Carbon Offsetting in the Aviation Industry: Determinants of Purchase Intention and Attitude

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Abstract

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Key words: carbon offsetting, aviation industry, purchase intention, attitude, sustainability, climate change, consumer behavior

Carbon emissions are one of the main drivers of climate change and the aviation sector contributes greatly to this development. However, the number of people using air travel is still rising. Consequently, carbon emissions will further increase and voluntary carbon offsetting programs have emerged as a valid measure to reduce CO2 emissions from air travel.

However, research reveals that voluntary carbon offset programs offered by airlines are barely used. Furthermore, it is still relatively unknown how these schemes are perceived by consumers. The purpose of this study is therefore to analyze which factors are influencing the purchase intention of and the attitude towards carbon offsetting programs.

Quantitative survey research was conducted and the following predictors and their effects on purchase intention and attitude were tested: former purchase of voluntary carbon offsetting programs, frequency of flying, environmental concern, perceived impact of flights on the environment, perceived credibility of the aviation industry in terms of carbon offsetting, perceived effectiveness of the programs, knowledge and awareness about the products.

Results are showing that especially former purchase, perceived effectiveness and environmental concern are influencing the purchase intention and the attitude of consumers. The results are used to give recommendations to airlines and institutions to increase the participation rate.

Abstrato

Compensação de carbono no sector da aviação: Determinantes da intenção de compra e da atitude

Autor: Richard David Heitmann

Palavras-chave: compensação de carbono, sector da aviação, intenção de compra, atitude, sustentabilidade, alterações climáticas, comportamento do consumidor

As emissões de carbono são um dos principais motores das alterações climáticas e o sector da aviação contribui em grande parte para este desenvolvimento. Como o número de pessoas que utilizam o transporte aéreo continua a aumentar e, consequentemente, as emissões de carbono continuarão a aumentar, os programas voluntários de compensação de carbono surgiram como uma medida válida para reduzir as emissões de CO2 provenientes do transporte aéreo.

No entanto, a investigação revela que os programas voluntários de compensação de carbono oferecidos pelas companhias aéreas são pouco utilizados. Além disso, ainda se desconhece a forma como estes programas são percecionados pelos consumidores. O objetivo deste estudo é, portanto, analisar quais os fatores que influenciam a intenção de compra e a atitude em relação aos programas de compensação de carbono.

Foi realizado um inquérito quantitativo e foram testados os seguintes determinantes e os seus efeitos na intenção de compra e na atitude: compra anterior de programas voluntários de compensação de emissões de carbono, frequência de voos, preocupação ambiental, perceção do impacto dos voos no ambiente, perceção da credibilidade da indústria da aviação em termos de compensação de emissões de carbono, perceção da eficácia dos programas, conhecimento e sensibilização para os produtos.

Os resultados mostram que, especialmente a compra anterior, a eficácia percebida e a preocupação ambiental estão a influenciar a intenção de compra e a atitude dos consumidores. Os resultados são utilizados para dar recomendações às companhias aéreas e às instituições para aumentar a adesão aos programas de compensação de carbono.

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Abbreviations

ANOVA Analysis of variance

COVID-19 Corona virus disease of 2019

CO2 Carbon dioxide

SAF Sustainable aviation fuel

UN United Nations

VCO Voluntary carbon offsetting

Chapter 1: Introduction

1.1 Background and relevance

Rising carbon emissions are one of the biggest threats to our climate by facilitating the global warming (Karl & Trenberth, 2003; Pachauri et al., 2015). Human-related activities are thought to be the main source of carbon emissions, including air travel (Karl & Trenberth, 2003). Due to the expansion of its carbon emissions, tourism, and especially air travel, is under growing scrutiny (Gössling et al., 2015). According to estimates by Gössling and Peeters (2015), CO2 emissions from tourism will rise up to 169% between 2010 and 2050. A significant part of that percentage can be attributed to air travel. Corresponding to that, the number of airline users is still rising (BITRE, 2009).

Carbon offsetting is one of the main approaches for addressing greenhouse mitigation and voluntary carbon offsetting programs can be effective in increasing consumer awareness of climate change and motivating people to bear some of the responsibility for it (Zhang et al., 2019b)

For consumers, such a carbon offset program works by giving them the chance to pay a certain amount to a fund (either directly from the airline or a partner company). This fund is then used to invest in climate protection, energy efficiency or reforestation projects (Zhang et al., 2019a).

