did indeed moderate the results, as detailed in the Online Supplement, Appendix G. Specifically, there is a significant interaction between political party and carbon pricing condition, F (5,344) = 6.75, $p < .001$, $\eta_p^2 = 0.08$, such that Democrats respond particularly well to the "upstream offset" condition, and Republicans respond particularly badly to the "Downstream Tax" and "Downstream Offset" conditions.

4. Study 1: discussion

Individuals who had read a brief description of a proposed regulation for a carbon fee described as a "carbon offset on aviation fuel production and importation" consistently reported a greater preference to purchase flights carrying a $14.00 carbon fee (versus similarly priced flights with no carbon fee) than, a) individuals who read other brief descriptions describing the carbon fee as a "carbon tax on airplane travel and cargo", and b) individuals who did not read any description of an additional carbon fee and for whom this $14.00 fee was embedded in the cost of the flight. In addition, individuals in the "upstream offset" condition equally preferred flights carrying a $14.00 carbon fee as compared to those in the "no-fee control" condition in which the $14.00 carbon fee was not even applied. In a separate study, reported in the web supplement Appendix E, we replicated these results with lengthier (~140 word) policy descriptions.

Study 2 was conducted to explore some potential psychological mechanisms that might underlie the preference for an "upstream offset" policy description. Specifically, we aimed to test whether the noted effects were mediated by participants' perceptions of an "upstream offset" having a greater environmental impact and/or better ensuring that those responsible for carbon emissions pollution are actually held accountable.

5. Study 2: material and methods

5.1. Participants

Participants were 1215 residents of the United States (53% women; M age = 36.99 years [SD = 11.88]) who were recruited through Amazon. com's Mechanical Turk website. Data was collected in two waves (n = 406 and n = 809), one month apart, combined with two other (unrelated) studies. A sample size of roughly 1215 was targeted, with the goal of at least 400 participants per cell, based on the modest sample sizes observed in Study 1 (e.g., d = 0.31) and the need for a larger sample size to test multiple, simultaneously estimated mediation models. Sample sizes in each between-subjects condition were as follows: upstream offset = 420, upstream tax = 378, downstream offset = 417.

5.2. Experimental manipulation: proposed carbon regulatory policies

Participants were randomly assigned to one of three conditions: "upstream offset", "upstream tax", or "downstream offset" and read a corresponding policy description, identical to those used in Study 1. Our aim was to focus on the "upstream offset" condition and learn *why* it was most preferred (in Study 1 and Study S1), by comparing it to the two most similar labelling conditions: "downstream offset" and "upstream tax". (To increase statistical power, this study did *not* include the "downstream tax", "no fee" or "no information" conditions of study 1.)

5.3. Measures of pro-environmental flight preference and policy support

In Study 2 participants' pro-environmental flight preference was gauged using a single flight pair choice. How likely participants would be to buy "Flight B to the island of Bequia for $310.99 plus an additional $14.00 carbon [offset] (or tax) on [aviation fuel production and importation] (or on airplane travel and cargo)" instead of "Flight A to the island of Nevis for $322.99" on a 7-point scale (from "1- Definitely Not" to "7- Definitely") served as our measure of pro-environmental flight choice.

In addition, participants were asked, "How much would you support the implementation of this carbon regulatory program on a national level?" Responses on this 7-point scale (from "1- Strongly opposed" to "7- Strongly support") served as our measure of policy support.

Participants in the second wave of data collection (n = 809) also reported preference for Flight B on the additional flight pair choice items that were included in Study 1. For this subsample we were able to create a 5-flight composite collapsed across flight pair choices and run identical analyses. The results of these are very similar, and are reported in the online supplement, Appendix I.

Table 1
Mean responses (with 95% CIs in brackets) to the flight preference, policy support, perceived impact, and perceived accountability questions in each condition in Study 2. In each row, means without shared superscripts are significantly different, $p < .05$.

