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Pay more, fly more? Examining the potential guilt-reducing and flight-encouraging effect of an integrated carbon offset

Gustav Bösehans [a,*], Jan Willem Bolderdijk [b], Jing Wan [c]

[a] School of Engineering, Newcastle University, NE1 7RU, UK
[b] Faculty of Economics and Business, University of Groningen, 9700 AB, NL, Netherlands
[c] Department of Marketing and Consumer Studies, Gordon S. Lang School of Business and Economics, University of Guelph, N1G 2W1, Canada

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1. Introduction

In the current age of global hypermobility (Adams, 2005), aviation is no longer exclusively a means of transport for the wealthy. Ticket prices have fallen to a fraction of prices from past decades and the air travel sector has grown rapidly with more passengers than ever travelling to various locations worldwide (European Commission, 2017; Gittens et al., 2017). As international air travel currently accounts for up to 5% of total greenhouse gas emissions (Larsson et al., 2018), this development is particularly worrying as the global warming potential of emissions from air travel may be as much as five-fold compared to emissions from rail, road or sea-based means of transport (Peeters et al., 2004), as emissions (especially NOx) are released directly into the upper atmosphere, affecting the ozone layer more strongly (Penner et al., 1999). By 2050, CO2 emissions from international aviation are expected to have increased to more than fivefold of 2005 levels (International Civil Aviation Organization (ICAO), 2016).

To buffer the harmful effects of aviation on the environment, *carbon offsets* purchased either directly through the operating airline or external websites, such as atmosfair.de, offer environmentally concerned air travellers the opportunity to compensate financially for their share of emissions caused by the flight. The revenue generated by carbon offsetting initiatives is subsequently invested into, for example, renewable energy, environmental education, or research on more energy efficient technologies, with the goal to ensure that the net effect of one's flight on the climate is zero. Based on estimations by Brouwer et al. (2008), offsetting initiatives could generate close to €23 billion annually to support climate mitigation activities. Although past research has suggested that many air travellers are neither aware of the existence of carbon offsets nor of the negative consequences of aviation (e.g. Gössling et al., 2009; Hares et al., 2010), more recent research suggests that carbon offsets are growing in popularity among certain segments of travellers such as young, adventurous people with a vegetarian/low climate impact diet (Schwirplies et al., 2019; Segerstedt & Grote, 2016).

1.1. The success and failure of carbon offsetting

Despite the popularity (and promotion) of offsetting initiatives in the past being rather modest (Frew & Winter 2008), previous research has suggested that the carbon offset market may also reach beyond *ecocentric* (i.e. those with a nature-centred value system) customers (Mair, 2011). Indeed, change appears to be imminent. The German press, for example, has coined a new term – *Flugscham*[1] (from Swedish 'flygskam') that first appeared in the Svenska Dagbladet[2] – to give a name to the increased guilt associated with flying among German (and Swedish) air travellers. In the wake of growing environmental awareness among the general population, fostered recently by global campaigners such as Greta Thunberg and the Fridays for Future demonstrations, the demand for carbon offsetting has increased dramatically with just 0.3 million tonnes of CO2 having been offset by airline passengers in 2008

* Corresponding author. School of Engineering, Cassie building 3.17, Newcastle University, NE1 7RU, Newcastle upon Tyne, UK.
E-mail address: Gustav.Bosehans@newcastle.ac.uk (G. Bösehans).

[1] English: flight shame, in Raab, K. (May 2019). Flugscham: Der dumme Weltbürger. Retrieved Nov 15, 2019, from https://www.zeit.de/entdecken/reisen/2019-05/flugscham-fliegen-reisen-umwelt-oekologisch-co2.

[2] Meiton, L. A. (March 2018). Wetterstrand om flygskatten: "Jag gillar piskor". Retrieved Nov 15, 2019, from https://www.svd.se/wetterstrand-om-flygskatten-jag-gillar-piskor.

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compared to 42.8 million tonnes in 2018 (Hamrick & Gallant, 2018). This is also illustrated by donations received by offset provider Atmosfair which have increased by 40% in 2018 alone, reaching €9.5 million ("40 percent more donations for CO2-Offsets", Zeit Online, June 12, 2019),[3] with donations projected to further increase in 2019.

However, while carbon offset donations are on the rise as a whole, only a minority of air travellers are currently voluntarily choosing to pay for a carbon offset. According to an inquiry by the BBC,[4] despite half of the 28 world's biggest airlines offering offsetting schemes, merely 1% of air travellers actually do purchase carbon offsets, exposing a significant attitude-behaviour gap which has been documented in the sustainable tourism domain (see Juvan & Dolnicar, 2014). The slow uptake of carbon offsets mirrors the situation in the wider project-based carbon market where, in 2008, voluntary transactions (mostly by corporations, institutions and individuals) represented only 11% of traded allowances (Capoor & Ambrosi, 2009), although the volume of voluntary transactions has continued to grow (see Kossoy & Guigon, 2012).

The low interest or willingness to purchase offsets may, to some extent, be the result of general concerns about the true effectiveness of offsetting schemes in combating global warming (Cames et al., 2016) and of some airlines providing information on schemes that is "inconsistent, limited, and sometimes inaccurate" (Becken & Mackey, 2017). Furthermore, it has been argued that, in a voluntary compliance system, which gives air travellers the opportunity to freeride on others' contributions, passengers might only be willing to participate if they perceive others to do the same. In Akter, Brouwer, Brander, and Van Beukering's (2009) research, a third of air travellers who were asked to pay a carbon-based travel tax indicated they were unlikely to actually pay their stated willingness-to-pay amount if the contribution was made voluntarily.

Tackling the limited success of offsetting has sparked a line of research into how the credibility and uptake of offsets can be improved (Ritchie et al., 2020; Schwirplies et al., 2019; Zhang et al., 2019a, 2019b, 2019c), including (failed) attempts to nudge consumers into purchasing carbon offsets (Tyers, 2018). Given the limited success of these measures, a much more radical, and potentially more effective, measure would be the introduction of *integrated carbon offsets* (ICOs) where an offset is automatically included in the ticket price. The latter could overcome the barriers posed by low interest and freeriding by making the offset of flight emissions the industry standard, an idea that is gaining renewed attention from airlines.

1.2. Introducing integrated carbon offsets to bridge the attitude-behaviour gap

The 2006-founded British all-business airline Silverjet, which would come to cease operations only two years later, was one of the first in the industry to include an ICO in their flight tickets.[5] In this scheme, passengers would gain carbon points for each flight which then could be used to support green projects selected by the airline, such as wind-power generation in India or free energy-saving light bulbs for poor families in Jamaica. Recently, this idea has been taken up once more by another British airline, EasyJet, which has vowed to spend £25 million annually on emission reduction certificates to offset flight emissions,[6] stating that the cost, safety, and performance of flights will not be impacted.[7] The US airline JetBlue also aims to offset greenhouse gas emissions (up to 15 to 17 billion pounds) by purchasing carbon credits and using cleaner-burning aviation fuel.[8] Finally, plans by Lufthansa state that, starting in 2020, the airline will offset emissions of "all European flights that fall under corporate fares […] at no extra cost to corporations".[9]

These recent developments suggest a shift in attention away from offering voluntary carbon offsets (VCOs) to integrated carbon offsets (ICOs), enabling airlines to not only boost their image by demonstrating their commitment to sustainable aviation, but also to bridge the commonly observed attitude-behaviour gap, as the decision to pay the offset is no longer placed on consumers. However, while ICOs could establish offsetting as a new norm, by automatically offsetting passengers' flight emissions, they may not be without risk.

1.3. The potential guilt-reducing and flight-encouraging effect of integrated carbon offsets

While recent developments suggest an increased willingness to pay for climate mitigation activities among the general public, it has been suggested that carbon offsets (voluntary or not) could do more harm than good – or, in other words, they could be a form of "bloodletting" (Wilson, 2011). In particular, air travellers have been shown to prefer offsetting their flight emissions over taking fewer flights (Gössling et al., 2009), as flying is still deeply entrenched within society (Cohen et al., 2011). Arguably, taking fewer flights would be most beneficial for the environment, as the evidence for the true effectiveness of carbon offsetting schemes is scarce[10]. Often, it remains uncertain whether airlines are able to compensate for flight emissions fully or only partially. To make matters worse, offsetting initiatives, by supposedly enabling travellers to fly in a "carbon neutral" way, could actually *encourage* environmentally conscious consumers to take a flight – instead of choosing greener alternatives such as trains or coaches – because they no longer have to feel guilty about the negative environmental consequences of aviation (Kotchen, 2009).

This may be due to the misconception that one 'green' choice (i.e., offsetting the carbon emissions of a flight) can compensate for an environmentally harmful behaviour, thus reducing the imbalance in one's moral environmental account (Sörqvist & Langeborg, 2019). In fact, given that all flights with an ICO included in the ticket price must involve some form of carbon offsetting, travellers may erroneously assume that such booked flights are entirely environmentally harmless, thus potentially functioning as a consumer guilt-reduction device. The potentially guilt-reducing effect of carbon offsets has been reiterated in various popular press articles including articles in the *New York Times*

[3] Zeit (June 2019). 40 Prozent mehr Spenden für CO2-Ausgleich. Retrieved Nov 15, 2019, from https://www.zeit.de/wirtschaft/2019-06/co2-klimaschutzorganisation-atmosfair-spenden-kompensation-treibhausgasemission.

[4] BBC News (May 2019). Climate change: Half world's biggest airlines don't offer carbon offsetting. Retrieved Nov 15, 2019, from https://www.bbc.co.uk/news/science-environment-48133365.

[5] Ringshaw, G. (November 2006). Business airline to go green on tickets. Retrieved Nov 25, 2019, from https://www.thetimes.co.uk/article/business-airline-to-go-green-on-tickets-w76b0bls3bm#.

[6] Topham, G. (November 2019). EasyJet to offset carbon emissions from all its flights. Retrieved Nov 25, 2019, https://www.theguardian.com/business/2019/nov/19/easyjet-offset-carbon-emissions-flights-thomas-cook-collapse.

[7] https://www.easyjet.com/en/sustainability (accessed Nov 25, 2019).

[8] Niiler, E. (2020). Do Carbon Offsets Really Work? It Depends on the Details. Retrieved May 21, 2020, from https://www.wired.com/story/do-carbon-offsets-really-work-it-depends-on-the-details/.

[9] Parsons, M. (November 2019). Corporate fares: Lufthansa to carbon offset all European flights. Retrieved Nov 25, 2019, from https://buyingbusinesstravel.com/news/corporate-fares-lufthansa-to-carbon-offset-all-european-flights/.