How these offset services are perceived by air travelers is still relatively unknown. Since now more and more airlines are offering the programs (Burns & Cowlishaw, 2014) and customer's awareness of environmental issues as well as greenwashing attempts grow (Zhang et al., 2018), it would be interesting to investigate what kind of attitude consumers have towards carbon offsetting programs these days and if air travelers are intending to purchase them. Furthermore, understanding the drivers behind voluntary carbon offset payments is vital and necessary to increase their uptake (Truong-Dinh et al., 2023).

What is known from the literature at this point is that only about 1% to 10% of fliers use aviation VCO products, which is a low acceptance level. According to Kim et al. (2016), there are two leading causes of poor adoption rates: a lack of knowledge and awareness of carbon offset schemes and the public's impression that these programs are unclear and unreliable (Babakhani et al., 2017). Programs that are jointly run by airline companies and other partners may also contribute to a loss of credibility because it is unclear who is providing the service (Gössling et

al., 2007). Further reasons for the low participation rates in these programs might be that consumers have been confused by conflicting arguments, such as some politicians' continued denial of climate change (Ritchie et al., 2020).

Research also shows that criticisms about voluntary carbon offsetting are prevalent. The most common complaint is that the offset programs are only inexpensive environmental pardons that travelers can use (Kollmuss & Bowell, 2007) without directly reducing their carbon footprint by altering their behavior (Gössling et al., 2007).

An important realization of these criticisms is that they are likely to be rooted in misinformation about how the global issue of climate change is working. There is a worldwide response needed to global warming no matter where the carbon emissions are reduced. That is why the offset programs are appealing not only because they are cost-effective for consumers, but they also help poorer nations where many of the offset programs are located to achieve more sustainable growth (Kollmuss et al., 2008; Peters-Stanley & Gonzalez, 2014).

1.2 Purpose of the study and research questions

Considering the low number of consumers adhering to voluntary carbon offsetting and the complexity of the factors contributing to this, the purpose of this study is to cast additional understanding to what is influencing the intention to purchase and the attitude towards carbon offsetting. The outcome of this study can help to understand better this critical relation and provide recommendations to the airlines, governments and program builders to stress the topic and raise more awareness as it still is one of the high potential measures everyone can easily do to reduce emissions and fight against climate change (Zhang et al., 2019b).

This study has the following specific research questions:

RQ1: Which factors are influencing the purchase intention of air travelers on carbon offsetting schemes?

RQ2: Which factors are influencing the attitude of air travelers towards carbon offsetting schemes?

1.3 Research method

The study is based on a quantitative research method which was executed by conducting survey research. The survey was designed to collect data to assess the effects of specific independent predictors on two dependent measures. Moreover, multiple tools such as Qualtrics, R-Studio,

Excel and PowerPoint have been used to create, design and analyze the survey and the collected primary data.

1.4 Dissertation outline

The dissertation consists of five chapters in total. The first chapter includes the introduction, where background information are shared together with a justification of the relevance of the study. In addition to that, the research questions and some brief information on the research method are provided. The second chapter then is dealing with the literature review, where basic information about the aviation industry, carbon emissions and carbon offsetting schemes are listed. Additionally, there are some practical insights into how the carbon offset programs are offered by different airlines. Lastly, the chapter presents the predictors of purchase intention of and attitude toward carbon offset programs in the aviation sector as well as the conceptual model of this study.

The third chapter contains the methodology describing the sample, the procedure, the design and the validity of the questionnaire. It is closed by the preliminary data analysis, which is checking the assumptions for the statistical tests applied. Chapter four presents the analysis of the collected data by giving some main insights about the constructs measured. Furthermore, the conceptual model is executed by applying two multiple linear regressions.

The last chapter, chapter five, concludes the findings and compares them with the findings of the literature. In addition, implications derived from the findings are given, as well as the limitations of this research.

Chapter 2: Literature review and the development of the conceptual model

2.1 The aviation industry and its growing carbon emissions

According to Macintosh and Wallace (2009), the carbon emissions from international air travel are going to rise more than 110% between 2005 and 2025 and looking up to 2050, there are predictions that the emissions will even grow up to 300% when there are no proper actions undertaken to reduce them. This increase is caused by the growing amount of people using aviation as a means of transportation (Higham et al., 2019). An average number of 180.000 daily flights worldwide in 2023 is impressively underlining this immense development (Flightradar24, n.d.).