Question	Upstream Offset	Upstream Tax	Downstream Offset
How likely would you be to buy Flight B instead of Flight A?(1 = Definitely not, 7 = Definitely)	5.16^{a}[5.07, 5.35]	4.73^{b}[4.63, 4.94]	4.89^{ab}[4.79, 5.1]
How much would you support the implementation of this carbon regulatory program on a national level?(1 = Strongly Opposed, 7 = Strongly Support)	5.08^{a}[5.00, 5.25]	4.84^{b}[4.74, 5.04]	4.63^{b}[4.53, 4.82]
Would you expect this carbon regulatory program to have a significant impact on climate change? (1 = Definitely not, 7 = Definitely)	4.2^{a}[4.12, 4.36]	3.86^{b} [3.77, 4.04]	3.88^{b}[3.79, 4.05]
Does this carbon regulatory program ensure that those who are responsible for carbon emission pollution are the ones who pay to reduce it? (1 = Definitely not, 7 = Definitely)	4.05^{a}[3.96, 4.22]	3.88^{a}[3.79, 4.07]	3.52^{b}[3.43, 3.69]

Table 2
Pearson correlations between measures in Study 2: flight preference, policy support, perceived impact, and perceived accountability. *** indicates $p < .001$, ** indicates $p < .01$, * indicates $p < .05$, and † indicates $p < .10$.

	Preference	Support	Impact	Accountability
Preference	–			
Support	.52***	–		
Impact	.44***	.68***	–	
Accountability	.35***	.55***	.57***	–

5.4. Measures of perceived environmental impact and carbon emissions accountability

Next, participants were asked two additional questions: "Would you expect this carbon regulatory program to have a significant impact on climate change?" and "Does this carbon regulatory program ensure that those who are responsible for carbon emission pollution are the ones who pay to reduce it?" Responses on both of these 7-point scales (from "1- Definitely not" to "7- Definitely" and from "1- Not at all" to "7- Very much", respectively) served as our potential mediators of interest. Participants in all three conditions also provided demographic information (e.g., age, sex, income).

6. Study 2: results

Data is publicly available for download at https://tinyurl.com/y75k6hkm. To test whether experimental condition affected pro-environmental flight preference (i.e., preference for the flight which included a carbon fee), we conducted an ANOVA on continuous preference for Flight B, with condition as the independent variable. Results revealed a significant main effect of experimental condition, $F(2,1212) = 4.25$, $\eta^2 = 0.007$, $p = .011$. Table 1 shows that the "upstream offset" condition appears to be most effective at eliciting pro-environmental flight preferences.

The "upstream offset" condition inspired greater pro-environmental flight preference than the "upstream tax" and marginally greater pro-environmental flight preference than the "downstream offset" conditions; $t(796) = 3.00$, $d = 0.21$, $p = .003$, and $t(835) = 1.90$, $d = 0.13$, $p = .058$, respectively.

To test whether experimental condition affected how much participants would support the policy on a national level, we conducted an ANOVA on policy support, with condition as the independent variable. Results revealed a significant main effect of experimental condition, $F(2,1215) = 5.81$, $p = .003$, $\eta_p^2 = 0.009$. Table 1 shows that the "upstream offset" condition appears to be most effective at eliciting policy support. Policy support in the "upstream offset" condition was marginally greater when compared to the "upstream tax", $t(796) = 1.79$, $d = 0.13$, $p = .073$, and significantly greater when compared to the "downstream offset" conditions, $t(835) = 3.46$, $d = 0.24$, $p = .001$.

To test whether experimental condition affected how much participants believed that the carbon regulatory program would have a significant impact on climate change, we conducted an ANOVA on perceived environmental impact, with condition as the independent variable. Results revealed a significant main effect of the experimental condition, $F(2,1212) = 4.95$, $\eta_p^2 = 0.007$, $p = .008$. Table 1 shows that the "upstream offset" condition appears to be most effective at eliciting high perceived environmental impact. Perceived environmental impact in the "upstream offset" condition was significantly greater when compared to the "upstream tax", $t(796) = 2.79$, $d = 0.20$, $p = .005$, and the "downstream offset" conditions, $t(835) = 2.70$, $d = 0.18$, $p = .007$.

To test whether experimental condition affected how much participants believed that the carbon regulatory program would ensure that those who are responsible for carbon emission pollution are the ones who pay to reduce it, we conducted an ANOVA on perceived carbon emissions accountability, with condition as the independent variable. Results revealed a significant main effect of the experimental condition, $F(2,1212) = 8.83$, $\eta_p^2 = 0.014$, $p < .001$. Table 1 shows that the "upstream offset" condition appears to be most effective at eliciting perceptions of holding accountable those responsible for the carbon emissions. Perceived carbon emissions accountability in the "upstream offset" condition was not statistically different when compared to the "upstream tax" condition, $t(796) = 1.27$, $d = 0.09$, $p = .21$, but was significantly greater when compared to the "downstream offset" condition, $t(835) = 4.14$, $d = 0.288$, $p < .001$.