[10] Struck, D. (April 2010). Buying carbon offsets may ease eco-guilt but not global warming. Retrieved Nov 15, 2019, from http://probeinternational.org/library/wp-content/uploads/2011/11/Buying-carbon-offsets-may-ease-eco-guilt-but-not-global-warming-CSMonitor1.pdf.

(2009),[11] when offsetting first gained wider media attention, and more recent articles in *Die Zeit*[12] and *Wired*[13] (both 2019). Carbon offsets might thus function as a form of "moral cleansing" (e.g., Zhong & Liljenquist, 2006) and may partly explain why even green consumers continue to fly (McDonald et al., 2015).

However, as far as we are aware, this prediction has not been tested empirically. That is, while it is often claimed that carbon offsets may function as a guilt-reduction device, to our knowledge, there is no empirical evidence that this is actually the case. Indeed, carbon offsets might not affect air travellers' guilt at all. If they did, however, then this could have serious consequences as described above. Hence, our point is not to settle the debate of whether carbon offsets can make flying entirely carbon neutral or even achieve a negative net carbon balance. Rather, we wanted to investigate one specific feature of the debate by addressing the following research question:

Does the presence of an integrated carbon offset (ICO) decrease anticipated guilt for environmentally concerned air travellers thereby encouraging them to take more flights?

Answering this research question requires a deeper look into some of the underlying psychological factors affecting pro-environmental behaviour. In particular, whether a specific behaviour (here: taking a flight) is perceived as a transgression in the first place, and thus how guilty a person will feel, if at all, will (amongst other factors) depend on how environmentally concerned that person is: that is, on the extent to which people endorse *biospheric* values.

1.4. Values and the mediating role of anticipated guilt in pro-environmental behaviour

Steg and colleagues defined biospheric values as reflecting "a concern with the quality of nature and the environment for its own sake, without a clear link to the welfare of other human beings" (Steg et al., 2014, p. 4). According to the Value-Belief-Norm Theory (VBN; Stern et al., 1999), people with strong biospheric values are more likely to be aware of and feel responsible for the negative environmental impact of their choices. Thus, these people may be particularly likely to experience *guilt* whenever they do choose to take a flight – that is, a negative affective state following a consumer decision that contradicts personal values or norms (Burnett & Lunsford, 1994). Furthermore, feelings of *ecological guilt* (i.e., specifically in relation to environmentally harmful behaviours) may not only arise after a transgression has occurred, but also in the face of an impending transgression.

This anticipated guilt has been shown to be a strong motivator for pro-environmental behaviour in previous studies (e.g., see Bamberg et al., 2007; Hunecke et al., 2001; Mallett, 2012, on ecological guilt; see Elgaaied, 2012; Lindenmeier et al., 2017; Muralidharan & Sheehan, 2018, on anticipated guilt). In a study by Elgaaied (2012), for example, anticipated guilt fully mediated the relationship between environmental concern and intentions to recycle. Support for the mediating role of anticipated emotions also comes from the application of the Norm Activation Model (NAM; Onwezen et al., 2013). In particular, the authors suggest that anticipated emotions, including anticipated guilt and pride, mediate the influence of personal norms on pro-environmental behaviour. Finally, in another study by Rees, Klug and Bamberg (2014), a 'guilty conscience' was found to predict participants' pro-environmental intentions and behaviour after having been confronted with human-caused as opposed to seemingly natural environmental damages.

1.5. The current research

Based on the evidence to date, we expect *anticipated guilt* to act as a strong buffer against environmentally harmful behaviours, such as flying, meaning that people who strongly endorse biospheric values should a) feel more guilty about flying and b) this guilt should subsequently motivate them to avoid transgressions and to opt for more sustainable alternatives whenever they are available. This is summarised in the following hypothesis:

Hypothesis 1. Respondents' anticipated guilt is expected to mediate the relationship between their biospheric values and their propensity to choose a flight over a low-emission alternative.

It follows that, if an integrated carbon offset was able to eliminate or substantially reduce emissions and therefore to reduce people's anticipated guilt about flying, it could actually lead these same individuals to choose to fly more often rather than choosing more environmentally friendly alternatives. We thus further hypothesised that, if an ICO is included in the flight option, that option may become less guilt-inducing (or the offset might even "neutralize" its negativity entirely) for those travellers who strongly endorse biospheric values, therefore increasing their propensity to choose air travel over alternatives.

In other words, we propose a moderated mediation effect:

Hypothesis 2. When an integrated carbon offset is included in the flight ticket, anticipated guilt no longer prevents participants who endorse biospheric values from choosing flights, thus increasing their propensity to select flights.

Hypotheses 1 and 2 are summarised in the proposed moderated-mediation model depicted in Fig. 1. To investigate whether carbon offsets can indeed reduce the guilt that environmentally concerned travellers experience, thereby making them fly more often, we tested this conceptual model in two separate online studies, conducted at two different time points, with two independent samples.

2. Study 1

To test our proposed model, we conducted an online study where participants were presented with nine hypothetical travel choice scenarios involving trips between major European cities by either taking a flight or train. Between subjects, we manipulated whether the available flight option did or did not include an integrated carbon offset (ICO). The value of the latter was determined based on calculations performed using German carbon offset provider atmosfair.de. In both conditions (Offset vs. No offset), ticket prices for both travel modes (train vs. plane) were based on actual travel offers that were the result of a Google search. To restrict choice, we selected the cheapest available offer for each

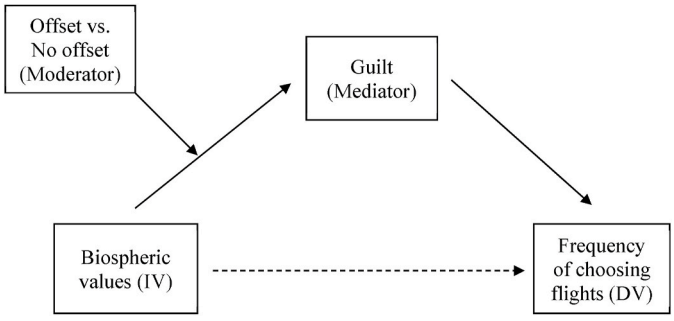


Fig. 1. Moderated mediation model (conceptual).

[11] Rosenthal, E. (November 2009). Paying more for flights eases guilt, not emissions. Retrieved Nov 15, 2019, from http://www.nytimes.com/2009/11/18/science/earth/18offset.html?_r=0.

[12] Erdmann, E. (June 2019). Fliegen ohne schlechtes Gewissen? (Flying without a bad conscience?). Retrieved Nov 15, 2019, from https://www.zeit.de/die-antwort/2019-06/co2-kompensation-klimabilanz-fluege-faq#ist-kompensieren-sinnvoll.

[13] Weiss, S. (August 2019). Carbon offsetting isn't a cure-all for your filthy flying habit. Retrieved Nov 15, 2019, from https://www.wired.co.uk/article/carbon-offsetting-uk-flights.

alternative. That is, the same departure date was chosen for the flight and train options, although departure times and potential stops (i.e., for the train options) could vary, due to selecting the cheapest offer for each alternative.

2.1. Design & procedure

In total, respondents were presented with nine pre-tested choice scenarios where they were asked to choose between either a flight or train option (see Table 1 for a summary of all the scenarios employed). Each scenario had a fixed departure location (Amsterdam) and varied in destination (e.g., London, Munich or Prague) to cover a range of travel distances (see Appendix A1 for an example scenario). Accordingly, travel distance (in km/miles) and thus travel time (in hours), price (in €) and emissions caused by the trip computed per passenger (in kg CO2) varied depending on the location. It should be noted that travel time by train was most strongly affected by destination with total travel time being between 58% (London) up to 327% (Milan) greater for the train compared to plane option.

However, despite involving a longer travel time, the environmentally friendly option (train) also caused 2–5 times less carbon emissions than the environmentally harmful option (plane), according to emission estimates by atmosfair.de. Please note that the original data presented in this study was collected in 2013. While atmosfair.de is still in operation today, the algorithm for computing flight emissions has changed, as have offsetting prices. Overall flight emission estimates, in particular, have increased substantially from 2013 to 2020.

After having given their consent, study participants were randomly assigned to either an "Offset" or "No offset" condition, meaning that in all the scenarios that respondents would receive the flight option would either *always* (Offset condition) or *never* (No offset condition) include an integrated carbon offset (ICO) paid for by the traveller.

A separate page with task instructions preceded the nine scenarios and a (hidden) timer was included on this page to ensure that respondents took enough time to read the instructions. In the Offset condition, instructions highlighted the presence of the ICO through an additional phrase attached to the price explanation (i.e., "The flight ticket always includes a so-called carbon offset in order to counteract the negative impact of the CO2 emissions caused by the trip"). In the subsequent scenarios, a carbon offset fee of 6–7€ was explicitly included in the flight ticket price accompanied by the following text across all scenarios (see below). This allowed us to test for the moderating role of offsets as depicted in Fig. 1.

> "*Flying is highly energy-intensive and causes a huge amount of CO2 emissions. In order to counteract the negative environmental impact of these emissions, this ticket includes an additional fee of X€ (original ticket price = XX€) which are invested in CO2 reduction programmes, such as planting trees, research in renewable energy sources or environmental education."

Participants faced the same travel choices in the Offset condition, the only difference being that the price of the flight option was higher than in the No offset condition, due to the integrated carbon offset being included in the ticket price (an additional 6–7€ for each scenario based on suggested donations from atmosfair.de). For each choice scenario, participants were asked to choose between one of the two options – that is, either plane or train. Additionally, we asked respondents to indicate which factor influenced their travel mode decision most (i.e., travel time, emissions or price) to get a better idea of the drivers influencing their choice.

2.1.1. Computing flight and anticipated guilt scores

The coding for flight scores was 1 if the participant chose the flight and 0 when the participant chose the train. Respondents' overall flight score equalled the sum of each of the nine scenario trip choices. Across all scenarios, respondents could achieve a maximum flight score of 9 which was obtained when choosing the plane consistently in all scenarios.

For each scenario, respondents' anticipated guilt was measured by asking "How guilty would you feel about choosing the flight option in this scenario?" with answers being given on a seven-point rating scale ranging from 1 – Not at all guilty to 7 – Very guilty. Respondents' guilt scores were subsequently averaged across all of the nine scenarios.

2.1.2. Measuring values and offsetting beliefs

A 16-item instrument was used to measure participants' value orientations (De Groot & Steg, 2007, 2008, 2010; Steg et al., 2014). Respondents rated the importance of these items (four items each for altruistic, biospheric, egoistic and hedonic values) such as "Protecting the environment: Preserving nature" [biospheric] as "a guiding principle in [their] life" on a 9-point Likert-scale format. Although all four value orientations were measured, the focus here was on the biospheric value dimension. Corresponding items for this value dimension were combined and averaged, showing very good reliability ($\alpha = 0.91$). The scale was presented in a counterbalanced order (either directly before or directly after the scenarios) in order to detect any potential influence of priming effects of the measure on respondents' travel mode choices. However, as no such priming effect emerged in the analysis, we collapsed the data across both orders of the survey.