The overall contribution of aviation to the global CO2 emissions was 2.4% in 2018 (Overton, 2022), which at first sight seems to be a small number but is close to Japan's total carbon emissions in 2021. In addition to that, when only looking at the European Union, the transportation sector is the only sector that has increased its emissions compared to 1990 (European Commission, 2022).

Figure 1 visualizes that after the decrease in CO2 emissions coming from air travel in 2020, which was forced by COVID-19, the emissions are now constantly rising again.

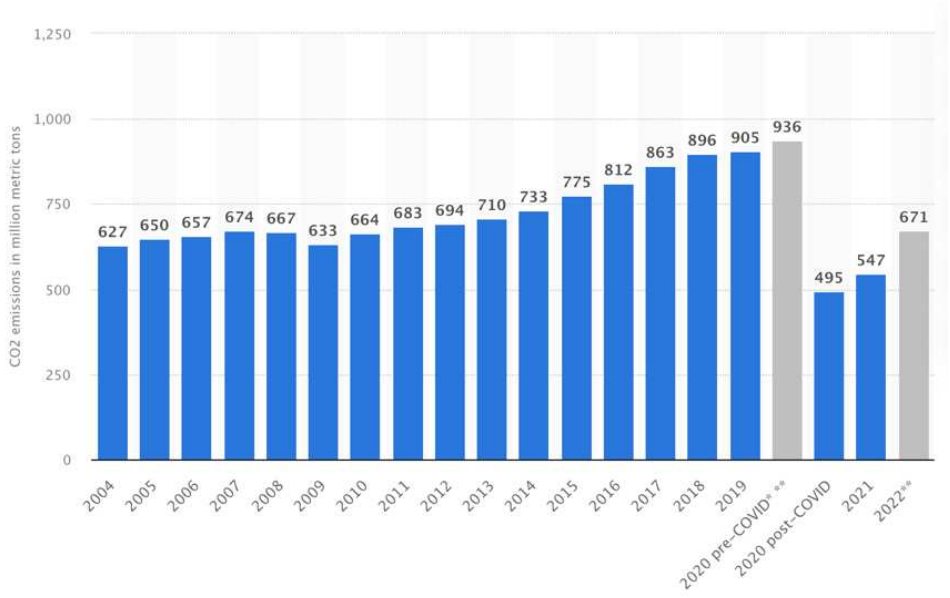

Figure 1: Carbon dioxide emissions from commercial aviation worldwide from 2004 to 2022 (Source: Statista, 2022)

2.2 Voluntary carbon offsetting in the aviation sector

As air travel is still one of the most important means of transportation for tourists, business and politics (Higham et al., 2016), it will be difficult for the industry to reduce the above-mentioned

carbon emissions within the near future since the demand for air travel is still rising (Bows-Larkin et al., 2016).

Furthermore, the aviation fuel exemptions, a kind of subsidization, have contributed to the industry's explosive growth. These exemptions reduce the pressure on airlines to maximize fuel efficiency (Oberthür, 2003). In addition to that, the predicted increase in efficiency through technological and operational measures in the aviation sector does not balance the anticipated rise in demand-driven emissions (Higham et al., 2019). Consequently, there is an increase in public pressure on the whole airplane industry to lower the carbon emissions effectively. Out of this dilemma, the idea of using voluntary carbon offsetting programs to compensate the carbon emissions of each individual air traveler arose. These programs offer the possibility to individuals to actively contribute toward initiatives that reduce/offset the carbon emissions caused by their air travel (Sgouridis et al., 2011).

Examples of these initiatives are investments into sustainable kerosene, planting trees or supporting climate protection projects, such as providing people in developing countries with energy-efficient goods. The concept of these programs is basically that each person is able to offset the carbon emissions he or she caused by preventing or reducing the same amount of CO2 at a different place (Liu et al., 2023).

The ways airlines are offering the VCO programs to their customers are different from airline to airline since the airlines are involved in different carbon offset projects. If the airlines are supporting external climate protection projects, they are getting carbon certificates or carbon credits from an authorized agency which is checking the projects and calculates the saved amounts of carbon emissions which are then assigned to the airline. However, the airline in this context is acting more as an intermediary because the payment is made by the consumer and with that also, the record for the compensated carbon emissions is accredited to the consumer (Gurgel, 2022; IATA, 2022; Kaplan, 2020).