6.1. Mediation analyses

We conducted two sets of mediation analyses to examine the processes associated with flight preference and policy support. We now examine each of these in turn.

6.1.1. Flight preference

Both perceived impact and perceived accountability were correlated with flight preference, as seen in Table 2. Furthermore, in a GLM with frame (3-levels: upstream offset, downstream offset, and upstream tax), perceived impact, and perceived accountability predicting flight preference, both impact, $F(1,1210) = 119.11$, $p < .001$, $\eta_p^2 = 0.09$, and accountability, $F(1,1210) = 26.77.11$, $p < .001$, $\eta_p^2 = 0.02$, remained as significant predictors of preference, while frame was reduced to marginal significance, $F(2,1210) = 2.31$, $p = .10$, $\eta_p^2 = 0.004$.

We also analyzed political affiliation and found that it did indeed moderate the results, as described in the Online Supplement, Appendix G. Specifically, Republicans were more responsive to policy description differences than Democrats, consistent with previous research on U.S. participants (Hardisty et al., 2010; Hart & Feldman, 2018).

Next, we conducted a simultaneous indirect effect analysis of the frame → impact → flight preference pathway and the frame → accountability → flight preference pathway. As seen in Fig. 2a, each leg of each mediation pathway is significant. We used a recommended bias-corrected bootstrapping procedure in R (Shrout & Bolger, 2002), with 5,000 bootstrap samples. To test the 3-level categorical framing variable, we used two dummy coded variables, and focus on the upstream offset condition (coded 1) versus the other two conditions (coded 0). This revealed significant mediation via both perceived impact,

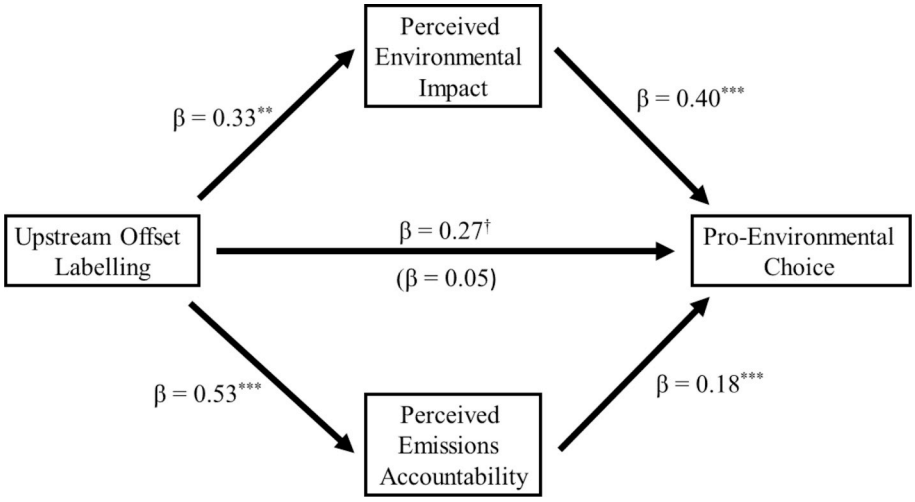

Fig. 2a. Mediation analysis of the effect of carbon labelling on flight preference in Study 2. † indicates p < .1, * indicates p < .05, ** indicates p < .01, and *** indicates p < .001.

β = 0.13, CI_{95} [0.03,0.24], p < .01, and perceived accountability, β = 0.09, CI_{95} [0.05,0.16], p < .001.

6.1.2. Policy support

Turning to the processes associated with policy support, it is again apparent that both perceived impact and perceived accountability are correlated with policy support, as seen in Table 2. As seen in Fig. 2b, each leg of each mediation pathway is significant. Again, in a model with frame (3-levels: upstream offset, downstream offset, and upstream tax), perceived impact, and perceived accountability predicting policy support, both impact, F (1,1210) = 483.98, $p < .001$, $\eta_p^2 = 0.29$, and accountability, F (1,1210) = 96.13, $p < .001$, $\eta_p^2 = 0.07$, remained as significant predictors of support, while frame dropped to non-significance, F (2,1210) = 1.26, $p = .29$, $\eta_p^2 = 0.002$.