After having completed the scenarios and value scale, we explained the notion of carbon offsetting in more detail (in both conditions) and subsequently asked participants to indicate to what extent they thought that carbon offsetting is *important* and *effective* including "I think that reducing global emissions by purchasing carbon offsets is …" with possible responses ranging from 1 – Not important at all to 7 – Of supreme importance and "I believe that reducing global emissions via carbon offsetting initiatives is …" with possible responses ranging from 1 – Not effective at all to 7 – Very effective. For both items, the midpoint of the scale (4) was "Don't know/Not sure". An attention check required respondents to select the right number (3) from several alternatives (1, 2, 4, 5, 8 or 9). Bivariate correlations between value orientations and remaining constructs that were measured are provided in Appendix A2.

Table 1
Hypothetical travel scenarios used in the survey sorted by emissions caused (Plane: Travel time takes into consideration arrival at the airport and time for check-in and security (2 h added per option); Train: Travel time includes waiting times for changing trains).

Destination (departure location: Amsterdam)		Travel time in h:mm	Emissions in kg CO2	Price in € (+ICO)
London	Plane	3:00	70	62 (+6)
	Train	4:44	29	68€
Paris	Plane	3:15	80	104.65 (+6)
	Train	5:03	27	89
Hamburg	Plane	4:15	80	126.53 (+6)
	Train	6:09	24	93
Basel	Plane	3:20	170	95 (+6)
	Train	6:45	40	81.70
Berlin	Plane	3:30	180	40 (+6)
	Train	6:00	35	44
Munich	Plane	3:50	200	117.46 (+6)
	Train	8:00	44	89
Prague	Plane	4:35	210	55 (+6)
	Train	10:14	47	49
Milan	Plane	3:40	250	75 (+7)
	Train	12:00	53	79
Nice	Plane	4:00	280	105 (+7)
	Train	11:00	75	117

2.2. Participant sample

Based on guidelines for empirical power to detect conditional indirect effects (i.e., moderated mediation) by Preacher et al. (2007), we determined 200 respondents to be a sufficient sample size to detect an effect size of 0.39 (standardised regression coefficient) at 100% power (at $\alpha = 0.05$). However, as these empirical power estimates are based on optimal experimental conditions, and therefore represent a rather liberal estimate, we aimed for a somewhat larger sample size. Study participants were recruited via means of the American paid participant pool, Amazon Mechanical Turk (MTurk), and received 50c (USD) for filling in the online survey. In total, 165 men (68%) and 79 women (32%) completed the survey ($N = 244$). Another two respondents did not complete the survey as they responded "No" when asked whether they understood the informed consent information ($n = 2$).

Respondents ranged in age from 18 to 68 ($M = 30.80$, $SD = 9.63$) with the majority of respondents aged between 18 and 30 years of age ($n = 160$, 66%). Regarding party affiliation, further demographic data suggested a majority of respondents identifying as Democrat ($n = 109$, 45.5%), followed by Independents ($n = 97$, 40.5%) and Republicans ($n = 33$, 14%). With respect to education, two thirds of respondents reported holding either a college or Master's/Doctoral degree ($n = 163$, 67%), followed by a High School degree or lower ($n = 75$, 31%). Finally, most respondents reported an average annual income of $39,999 or lower ($n = 128$, 52%), with about a quarter of respondents earning between $40,000-$69,999 ($n = 58$, 24%) and a minority of respondents earning $70,000 or more ($n = 20$, 8%). Remaining respondents did not provide any information about their income ($n = 38$, 16%).

2.3. Descriptive data analysis

On average, respondents chose the plane in at least four out of the nine scenarios ($M = 4.39$, $SD = 2.40$) and did not report feeling particularly guilty about flying – with the mean falling towards the lower end of the 7-point scale ($M = 3.05$, $SD = 1.54$) – despite considering biospheric values to be important ($M = 4.36$, $SD = 1.46$). Overall, however, there was a general tendency among respondents to view carbon offsetting as both somewhat important ($M = 4.73$, $SD = 1.31$) and somewhat effective ($M = 4.47$, $SD = 1.32$). Fig. 2 shows the distribution of flight scores across the No offset ($n = 108$) and Offset ($n = 110$) conditions, while Appendix A3 provides a detailed overview of individual scenarios.

2.4. Hypothesis testing

To formally test for the mediating role of anticipated guilt (*Hypothesis 1*) and the potential guilt reducing, and thus flight encouraging, effect of a carbon offset for participants who endorse biospheric values (*Hypothesis 2*), the proposed moderated mediation model was tested with Hayes's (2017) Process macro v3.5 (Model 7) in SPSS 25. In this model, biospheric values were entered as the independent variable, guilt scores as the mediator variable and flight scores as the outcome or dependent variable (all variables were mean centred). Offset condition (Offset vs. No offset) was entered as a proposed moderator of the biospheric values and guilt scores relationship. The number of bootstrap samples to calculate percentile bootstrap confidence intervals (*Boot CIs*) for the indirect (mediation) effect at different levels of the moderator variable (i.e., Offset condition) was set to 5000.

This model was partially supported as shown in Fig. 3 below.

As expected, a biospheric value orientation positively predicted reported feelings of anticipated guilt ($\beta = 0.41$, $t = 5.04$, $p < .001$, *CI:* 0.25, 0.57). That is, participants who strongly endorse biospheric values expected to feel guiltier about flying. Respondents' flight scores (i.e., the propensity of choosing the flight rather than train option averaged across all nine scenarios), in turn, were negatively predicted by respondents' guilt scores ($\beta = -0.28$, $t = -4.45$, $p < .001$, *CI:* −0.40, −0.15). In other words, the guiltier people expected to feel about flying, the less likely they were to choose the plane option. The results also indicated a direct effect of biospheric values on flight scores ($\beta = -0.25$, $t = -3.95$, $p < .001$, *CI:* −0.37, −0.12), suggesting that environmentally concerned respondents were less likely to select the flight option to begin with, independent of how guilty they felt. Combined, these results support the mediating role of anticipated guilt in predicting respondents' flight scores.

Next, we examined how the presence of a carbon offset influenced this pattern. The presence of a carbon offset did not seem to decrease the guilt that participants experienced about flying (Main effect offset: $\beta = 0.02$, $t = 0.20$, $p = .84$, *CI:* −0.21, 0.26) – with a guilt average of 2.95 ($SD = 1.53$) and 3.05 ($SD = 1.52$) in the No Offset and Offset condition, respectively – and this was no different among people scoring higher on biospheric values (Interaction between offset and biospheric values: $\beta = -0.08$, $t = -0.64$, $p = .53$, *CI:* −0.31, 0.16). Instead, we find an indirect effect of guilt both when carbon offsets are included ($\beta = -0.09$, *Boot CI*: −0.18, −0.03) as well as when carbon offsets are *not* included ($\beta = -0.11$, *Boot CI*: −0.19, −0.05). In other words, guilt prevents participants who endorse biospheric values from choosing flights, even when offsets are included in the flight. In sum, while confirming the mediating role of guilt (Hypothesis 1), we find no indication of *moderated* mediation (Hypothesis 2).

To test the robustness of our results, we excluded respondents who evidenced a very short time of reading the task instructions (i.e. < 10 s, $n = 24$), filled in the attention check incorrectly ($n = 1$), or showed a highly unusual response pattern ($n = 1$). The latter respondent disregarded the instructions for filling in the value items by choosing "of supreme importance" for each item although the instructions explicitly stated that there are usually "no more than two such values". This left a final sample of 218 survey respondents (140 male, 78 female). With these exclusion criteria applied, we again find that biospheric values predict both anticipated guilt ($\beta = 0.43$, $t = 5.12$, $p < .001$, *CI:* 0.27, 0.60) and flight scores ($\beta = -0.23$, $t = 3.50$, $p < .001$, *CI:* −0.37, −0.10), with anticipated guilt acting as a mediator ($\beta = -0.28$, $t = 4.22$, $p < .001$, *CI:* −0.41, −0.15). Again, we find no support of moderated mediation with the indirect effect of guilt being present both when carbon offsets are included ($\beta = -0.10$, *Boot CI*: −0.19, −0.04) as well as when carbon offsets are *not* included ($\beta = -0.12$, *Boot CI*: −0.20, −0.05).

2.5. Discussion

We tested whether an integrated carbon offset (ICO) included in a flight ticket would encourage environmentally concerned air travellers to prefer the plane over a low-emission, yet less convenient, alternative (i.e., the train), by reducing their anticipated guilt associated with flying. We tested for this potential impact of an ICO on travellers' mode choices through a series of hypothetical travel scenarios administered via an online survey.

In line with previous research, we found support for the mediating role of anticipated guilt in influencing respondents' behaviour (Bamberg et al., 2007; Elgaaied, 2012; Hunecke et al., 2001; Lindenmeier et al., 2017). In particular, it seems that participants who strongly endorse biospheric values feel guilty about flying, and that guilt prevents them from choosing flights (supporting Hypothesis 1). However, this pattern emerges independent of whether or not an integrated carbon offset is included in the ticket price (not supporting Hypothesis 2).

3. Study 2

Based on the aforementioned study results, it is tempting to conclude that ICOs do not function as a consumer guilt-reduction device. However, there may be various reasons why we did not find a guilt-reducing, and therefore flight-encouraging effect of offsets.