2.3 Current carbon offsetting programs offered by airlines

To get an idea of how airlines are offering voluntary carbon offset programs to their customers, the following airlines and their corresponding websites have been checked. The mentioned airlines have been chosen in order to reveal the differences between low-cost and flag carriers (ICAO, n.d.; Raguraman, 1997) and to demonstrate the variety of carbon offsetting offers. Another criterion was the geographic focus of only selecting European airlines.

Airline	Country	Classification	Reference
Ryanair	Ireland	Low-cost carrier	(Ryanair, n.d.)
Vueling	Spain	Low-cost carrier	(EAN, 2019)
Transavia	The Netherlands	Low-cost carrier	(Transavia, n.d.)
EasyJet	United Kingdom	Low-cost carrier	(ICAO, 2003)
TAP Air Portugal	Portugal	Flag carrier	(European Union, 2021)
Lufthansa	Germany	Flag carrier	(Deutsche Welle, n.d.)
KLM	The Netherlands	Flag carrier	(IATA, 2023)
Air France	France	Flag carrier	(CAPA, n.d.)

Table 1: Overview of airlines and their classifications

Starting with Ryanair, one is able to purchase a carbon compensation right at the checkout when booking a flight via their website. Then there is the option to decide between a full or partial compensation. Ryanair is supporting different climate projects in developing countries and by paying a fixed amount, the customer is directly supporting one of these projects and that way the emissions are compensated. Ryanair is assuring that 100% of the amount paid by the customer is contributing to the climate project. For the distance Cologne – Lisbon, the website calculates an amount of 124kg of CO2 emissions per person. A full compensation via one of the climate projects would cost 2.97€, a partial compensation costs 2€ (Ryanair, n.d.).

Portuguese flag carrier TAP Air Portugal is following a very similar approach, only giving the consumer the possibility to add a carbon offset contribution at the end of the booking process on their website. They are showing the calculated number of emissions and are shortly explaining the project, which will be supported with the paid amount. The website claims that the project is UN-certified. For the distance Lisbon – Dusseldorf, the payable amount for the offsetting is presented as 1.93€ (TAP Air Portugal, n.d.).

The low-cost carriers Vueling and Transavia utilize this one-option method, too (Transavia, n.d.; Vueling, n.d.).

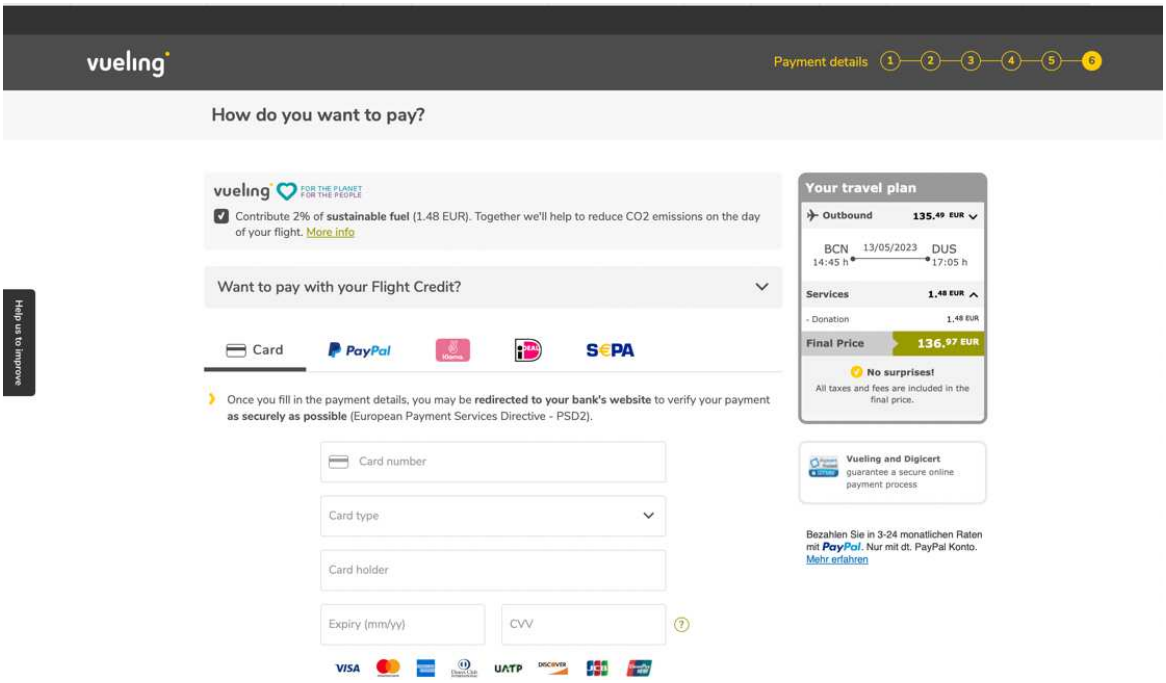

Figure 2: Offsetting option offered by Vueling (Source: Vueling, n.d.)