Next, we conducted a simultaneous indirect effect analysis of the frame → impact → policy support pathway and the frame → accountability → policy support pathway, as seen in Fig. 2b, using the same bootstrapping procedure with 5,000 bootstrap samples. This revealed significant mediation via both perceived impact, β = 0.19, CI_{95} [0.06,0.34], $p < .01$, and perceived accountability, β = 0.13, CI_{95} [0.07,0.21], $p < .001$.

6.2. Political affiliation

As detailed in the Online Supplement, there was a significant interaction between political affiliation and carbon pricing condition, F (2,773) = 4.96, $p < .01$, $\eta_p^2 = 0.01$, such that carbon pricing condition had a slightly stronger effect on the policy support of Republicans than Democrats. In particular, the "upstream tax" pricing condition was supported by Democrats much more than Republicans.

7. Study 2: discussion

The results of Study 2 are consistent with those of Study 1, while adding important additional nuances which may hint at the psychological mechanisms underlying the noted success of the "upstream offset" policy description. When a proposed carbon fee was described as a "carbon offset on aviation fuel production and importation" (versus other descriptions), individuals were more likely to purchase a flight carrying the carbon fee instead of a similarly priced flight with no fee, and were more likely to support the proposed carbon regulation policy. These individuals were also more likely to perceive the policy as having a more significant impact on climate change, and believe that the policy would better ensure that those responsible for carbon emissions pollution were the ones held accountable for paying the fee.

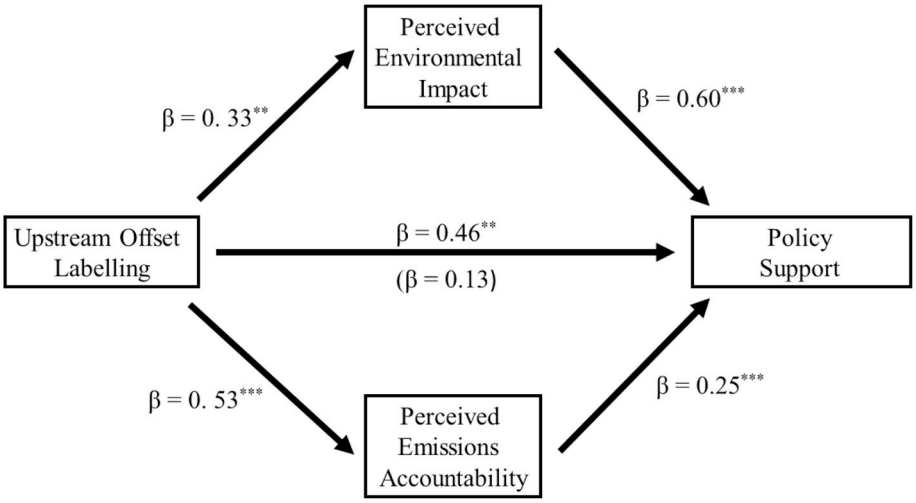

Fig. 2b. Mediation analysis of the effect of carbon labelling on policy support in Study 2. † indicates p < .1, * indicates p < .05, ** indicates p < .01, and *** indicates p < .001.

Mediation analyses revealed that participants' increased pro-environmental flight preference and heightened policy support was driven by perceptions that the "upstream offset" policy would have a greater impact on climate change (versus "upstream tax" and versus "downstream offset" conditions) and, would better ensure that those who are responsible for carbon emissions pollution are actually the ones held accountable for covering the cost (versus the "downstream offset" condition only).

8. General discussion and conclusions

Across three studies, U.S. consumers were consistently more likely to choose to purchase a flight with a carbon price when the additional price was described as a "carbon offset for aviation fuel production and import" than when it was described using other frames, such as a "carbon tax for airplane travel". Notably, this *upstream offset* frame was popular enough among consumers that it counteracted the expected preference to avoid the $14.00 additional cost of the fee. In addition to the two studies reported above, we ran another study (reported in the online supplement, Appendix E) which replicated the flight preference results.

The description of the point of regulation (upstream vs downstream) does seem to have a notable impact on consumer preferences. A "downstream" carbon offset was not nearly as popular as an "upstream" carbon offset. Why? The upstream offset is perceived both to help the environment more and to hold accountable those responsible for the emissions. In other words, the upstream offset condition addresses both the perceived causes and consequences of the emissions. This is true even though the cost to consumers for each policy was held constant in our studies, regardless of whether the price was described as applying upstream or downstream.