First, we asked US participants (MTurkers) to reflect on their preferred mode of transport while travelling to various destinations in

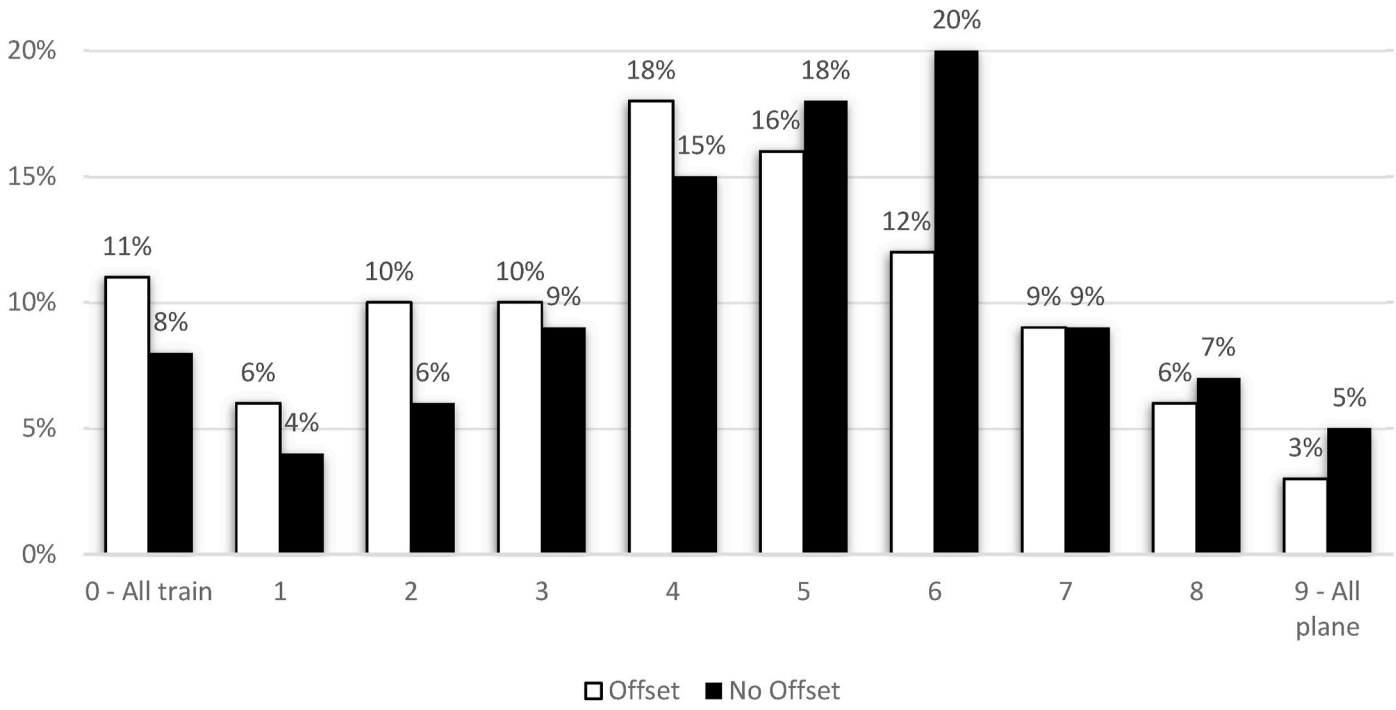


Fig. 2. Distribution of flight scores (0–9) between Offset and No offset conditions.

Europe from one departure point - Amsterdam. Since American participants may have imagined that they need a long-haul flight to get to Amsterdam in the first place, the CO2 emissions caused by additional within-Europe flights from Amsterdam may seem rather trivial by comparison, and thus not very guilt-eliciting. Second, the study layout, involving multiple separate travel offers from the same departure point (i.e. Amsterdam), may have seemed unrealistic. Third, we asked respondents repeatedly (i.e., in each scenario) how guilty they would feel about choosing the flight option. This format may have led to social desirability bias, whereby participants, after being prompted repeatedly, may have concluded that they "should" feel somewhat guilty for choosing to fly. Fourth, the data was collected several years ago (2013). It is likely that concerns over CO2 emissions have increased since then, making guilt a more significant barrier against flying today. Fifth, the purpose of carbon offsets may have been too unfamiliar to American participants at the time of data collection (2013) for them to experience reduced guilt. Carbon offsets, at the time of writing, are a more commonly known practice within the airline industry than a few years ago and flight operators are offering more sophisticated offsetting schemes and communicate about their initiatives to consumers on their websites (e.g., EasyJet). As a result, we may potentially find a different outcome today, given that travellers may be more concerned about emissions arising from air travel and more aware of carbon offsets.

To address these potential issues, we conducted a new study in 2020, in which a larger, non-American sample (i.e., UK residents) was asked to make multiple travel choices within Europe, using a more credible setting - planning a round-trip across various European cities. We also updated our stimulus material to reflect the communication around offsets currently employed by flight operators. We pre-registered the procedure, hypotheses and analysis of this replication study (visit https://aspredicted.org/ai2jy.pdf) and conducted the main analysis identically to Study 1.

3.1. Design & procedure

A European sample of native English speaking respondents resident in the UK (England only) was recruited through the Prolific Academic Ltd participant pool, allowing us to compare our previous study results with a European sample. To address the possibility that the conditional indirect effect in Study 1 could not be detected due to insufficient sample size, we almost doubled the sample size in Study 2 ($N = 400$), based on recommendations by Preacher et al. (2007), to increase our power.

As in Study 1, respondents were randomly assigned to either an Offset or No offset condition and were presented with eight scenario choices to seven destinations across Europe.

This time, the scenarios were presented as part of a single roundtrip, starting from and returning to London (see Fig. 4). This provided a more coherent narrative than Study 1 and avoided respondents having to imagine additional steps, such as an extra long-haul flight. Similar to Study 1, journeys were based on actual travel offers available online and involved a dichotomous choice between a flight and train (or bus) option (see Fig. 5 for an example and Table 2 for an overview of all of the roundtrip stages).

An effort was made to match flights and bus or train journeys as closely as possible on departure/arrival time, travel duration and price (see Table 2). This information was identical across both conditions (i.e., No offset and Offset). In line with common recommendations by airlines, only 90 min of additional time prior to the flight departure were added to each flight option in Study 2.

Importantly, rather than providing emission estimates and specifying the additional cost incurred by the integrated carbon offset (as in Study 1), a footprint symbol was shown next to the plane option in the Offset condition (see Fig. 5 for an example and Fig. 6 for an enlarged version). This symbol indicated that the flight emissions would be compensated by the airline and that this offset is included in the plane ticket price at no extra cost (see text below). As airlines do typically neither provide flight emission estimates, nor any detailed information on whether flight emissions are either fully or partially compensated, the amount of emissions, and how emissions would be offset, was not further specified.

The following text was shown in the instructions of both the Offset and No Offset conditions (prior to completing the scenarios), whereas the footprint symbol and its explanation [in brackets] were only shown

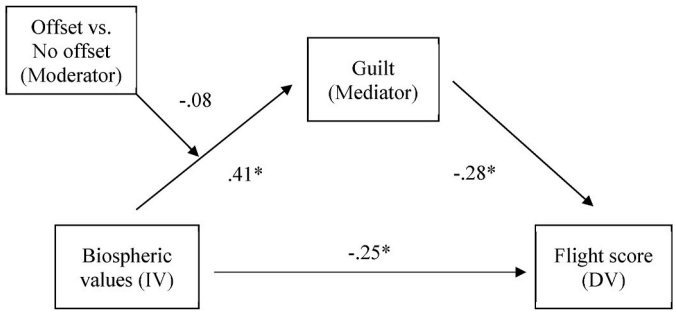


Fig. 3. Moderated mediation model, *p < .001.

in the Offset condition:

> "Please remember that, compared to travel by bus or rail, flying is **highly energy-intensive** and causes a high amount of CO2 emissions. [In order to counteract the negative environmental impact of these emissions, all the flight options, at each stage of the round trip, include a **carbon offset** as indicated by the [footprint] symbol. This means that the carbon emissions from the fuel used during the flight, while still being released into the atmosphere, will be compensated by the airline through investment in **green initiatives** such as planting trees or supporting the use of sustainable energy in developing countries. This offset is included in the price of the plane ticket.]"

As an attention check, we asked respondents to correctly identify the meaning of the footprint symbol shown in the Offset condition. There were three answer options: 'No idea, I haven't seen it in the study' (correct answer for those in the No Offset condition), 'The symbol means that the option is the most environmentally friendly' (incorrect option in both conditions) and 'The symbol means that the CO2 emissions of this option are compensated' (correct answer for those in the Offset condition).

3.1.1. Computing flight and anticipated guilt scores

The coding of flight scores was identical to Study 1 (i.e., 1 for selecting the flight and 0 for selecting the bus/train option) and respondents could reach a maximum flight score of 8 (i.e., when always choosing the plane) across all scenarios. We did make changes, however, in the way anticipated guilt was measured. Instead of asking respondents how guilty they would feel about choosing the flight option in each separate scenario (as in Study 1), here we only measured guilt once, *after* respondents had made all their scenario choices, thus reducing social desirability bias. Specifically, guilt was measured using four items rated on a standard 7-point Likert-scale including "I felt guilty [bad/conflicted] about choosing flights, if any, as part of my roundtrip" and "I felt good about choosing bus/train journeys, if any, as part of my roundtrip"), showing good reliability ($\alpha = 0.86$).

3.1.2. Measuring values and offsetting beliefs

As in Study 1, we measured respondents' values and asked them to report their attitudes towards carbon offsets (i.e., importance, effectiveness and usefulness) measured on a basic 7-point Likert-scale (Strongly disagree to Strongly agree). In addition, respondents were asked about their prior experience or familiarity with carbon offsets, whether they considered emissions when booking and travel, and whether they think that air- and bus/train lines should be obliged to provide emission estimates of booked journeys.

3.2. Participant sample

UK participants (England only) were recruited via means of the paid participant pool Prolific Academic and received a financial reward of 74p (about 91c in USD) for filling in the online survey. In total, 273 women (68%) and 127 men (32%) completed the survey ($N = 400$). The majority of respondents were young to middle-aged adults with 82% of respondents being between 18 and 44 years old ($n = 328$). Less than half of the sample reported having completed a university degree as their highest level of education ($n = 180$, 45%), followed by respondents having completed secondary school education ($n = 139$, 35%) and those having some university education but no degree ($n = 65$, 16%). Moreover, the majority of respondents reported being currently employed ($n = 271$, 68%) and having a gross annual household income of £39,999 or less ($n = 245$, 65%).

Of the current sample, 14.5% of respondents ($n = 58$) reported having purchased a carbon offset or having booked a flight from an airline that invests in offset initiatives before, whereas 36.5% have not done so but intend to do so in the future ($n = 146$), 9.5% have not done so and do not intend to ($n = 38$) and 39.5% have never heard of carbon offsets before ($n = 158$). Moreover, 41% of respondents indicated considering emissions when booking travel at least some of the time ($n = 164$) and 68% agreed that air- and bus/trainlines should be obliged to provide the estimated carbon emissions of booked journeys ($n = 273$).

3.3. Descriptive data analysis

Across both conditions, survey respondents chose the flight option in less than half of scenarios ($M = 3.65$, $SD = 1.57$) and reported little anticipated guilt with regard to including flights as part of their roundtrip ($M = 3.84$, $SD = 1.45$), while considering biospheric values ($\alpha = 0.87$) to be important ($M = 4.49$, $SD = 1.50$). Moreover, respondents somewhat agreed that travelling using sustainable modes is important to them ($M = 4.42$, $SD = 1.56$) and somewhat agreed that carbon offsets are effective ($M = 4.51$, $SD = 1.31$), important ($M = 4.78$, $SD = 1.51$) and useful ($M = 5.13$, $SD = 1.22$).