A different approach is executed by German flag carrier Lufthansa: when booking a flight, Lufthansa is offering a so-called "Green Economy" tariff, which already includes the offset of 80% of the carbon emissions of one person for the selected flight by investing in sustainable aviation fuel which then will be used for a future flight. The package is approximately 70€ more expensive than the ordinary economy class package (Lufthansa, n.d.).

But Lufthansa is then offering another way to let their customers offset their carbon emissions. Via the nonprofit project Compensaid, coming from its own Innovation Hub, Lufthansa clients can enter the flight details and are then getting the amount of carbon emissions they would issue by taking this flight. For the distance Lisbon – Duesseldorf, the website is calculating 144kg of CO2. The customer can then decide via a scale how fast (in years) these emissions should be reduced/offset. If the customer wants to reduce the whole amount of emissions immediately, one can invest in SAF. The sustainable fuel has 80% less carbon emissions than kerosene and Lufthansa can use the SAF for the next flight. This compensation type would cost for the above-mentioned distance approximately 110€. The other option is to offset the emissions after ten years by investing in climate projects. The amount for the same distance for this option is 2.88€. The scale can be adjusted to one, two, three, etc. years and then emissions will be offset by a mix of both options depending on how fast the emissions should be compensated. For faster compensation, there is a higher percentage of SAF needed (more expensive); for slower compensation, the percentage of climate projects is higher (Compensaid & Lufthansa, n.d.).

Other airlines, like low-cost carrier EasyJet, are not offering any carbon offsetting option during the booking process on their website (easyJet, n.d.). However, since the beginning of 2023, they have been partnering with South Pole, a carbon offset company supporting corporations, institutions and governments to offset their carbon emissions (South Pole, n.d.). Entering the joint website of South Pole and EasyJet, consumers can enter their flight details and are then able to choose between three climate projects (run by South Pole) to offset their calculated emissions for their flight. Each project is described shortly on the website. What is remarkable in comparison to Lufthansa and Compensaid is the possibility for air travelers to choose the amount of CO2 in tons they want to compensate, meaning that they can offset even more than there are emissions from their flight. The price is stated per ton and the minimum they can offset is the amount of CO2 produced by their chosen flight (South Pole & easyJet, n.d.).

The Dutch flag carrier KLM is presenting its voluntary carbon offset programs in another way. During the booking process, there is the possibility to select a CO2 impact program. Selecting this option, firstly, an explanation about the two different options for the offsetting is shown. KLM is sourcing SAF on the one hand; on the other hand, they have reforestation programs certified by the assurance company KPMG. After explaining the two options, KLM gives the consumers four choices on how the carbon offsetting of the selected flight should be processed. The four choices are presented next to each other with an increasing price from left to right. The first choice is to offset the emissions by restoring forests and paying 2.90€ for 176kg CO2 (distance Lisbon – Amsterdam). The second package is then a combination of reforestation (for setting off 172kg CO2) and sustainable aviation fuel (for reducing 4kg CO2) and costs 6€. The third option is again a combination: 127 kg of carbon emissions are offset by reforestation and 34kg of carbon emissions are reduced by SAF. This option costs 34€. The last choice is then a pure investment in SAF which should then reduce the emissions by the total amount of 176 kg. The costs for that option are 128.80€ (KLM, n.d.).

The French flag carrier Air France has implemented a very similar procedure with the difference that they are only offering the investment into SAF. When asked to add baggage, one could choose the button “Environment” and is then able to choose from three different options for the reduction of the carbon emissions. For the distance Lisbon – Paris, the airline calculates an amount of 156kg CO2. Option one costs 34€ and is reducing 46kg of emissions, option two costs 56€ and reduces 78kg and option three reduces the whole 156kg of carbon emissions and costs therefore 112.70€ (Air France, n.d.).

2.4. Predictors of purchasing intention of and attitude toward carbon offsetting programs in the aviation sector

Evidence suggests that the purchasing intention and attitude regarding carbon offsetting programs in the aviation sector can be determined by multiple variables. In the following, the predictors for both dependent measures are explained in more detail.