Our findings contribute to previous studies on tax aversion. In addition to replicating the general finding of tax aversion in U.S. consumers (Hardisty et al., 2010; Sussman & Olivola, 2011) and the effectiveness of environmental frames (Parag, Capstick, & Poortinga, 2011), we introduce and measure the psychological dimension of "upstream" vs "downstream" framing: not only are taxes disliked, but this is particularly true for "downstream" taxes on consumers, as opposed to "upstream" offsets for producers. We also contribute new explanations for tax aversion in environmental policy: that taxes are not perceived to be effective for making an environmental impact, and that taxes may not be seen as holding the right people accountable.

In future research, it would be interesting to see if "upstream" vs "downstream" descriptions influence the order and balance of thoughts in the way predicted by Query Theory (Johnson et al., 2007): perhaps "downstream" costs induce a negative cognitive bias in the same way that taxes do, influencing subsequent information processing. An additional cost or penalty applied to "me" may be more likely to trigger an immediate negative evaluation.

It would also be interesting to study how "upstream" vs "downstream" descriptions influence goal framing (Lindenberg & Steg, 2007; Steg et al., 2016), and whether perhaps the "upstream" and "offset" frames induce a "normative" goal of doing the right thing, whereas the "downstream" and "tax" goes may induce a "gain" goal of maximizing resources.

The implications for policy are somewhat nuanced. Countries or states that wish to enact a carbon price may want to use the "upstream offset" frame (paired with a brief description), especially if competing with other countries without a carbon fee. Our results suggest that consumers may in fact prefer airline flights with an upstream carbon offset; this preference may be strong enough to counteract any additional cost to the country or state that implements it (though this should be tested in future research in field studies). The implementing country could potentially realize further benefits if the offset investment helps finance sustainable low-carbon development in that country. Furthermore, aviation consumers might be more accepting of "upstream offset" regulation than "downstream tax" regulation. In fact, our findings suggest that customers may be willing to purchase tickets that include appropriately described carbon offsets even if the cost is higher; these descriptions may still be effective even when they are as short as 28 words in length.

These findings have policy implications for the new market-based measure adopted for the international civil aviation sector, which has an offsetting program as a central feature, with a relatively upstream point of obligation at the level of airlines. Our research suggests that airlines might wish to highlight their carbon offset purchases for their customers in order to increase customer receptivity. Our findings also suggest that participation in CORSIA could thus bring overall economic benefits rather than costs for participating airlines and that countries may thus benefit from opting-in to the initial voluntary phase. If the goal of a carbon price is to limit the aviation sectors' climate impact, a carefully vetted upstream offset program with strong offset quality requirements may be an effective solution. Future research could further examine if customer preferences vary with the type of offset and how best to communicate about offsets to customers to elicit the most favorable response.

The studies reported here have several important limitations. First, the scenarios and answers are hypothetical, and therefore participants may have tried to give answers that "look good", but that do not represent their real views and behavior. For example, in Study 1, we found that the flight including a $14 upstream offset was equally preferred (or even slightly more preferred) as compared to a flight with no carbon fee. When spending actual money, consumers may weight that $14 cost more heavily, and prefer the "no-fee" flight. Therefore, these results need to be tested with real flight choices in the future. Second, we only sampled U.S. consumers, and the results may be different in other regions and cultures. For example, taxes may be less odious in other countries (such as Northern European countries), and environmental regulation may be more popular. This should be explored in future research. Third, the sample population we used, Amazon Mechanical Turk, is not representative of the U.S. population. Specifically, MTurkers tend to be younger, more educated, and lower income than the general U.S. population (Paolacci et al., 2010). As such, this group may be more price sensitive, and also more pro-environmental than the U.S. population, both of which could affect our results. Fourth, while the key findings of the present research were replicated across three studies (the two studies in the main manuscript plus one in the supplemental material), the effect sizes are small. As such, while framing of carbon prices may be a helpful tool, it should not be considered a panacea for consumer acceptance of carbon prices, and should be combined with other measures.

Up/downstream framing is a useful new dimension in environmental consumer psychology. It can readily be applied in the airline industry, as well as in other domains and contexts more broadly, opening new avenues for research and practice. For example, when products that include a charitable donation (e.g. "$1 from every purchase is donated to Green Peace"), who gets the credit for the good deed, the consumer, the firm, or both? We suspect that "downstream" pricing may be more effective in these contexts, but this should be tested in future research.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jenvp.2019.101342.

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