In sum, despite being collected seven years later, these results are broadly consistent with the findings of Study 1. The histogram in Fig. 7 shows the distribution of flight scores across the No Offset ($n = 190$) and Offset ($n = 210$) conditions in Study 2.

3.4. Hypothesis testing

The main analysis was repeated following the same steps as outlined in Section 2.4. Fifteen respondents did not enter the main analysis due to missing data – that is, because they either missed one or more of the scenario choices ($n = 6$), biospheric values items ($n = 6$) or guilt items ($n = 3$). Fig. 8 shows the moderated mediation model of Study 2 ($N = 385$).

In line with findings from Study 1, a biospheric value orientation predicted anticipated guilt ($\beta = 0.40$, $t = 5.48$, $p < .001$, *CI:* 0.26, 0.54) which, in turn, predicted flight scores ($\beta = -0.11$, $t = -2.02$, $p = .04$, *CI:* −0.22, −0.00). Contrary to the findings of Study 1, however, biospheric values no longer predicted flight scores directly when guilt was included as a predictor ($\beta = -0.06$, $t = -1.06$, $p = .29$, *CI:* −0.17, 0.05), indicating that guilt fully mediates the relationship between biospheric values and flight scores. Omitting other predictors from the model, the effect of biospheric values on flight scores is marginally significant ($\beta = -.10$, $t = 1.95$, $p = .05$, *CI*: −0.20, 0.00). Bootstrap tests (5000 samples, mediation-only model) confirmed the proposed *indirect* effect of the endorsement of biospheric values on flight scores via anticipated guilt ($\beta = -0.04$, *Boot CI*: −0.09, 0.00) resulting in a total effect of $\beta = -0.10$, $t = -1.97$, $p = .05$, *CI:* −0.20, −0.00. The first hypothesis (mediation) was thus supported by the data:

People with stronger biospheric values feel more guilty about flying, and that guilt prevents them from preferring flights.

With regard to the second hypothesis (moderation), the predicted

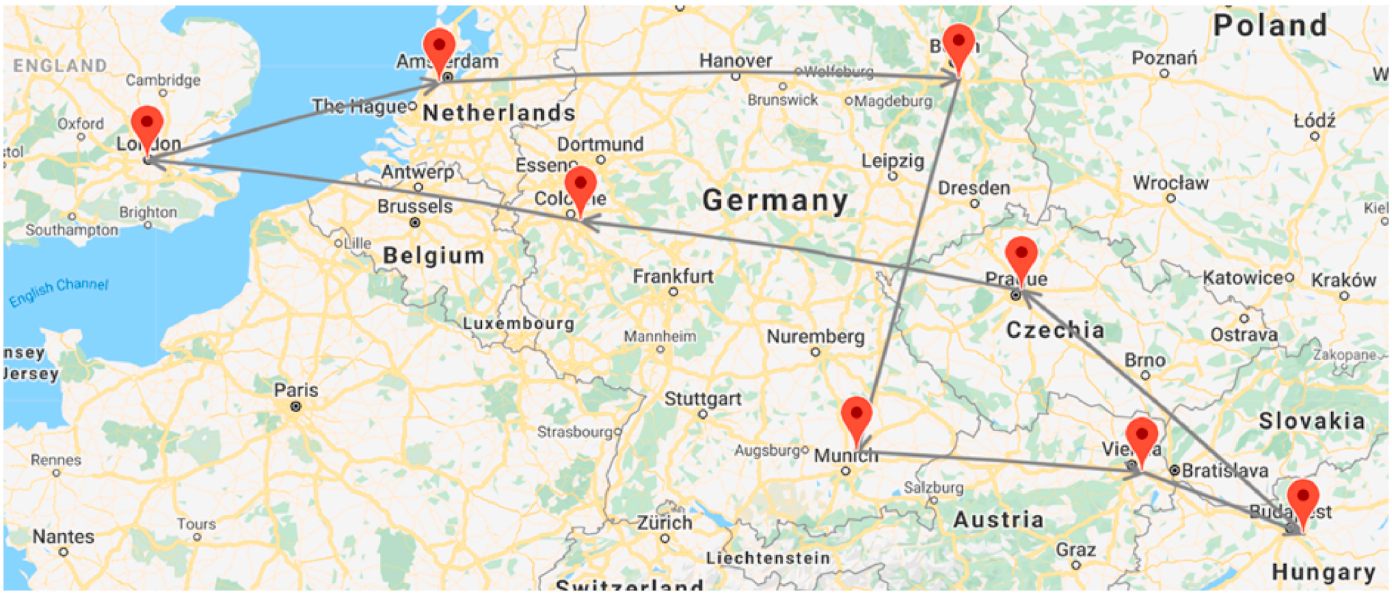


Fig. 4. EU roundtrip stages starting from and returning to London.

moderating role of Offset condition on guilt scores was again not supported by the data. That is, although we found a direct effect of Offset condition on anticipated guilt ($\beta = 0.20$, $t = 2.06$, $p = .04$, *CI:* 0.01, 0.38), this effect was in the opposite direction – that is, respondents reported higher rather than lower anticipated guilt in the Offset condition (Offset: $M = 3.90$, $SD = 1.47$; No Offset: $M = 3.77$, $SD = 1.43$). Moreover, the biospheric values by Offset condition interaction was not significantly different from zero ($\beta = -0.01$, $t = -0.08$, $p = .93$, *CI:* −0.20, 0.18) suggesting that participants who endorse biospheric values do not feel less guilty due to the offset being present. Rather, we find an indirect effect of guilt both when carbon offsets are included ($\beta = -0.04$, *Boot CI:* −0.10, −0.00) as well as when carbon offsets are *not* included ($\beta = -0.04$, *Boot CI:* −0.09, −0.00). Therefore, as in Study 1, we find that guilt prevents participants who endorse biospheric values from choosing flights, even when offsets are included in the flight ticket.

In sum, replicating the results of Study 1, we found that participants who endorse biospheric values feel more guilty, and this anticipated guilt prevents them from preferring to fly, but we found no evidence of offsets reducing their guilt. To check whether this null-effect was not driven by participants failing to understand what carbon offsets are, or having missed the fact that carbon emissions were offset in the Offset condition, we subsequently conducted two robustness checks.

Some participants reported never having heard of carbon offsets prior to this study. Including such participants may have obscured any effects that the inclusion of offsets may have because these participants may not perceive them to be a viable way to reduce the environmental harm of flying. To address this concern, we conducted the same analyses without these respondents ($n = 158$). The results were identical ($N = 230$):

We still find that participants who endorse biospheric values feel more guilty ($\beta = 0.29$, $t = 2.97$, $p < .01$, *CI:* 0.10, 0.48), and therefore intend to fly less ($\beta = -0.14$, $t = -1.94$, $p = .05$, *CI:* −0.27, 0.00), but find no indication of offsets *reducing* anticipated guilt for environmentally concerned respondents (Interaction effect: $\beta = 0.12$, $t = 0.93$, $p = .35$, CI: −0.13, 0.38). Instead, if anything, it seems that participants in the Offset condition actually experienced *more* guilt (Main effect: $\beta = 0.26$, $t = 2.05$, $p = .04$, *CI:* 0.01, 0.51).

Finally, we only considered respondents who answered the attention check correctly ($N = 272$). The majority of participants in the Offset condition passed the attention check asking about the meaning of the footprint symbol: 88% ($n = 186$) correctly ticked 'This symbol means that CO2 emissions of this option are compensated'. Many participants in the No Offset condition, however, did not: 55% ($n = 103$) failed to tick 'No idea, I haven't seen it in the study' option, which would have been the correct option, and instead ticked one of the two alternatives. This was unexpected, but likely caused by the specific wording of the question: participants in the No Offset condition could still try to guess the meaning of the footprint symbol, even if they had not seen it, and may have assumed that they were expected to guess. Thus, we decided that for the main analysis, it was not meaningful to exclude participants based on this criterium that we initially had included in the As Predicted pre-registration. When excluding these participants though, we observed the same pattern of results (albeit less pronounced): biospheric participants feel more guilty ($\beta = 0.48$, $t = 4.01$, $p < .001$, *CI:* 0.24, 0.71), and that guilt seems to prevent them from preferring flights ($\beta = -0.11$, $t = -1.70$, $p = .09$, *CI:* −0.23, 0.02), but we find no indication of offsets reducing guilt (Main effect: $\beta = 0.08$, $t = 0.61$, $p = .54$, *CI:* −0.17, 0.33), including among participants who endorse biospheric values (Interaction effect: $\beta = -0.11$, $t = 0.82$, $p = .41$, *CI:* −0.39, 0.16).

4. General discussion

Across two independent studies, we confirm that guilt does prevent environmentally-concerned (biospheric) travellers from preferring flights, but found no evidence that the introduction of an integrated carbon offset, either paid for by the traveller (Study 1) or sponsored by the operating airline (Study 2), would reduce that guilt and thus boost travellers' propensity to choose more flights.

In Study 1, the presence of a carbon offset neither had an influence on respondents' reported level of anticipated guilt nor on the frequency with which they selected the flight option. Contrary to predictions, respondents in the Offset condition actually chose the plane less often compared to the No Offset condition. In Study 2, addressing most of the shortcomings of Study 1, we did find a significant main effect of offsets, albeit in the opposite direction. That is, respondents in the Offset condition actually tended to report higher rather than lower levels of

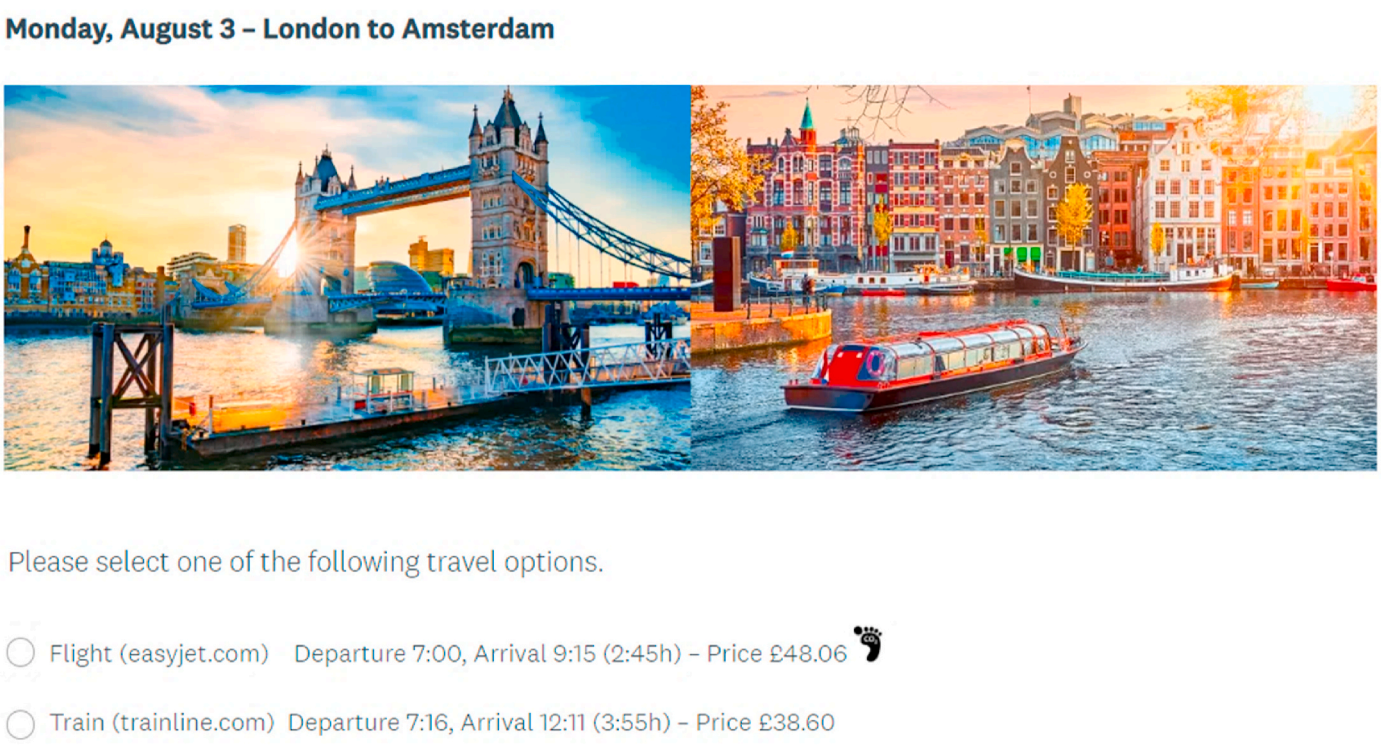


Fig. 5. Example scenario in the Offset condition (Stage 1 of the roundtrip).

anticipated guilt, although this did not affect the frequency with which they selected flights, which did not differ between conditions. While we highlighted the environmental harmfulness of aviation in both conditions, it is possible that the offset information made the former more salient. In Study 2, participants received more detailed information about the benefits of offsets, but also more detailed information about the harm of flying. More importantly, though, both studies supported the predicted mediating role of anticipated guilt in travellers' choices with those endorsing biospheric values reporting higher anticipated guilt and, as a result, showing a decreased preference for journeys by plane.

The absence of the hypothesised moderation effect may have several explanations. On the one hand, it is possible that environmentally concerned respondents do not let themselves off the hook that easily with regard to their environmentally harmful decisions. Indeed, previous research has shown that consumers report feeling guilty about and accept blame for their environmentally harmful decisions (Jayaratne & Sullivan-Mort, 2016; Mallett et al., 2013). Hence, being aware of the negative environmental impact of aviation, even offsetting their flight emissions may do little to reduce their feelings of guilt, especially when offsetting initiatives are only believed to be 'somewhat' as opposed to 'very effective' as in the present research. An alternative explanation is that, because participants who were confronted with offsets being included in the ticket price automatically did not *choose* to pay extra to offset their emissions, they were not able to establish any moral credentials, which are often needed to license immoral behaviours (Sachdeva et al., 2009). That is, as acting in an environmentally friendly way

Table 2
Study 2 roundtrip stages based on actual offers. Please note that the travel duration by plane includes 90 min of additional time prior to the flight departure. Roundtrip stages marked with an * involve a time zone shift with a difference of ± 1 h.

Roundtrip Stage	Travel mode	Departure/ Arrival time	Travel time in h:mm	Price in £
August 3, 2020	Plane	7:00/9:15	2:45	48.06
London – Amsterdam*	Train	7:16/12:11	3:55	38.60
August 6, 2020	Plane	9:00/10:30	3:00	72.49
Amsterdam - Berlin	Train	7:00/13:22	6:22	38.51
August 9, 2020	Plane	14:55/16:15	2:50	42.02
Berlin - Munich	Train	8:05/12:01	3:56	46.59
August 12, 2020	Plane	11:20/12:25	2:35	158
Munich - Vienna	Train	7:24/11:30	4:06	27.14
August 15, 2020	Plane	10:00/10:45	2:15	112
Vienna - Budapest	Train	9:42/12:19	2:37	32.97
August 18, 2020	Plane	19:40/20:55	2:45	50
Budapest - Prague	Bus	23:30/5:45	6:15	17.50
August 21, 2020	Plane	13:45/15:00	2:45	50
Prague - Cologne	Bus	23:00/8:05	9:05	21.30
August 24, 2020	Plane	13:00/13:20	2:50	44
Cologne – London*	Train	9:43/14:05	5:22 (1 ch)	75.31

Fig. 6. Enlarged footprint symbol used in the Offset condition.

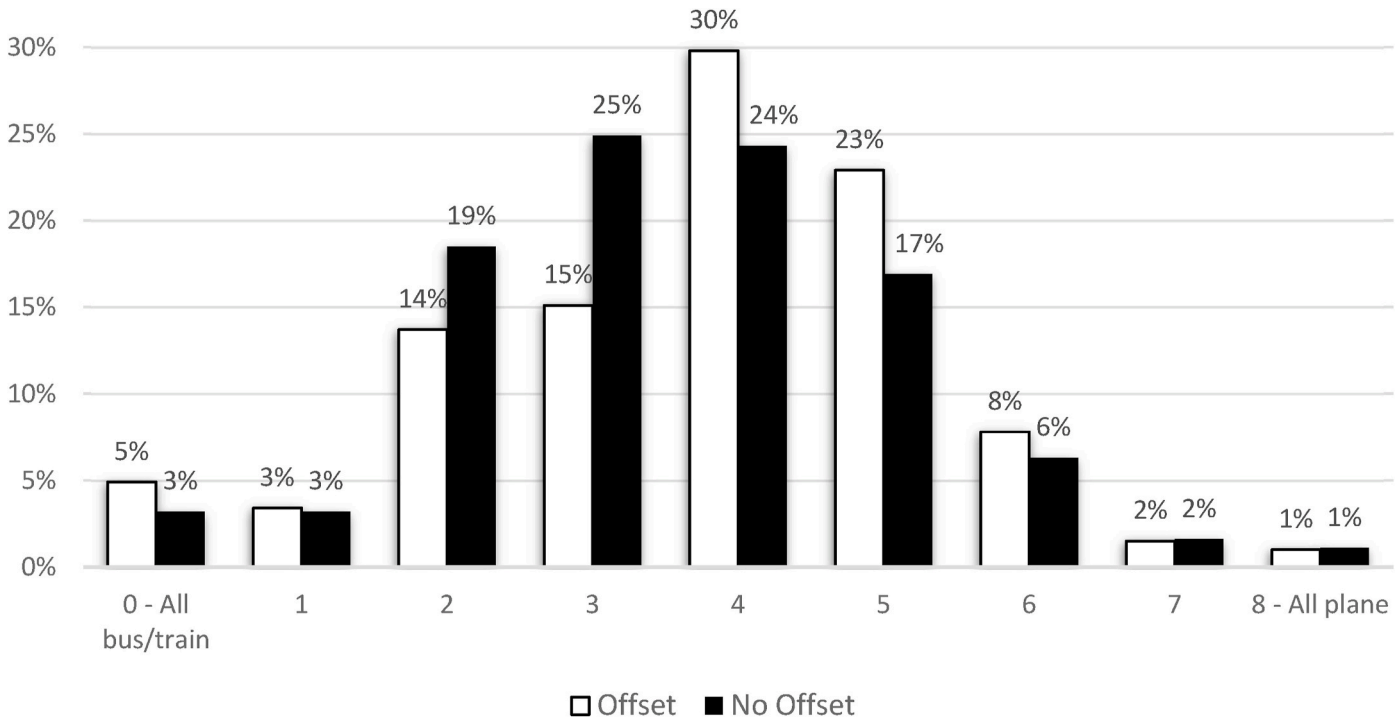


Fig. 7. Distribution of flight scores (0–8) between Offset and No offset conditions.

has been shown to be psychologically rewarding (Taufik et al., 2015), it may be the very act of donating on a *voluntary* basis that buffers people's feelings of guilt, potentially resulting in an increase in the propensity to take a flight. Support for this explanation stems from research on licensing in consumer choices.

Khan and Dhar (2006), for instance, demonstrated that when students imagined to have performed a good deed, such as donating or volunteering, they were subsequently more likely to select a luxury item for themselves compared to a non-luxury or utility item. This effect, however, diminished when the good deed was attributed to an external cause (e.g., having to do community service as the result of a driving violation). With the inclusion of a carbon offset in the present study being the (unchangeable) default for the flight option, it is thus possible that, by taking away people's freedom to donate on a voluntary basis, they did not receive a 'warm glow', as may have been the case with a voluntary carbon offset (VCO), thus discouraging them from choosing more flights. This could be explored in future research as outlined below.

4.1. Implications of the findings

Given the low uptake of voluntary carbon offsets (VCOs) and the difficulty in implementing more ambitious alternatives, such as taxing aviation fuel (Seely, 2012), our research findings might be particularly interesting to airlines. First, our results suggest that air travellers are generally supportive of carbon offsets. Second, we neither found any evidence that integrated carbon offsets reduce or eliminate environmentally concerned air travellers' guilt associated with flying nor that they increase travellers' propensity to choose flights. Thus, based on our results, an integrated carbon offset included in the ticket price on behalf of the customer (either paid for by the customer or sponsored by the airline), could pose a viable alternative to a VCO, assuming that the airline was able to convince customers of its effectiveness, while being transparent in terms of what the ICO will be used for or even letting their customers have a say in the latter. Our results also have implications for policy makers. With recent research suggesting that measures such as an EU-wide carbon-based flight ticket tax (Krenek & Schratzenstaller, 2017) have rather negative connotations among consumers (Hardisty et al., 2019), ICOs may turn out to be more easily acceptable measures to curb emissions, while at the same time exerting a net positive effect.

However, the fact that we did not find evidence of a flight-encouraging effect of ICOs does not mean that there is no risk of offsets *promoting* flights – a null effect cannot 'prove' that. That is, although we used realistic scenarios based on actual travel offers in our studies and were able to rule out some of the reasons behind the lack of our hypothesised effect (e.g., lack of attention, unfamiliarity with or disbelief in the effectiveness of offsets), there may be alternative explanations why we did not find the predicted effect of ICOs in our sample, such as the type and presentation of stimuli used. Consequently, what this series of studies seems to suggest is that simply dismissing offsets based on the assumption that they will reduce guilt and therefore lead to more flying is not per se warranted.

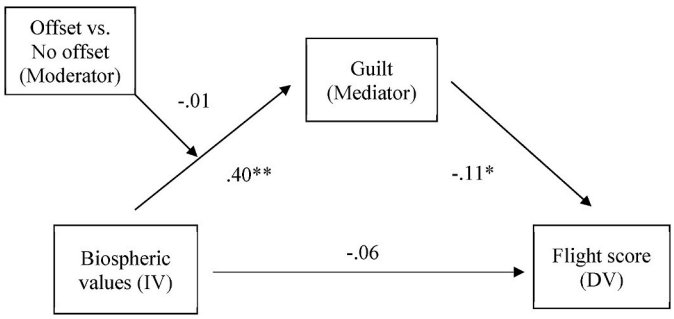


Fig. 8. Moderated mediation model, **p < .001, *p < .05.

4.2. Directions for future research

In our experiments, which focused on the guilt-reducing and flight-encouraging potential of ICOs, the offset decision was made on the respondent's behalf, as opposed to on a voluntary basis. However, given that offsetting still occurs primarily on a voluntary basis, a future study design could explore how actively choosing to offset emissions (i.e., opting in as in the case of VCOs) compares to emissions being offset automatically (ICOs) with respect to affecting not only consumers' individual but also their collective guilt (Jensen, 2019). It is possible that, for offsets to have a guilt-reducing (and thus potentially flight-encouraging effect), the latter need to occur on a voluntary basis and at the traveller's own expense. That is, in addition to the offset decision being made on the respondent's behalf versus being voluntary, another point to consider is *who* is paying for the carbon offset – the airline or traveller – which might have implications for the proposed guilt-reducing and flight-encouraging potential of offsets.

That is, with airlines sponsoring the carbon offset on travellers' behalf, ICOs may be taking away environmentally concerned travellers' opportunity to establish moral credentials by incurring a personal (monetary) cost for the greater good. In contrast, for less environmentally concerned travellers, an ICO, if paid for by the traveller rather than the operating airline, could result in an ironic effect akin to Gneezy and Rustichini's (2000) study. In this study, a monetary fine for parents arriving late to pick up their children led to an increase of the undesirable target behaviour, as parents were paying for the right to arrive late. Likewise, having to pay for an ICO may signal the right to pollute for some air travellers.

While we found no such short-term 'bloodletting' effect, ICOs could still function as a form of moral licensing in ways that are more difficult to track. That is, it is imaginable that flying 'carbon neutral' may, despite the fact that it does not seem to promote flying in the short run, still establish moral credentials allowing people to behave in a more lenient manner in other domains (Sachdeva et al., 2009). To illustrate, even if booking a flight with an ICO, or purchasing a VCO prior to taking a flight, the utility of this pro-environmental act decreases if travellers subsequently behave less environmentally friendly in other situations (e.g., using more hotel resources or renting a car rather than using public transport).

Finally, the type of offsetting scheme may affect people's perceived effectiveness of carbon offsets. In our research, we did not specify how respondents' emissions would be offset. However, offsetting schemes (e.g., tree planting, renewable energy, or carbon capture) may differ in their perceived effectiveness and therefore guilt-reducing and flight-encouraging potential. This highlights the importance of considering the bigger picture when carbon offsets are concerned.

4.3. Conclusion

In the current study, we found that anticipated guilt prevents people who endorse biospheric values from flying, but found no evidence for either a guilt-reducing or flight-encouraging effect of an integrated carbon offset. Our findings suggest that ICOs need not license environmentally concerned travellers to take a flight instead of more sustainable travel modes when such alternatives exist. Instead, ICOs paid for by either the customer (Study 1) or sponsored by the airline itself (Study 2), could be considered as a viable alternative to VCOs which, despite recent surges, continue to have a fairly low uptake. Notably, however, those who care most about the environment may be the least likely to take a flight at all and their flight emissions being offset may do little to nothing to change that. For these travellers, it seems that there may be no such thing as *sustainable* air travel – or, at least, not yet.

CRediT authorship contribution statement

Gustav Bösehans: Conceptualization, Methodology, Formal analysis, Writing - original draft. **Jan Willem Bolderdijk:** Conceptualization, Methodology, Writing - review & editing. **Jing Wan:** Conceptualization, Methodology, Writing - review & editing.

Appendix A. Supplementary data

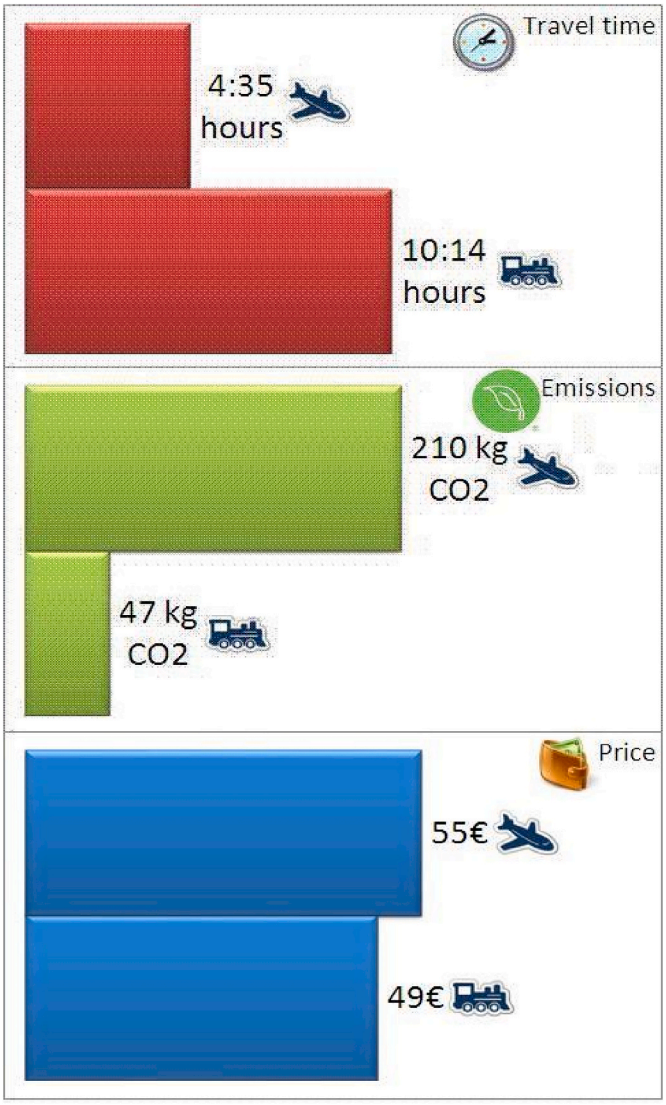
Supplementary data to this article can be found online at https://doi.org/10.1016/j.jenvp.2020.101469.

6. Appendix

A1. Example scenario

Trip from Amsterdam to Prague, Czech Republic (Distance: 546mi/878 km).

TRAVEL INFORMATION.
You can choose to travel to Prague by plane or by train. Below you will find more information on these travel options.



A2. *Correlations between measured constructs including values, flight scores, guilt scores, importance and effectiveness beliefs*

	Altru	Bio	Ego	Hedo	Flight	Guilt	Important	Effective
Altru	–							
Bio	.55**	–						
Ego	-.06	-.02	–					
Hedo	.10	.15*	.31**	–				
Flight	-.19**	-.35**	.15*	.13	–			
Guilt	.28**	.40**	-.23	-.23**	-.38**	–		
Important	.23**	.40**	.06	.13	-.22**	.36**	–	
Effective	.24**	.27**	.08	.08	-.11	.26**	.72**	–

Note: *p < .05, **p < .01 Altru = altruistic, Bio = biospheric, Ego = egoistic, Hedo = hedonic.

A3. *Travel mode choices by offset condition (No Offset: N = 108; Offset: N = 110), including self-reported most influential factors for respondents' choices and anticipated guilt scores – highest proportions (%) in bold*

Scenario	% Plane	% Train	% Travel Time	% Emissions	% Price	Mean Guilt	Total N
Prague	**79**	21	**74**	16	10	3.03 (*SD* = 1.8)	108
Berlin	**63**	37	**46**	31	23	3.14 (*SD* = 1.8)	108
Milan	**85**	15	**78**	13	9	3.14 (*SD* = 1.95)	108
London	48	**52**	26	**43**	31	2.80 (*SD* = 1.74)	108
Nice	**86**	14	**71**	13	16	3.06 (*SD* = 1.82)	108
Basel	48	**52**	**41**	25	34	3.00 (*SD* = 1.82)	108
Paris	12	**88**	20	27	**53**	2.94 (*SD* = 1.74)	108
Munich	40	**60**	40	14	**46**	3.11 (*SD* = 1.74)	108
Hamburg	9	**91**	16	23	**61**	2.85 (*SD* = 1.79)	108
Prague	**68**	32	**65**	15	20	3.21 (*SD* = 1.75)	110
Berlin	46	**54**	**44**	40	16	3.24 (*SD* = 1.83)	110
Milan	**80**	20	**77**	13	10	3.31 (*SD* = 1.77)	110
London	30	**70**	36	**51**	13	2.85 (*SD* = 1.80)	110
Nice	**83**	17	**72**	14	14	3.27 (*SD* = 1.71)	110
Basel	42	**58**	37	23	**40**	3.18 (*SD* = 1.75)	110
Paris	15	**85**	18	25	**57**	2.86 (*SD* = 1.79)	110
Munich	35	**65**	34	15	**51**	3.02 (*SD* = 1.79)	110
Hamburg	9	**91**	12	19	**69**	2.94 (*SD* = 1.83)	110

References

Adams, J. (2005). Hypermobility: A challenge to governance. In C. Lyall, & J. Tait (Eds.), *New modes of governance: Developing an integrated policy approach to science, technology, risk and the environment*. Aldershot: Ashgate.

Akter, S., Brouwer, R., Brander, L., & Van Beukering, P. (2009). Respondent uncertainty in a contingent market for carbon offsets. *Ecological Economics, 68*(6), 1858–1863.

Bamberg, S., Hunecke, M., & Blöbaum, A. (2007). Social context, personal norms and the use of public transportation: Two field studies. *Journal of Environmental Psychology, 27*, 190–203.

Becken, S., & Mackey, B. (2017). What role for offsetting aviation greenhouse gas emissions in a deep-cut carbon world? *Journal of Air Transport Management, 63*, 71–83.

Brouwer, R., Brander, L., & Van Beukering, P. (2008). "A convenient truth": Air travel passengers' willingness to pay to offset their CO_2 emissions. *Climatic Change, 90*(3), 299–313.

Burnett, M. S., & Lunsford, D. A. (1994). Conceptualizing guilt in the consumer decision-making process. *Journal of Consumer Marketing, 11*(3), 33–43.

Cames, M., Harthan, R. O., Füssler, J., Lazarus, M., Lee, C. M., Erickson, P., & Spalding-Fecher, R. (2016). How additional is the clean development mechanism? Analysis of the application of current tools and proposed alternatives. Retrieved November 14, 2019, from https://ec.europa.eu/clima/sites/clima/files/ets/docs/clean_dev_mechanism_en.pdf.

Capoor, K., & Ambrosi, P. (2009). *State and trends of the carbon market 2009*. The World Bank. Retrieved Nov 25, 2019, from https://openknowledge.worldbank.org/bitstream/handle/10986/13403/48998.pdf?sequence=1.

Cohen, S. A., Higham, J. E., & Cavaliere, C. T. (2011). Binge flying: Behavioural addiction and climate change. *Annals of Tourism Research, 38*(3), 1070–1089.

De Groot, J. I. M., & Steg, L. (2007). Value orientations and environmental beliefs in five countries: Validity of an instrument to measure egoistic, altruistic and biospheric value orientations. *Journal of Cross-Cultural Psychology, 38*, 318–332.

De Groot, J. I. M., & Steg, L. (2008). Value orientations to explain beliefs related to environmental significant behavior: How to measure egoistic, altruistic, and biospheric value orientations. *Environment and Behavior, 40*(3), 330–354.

De Groot, J. I. M., & Steg, L. (2010). Relationships between value orientations, self-determined motivational types and pro-environmental behavioural intentions. *Journal of Environmental Psychology, 30*, 368–378.

Elgaaied, L. (2012). Exploring the role of anticipated guilt on pro-environmental behavior – a suggested typology of residents in France based on their recycling patters. *Journal of Consumer Marketing, 29*(5), 369–377.

European Commission. (2017). EU aviation: 25 years of reaching new heights. Retrieved July 7, 2019, from https://ec.europa.eu/transport/modes/air/25years-eu-aviation_en.

Frew, E., & Winter, C. (2008). Purchasing carbon offset flights in Australia: An exploration of airline websites. *CAUTHE 2008: Tourism and Hospitality Research, Training and Practice*, 383–392.

Gittens, A., Poole, J., De Juniac, A., Liu, F., & Pie, J. (2017). Aviation benefits. Retrieved July 7, 2019, from https://www.iata.org/policy/Documents/aviation-benefits-%20web.pdf.

Gneezy, U., & Rustichini, A. (2000). A fine is a price. *The Journal of Legal Studies, 29*(1), 1–17.

Gössling, S., Haglund, L., Kallgren, H., Revahl, M., & Hultman, J. (2009). Swedish air travelers and voluntary carbon offsets: Towards the co-creation of environmental value? *Current Issues in Tourism, 12*(1), 1–19.

Hamrick, K., & Gallant, M. (2018). Voluntary carbon market insights: 2018 Outlook and first-quarter trends. Retrieved November 14, 2019, from https://www.forest-trends.org/publications/voluntary-carbon-markets/.

Hardisty, D. J., Beall, A. T., Lubowski, R., Petsonk, A., & Romero-Canyas, R. (2019). A carbon price by another name may seem sweeter: Consumers prefer upstream offsets to downstream taxes. *Journal of Environmental Psychology, 66*, 101342.

Hares, A., Dickinson, J., & Wilkes, K. (2010). Climate change and the air travel decisions of UK tourists. *Journal of Transport Geography, 18*(3), 466–473.

Hayes, A. F. (2017). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach* (2nd ed.). New York, NY: Guilford Press.

Hunecke, M., Blöbaum, A., Matthies, E., & Höger, R. (2001). Responsibility and environment: Ecological norm orientation and external factors in the domain of travel mode choice behavior. *Environment and Behavior, 33*(6), 830–852.

International Civil Aviation Organization (ICAO). (2016). *On board – a sustainable future*. Environmental Report. Retrieved July 7, 2019, from https://www.icao.int/environmental-protection/Documents/ICAO%20Environmental%20Report%202016.pdf.

Jayaratne, M., & Sullivan-Mort, G. (2016). Sustainability living in a carbon priced economy: Trade-offs in purchasing and practices and sustainability guilt. In C. Campbell, & J. Ma (Eds.), *Looking forward, looking back: Drawing on the past to shape the future of marketing* (pp. 247–255) (Developments in Marketing Science: Proceedings of the Academy of Marketing Science. Springer, Cham).

Jensen, T. (2019). Epilogue: The future of environmental guilt. In *Ecologies of Guilt in environmental rhetorics* (pp. 147–156). Cham: Palgrave Studies in Media and Environmental Communication. Palgrave Pivot.

Juvan, E., & Dolnicar, S. (2014). The attitude–behaviour gap in sustainable tourism. *Annals of Tourism Research, 48*, 76–95.

Khan, U., & Dhar, R. (2006). Licensing effect in consumer choice. *Journal of Marketing Research, 43*(2), 259–266.

Kossoy, A., & Guigon, P. (2012). *State and trends of the carbon market 2012*. The World Bank. Retrieved Nov 25, 2019, from https://openknowledge.worldbank.org/bitstream/handle/10986/13336/76837.pdf?sequence=1&isAllowed=y.

Kotchen, M. J. (2009). Offsetting green guilt. *Stanford Social Innovation Review, 7*(2), 26–31.

Krenek, A., & Schratzenstaller, M. (2017). Sustainability-oriented tax-based own resources for the European union: A European carbon-based flight ticket tax. *Empirica, 44*(4), 665–686.

Larsson, J., Kamb, A., Nässén, J., & Åkerman, J. (2018). Measuring greenhouse gas emissions from international air travel of a country's residents methodological development and application for Sweden. *Environmental Impact Assessment Review, 72*, 137–144.

Lindenmeier, J., Lwin, M., Andersch, H., Phau, I., & Seemann, A. K. (2017). Anticipated consumer guilt: An investigation into its antecedents and consequences for fair-trade consumption. *Journal of Macromarketing, 37*(4), 444–459.

Mair, J. (2011). Exploring air travellers' voluntary carbon-offsetting behaviour. *Journal of Sustainable Tourism, 19*(2), 215–230.

Mallett, R. K. (2012). Eco-guilt motivates eco-friendly behavior. *Ecopsychology, 4*(3), 223–231.

Mallett, R. K., Melchiori, K. J., & Strickroth, T. (2013). Self-confrontation via a carbon footprint calculator increases guilt and support for a proenvironmental group. *Ecopsychology, 5*(1), 9–16.

McDonald, S., Oates, C. J., Thyne, M., Timmis, A. J., & Carlile, C. (2015). Flying in the face of environmental concern: Why green consumers continue to fly. *Journal of Marketing Management, 31*(13–14), 1503–1528.

Muralidharan, S., & Sheehan, K. (2018). The role of guilt in influencing sustainable pro-environmental behaviors among shoppers: Differences in response by gender to

messaging about England's plastic-bag levy. *Journal of Advertising Research, 58*(3), 349–362.
Onwezen, M. C., Antonides, G., & Bartels, J. (2013). The Norm Activation Model: An exploration of the functions of anticipated pride and guilt in pro-environmental behaviour. *Journal of Economic Psychology, 39*, 141–153.
Peeters, P., van Egmond, T., & Visser, N. (2004). *European tourism, transport and environment. Final version*. Breda: NHTV CSTT.
Penner, J. E., Lister, D., Griggs, D. J., McFarland, M., & Dokken, D. J. (1999). *Aviation and the global atmosphere: A special Report of the intergovernmental Panel on climate change*. Cambridge University Press.
Preacher, K. J., Rucker, D. D., & Hayes, A. F. (2007). Addressing moderated mediation hypotheses: Theory, methods, and prescriptions. *Multivariate Behavioral Research, 42*(1), 185–227.
Ritchie, B. W., Sie, L., Gössling, S., & Dwyer, L. (2020). Effects of climate change policies on aviation carbon offsetting: A three-year panel study. *Journal of Sustainable Tourism, 28*(2), 337–360.
Sachdeva, S., Iliev, R., & Medin, D. L. (2009). Sinning saints and saintly sinners: The paradox of moral self-regulation. *Psychological Science, 20*(4), 523–528.
Schwirplies, C., Dütschke, E., Schleich, J., & Ziegler, A. (2019). The willingness to offset CO2 emissions from traveling: Findings from discrete choice experiments with different framings. *Ecological Economics, 165*, 106384.
Seely, A. (2012). *Taxing aviation fuel*. London: House of Commons Library.
Segerstedt, A., & Grote, U. (2016). Increasing adoption of voluntary carbon offsets among tourists. *Journal of Sustainable Tourism, 24*(11), 1541–1554.
Sörqvist, P., & Langeborg, L. (2019). Why people harm the environment although they try to treat it well: An evolutionary-cognitive perspective on climate compensation. *Frontiers in Psychology, 10*, 348.
Steg, L., Perlaviciute, G., Van der Werff, E., & Lurvink, J. (2014). The significance of hedonic values for environmentally relevant attitudes, preferences, and actions. *Environment and Behavior, 46*(2), 163–192.
Stern, P. C., Dietz, T., Abel, T., Guagnano, G. A., & Kalof, L. (1999). A Value-Belief-Norm Theory of support for social movements: The case of environmentalism. *Human Ecology Review, 6*(2), 81–97.
Taufik, D., Bolderdijk, J. W., & Steg, L. (2015). Acting green elicits a literal warm glow. *Nature Climate Change, 5*(1), 37–40.
Tyers, R. (2018). Nudging the jetset to offset: Voluntary carbon offsetting and the limits to nudging. *Journal of Sustainable Tourism, 26*(10), 1668–1686.
Wilson, T. D. (2011). *Redirect: The surprising new science of psychological change*. Little, Brown and Company.
Zhang, B., Ritchie, B., Mair, J., & Driml, S. (2019a). Can message framings influence air passengers' perceived credibility of aviation voluntary carbon offsetting messages? *Journal of Sustainable Tourism, 27*(9), 1416–1437.
Zhang, B., Ritchie, B., Mair, J., & Driml, S. (2019b). Is the airline trustworthy? The impact of source credibility on voluntary carbon offsetting. *Journal of Travel Research, 58*(5), 715–731.
Zhang, B., Ritchie, B., Mair, J., & Driml, S. (2019c). An exploratory pilot study on air passengers' perceived benefits of aviation voluntary carbon offsetting programs. In *Cauthe 2019: Sustainability of tourism, hospitality & events in a disruptive digital age: Proceedings of the 29th annual conference* (pp. 395–398). Australia: Central Queensland University.
Zhong, C.-B., & Liljenquist, K. (2006). Washing away your sins: Threatened morality and physical cleansing. *Science, 313*, 1451–1452.