Experience (usage of a carbon offsetting program in the past)

As past behavior is one of the strongest predictors of future behavior (Harris et al., 2016), this study is using experience as a predictor to analyze the effect of having already participated in voluntary carbon offsetting on purchase intention as well the attitude towards carbon offsetting.

Several studies have already taken the former participation in offset programs into account, but none was measuring the direct effect of experience on purchase intention and attitude. Mair (2011) investigated the profiles of participants in voluntary offset programs and whether they are ecocentric and have similar socio-demographic characteristics as environmentally engaged people.

Lu & Shon (2012) were asking about the purchase experience of CO2 compensation programs in their questionnaire but were then not pursuing the results further in their study. Similar cases are the studies of MacKerron et al. (2009) and Choi & Ritchie (2014), where former purchasing of offsetting was asked to participants of their survey, but when investigating the willingness to pay, they were not using this determinant. This is another reason why this study considers the predictor of experience since new value can be added to this field of study.

Frequent flyer

The frequency of flying as a predictor for purchase intention of VCO is quite common in current research as it seems to be a straightforward determinant. On the other hand, the prediction of attitude toward VCO with the help of the frequency of air travel has no significant evidence by literature so far.

Rotaris et al. (2020) were exploring the effect of being a frequent flyer on the willingness to pay for VCO and discovered that the sensitivity of a frequent flyer in regards to the price is smaller than the one of occasional flyers. This finding is supported by the study of Brouwer et al. (2008) who are displaying that the frequency of flying has a very significant effect on the willingness to pay across all nationalities.

A much smaller effect of travel frequency on willingness to pay but still considered as a determinant can be concluded from the research of Lu & Shon (2012). Gössling et al. (2009) are assessing the frequency of flying by asking for the number of journeys made within the last 12 months. Their outcome shows that nearly half of their sample is taking more than 30 flights per year and that among this group, the probability of CO2 compensation is much higher than among the group of less frequent travelers. Contrary to these findings is the result coming from the study of Segerstedt & Grote (2016), which is stating that travel frequency has no significant effect on willingness to purchase VCO.

A more detailed outcome is provided by Ritchie et al. (2021) as they found that the number of flights taken is influencing the willingness to pay for VCO but that this correlation is not always positive and linear. The segment of their study willing to pay the most is less likely to be a frequent air traveler.

Having different findings for the effect of this predictor provides a great justification for implementing it as a measure of purchase intention and attitude in this study.

Environmental concern

The factor of environmental concern is another broadly discussed predictor of purchase intention and attitude regarding VCO within the literature. The study of Babakhani et al. (2017) suggests as a conclusion that VCO offers should put a promotional focus on social benefits of the programs as that way, environmentally concerned air travelers are more likely to participate, proving that there is an effect of environmental concern on purchase intention.

Araghi et al. (2016) are then mentioning that in their study, the role of environmental concern in terms of purchase intention was not studied detailed enough and are suggesting further research to include it as a direct predictor. Choi et al. (2016) are going one step further and claiming via two hypotheses that environmental attitudes and concerns are influencing the purchase intention of VCO as well as the attitude towards environmental actions such as VCO. Results are showing that they can confirm both hypotheses.

The research conducted by Tyers (2018) provides suggestions for how to nudge people to participate in VCO and is claiming that the most accessible people to nudge into a purchase are air travelers with a high environmental concern. Additionally, McKercher et al. (2010) found evidence that environmental concern in general is high among air travelers but that there is little acceptance for changing their travel behavior (including the participation in VCO). This could be an indication that environmental concern is not a significant predictor of purchase intention

and attitude. Truong-Dinh et al. (2023) is using the construct of environmental concern by claiming that the effect of self-efficacy towards environmental issues is fertilizing the motivation to participate in pro-environmental initiatives. Mair (2011) is confirming this finding, at least to some extent, by stating that those consumers who have already participated in a VCO scheme have favorable attitudes toward the environment.

All these studies are confirming the importance of the role of environmental concern when it comes to predict the purchase intention of VCO. Consequently, it is implemented in the conceptual model of this study, meaning that it also acts as a measure of attitude towards VCO.

Perceived impact of flights on the environment

The perceived impact of flights on the environment is a further important factor when it comes to the investigation of purchase intention of VCO. There is only limited research on the relationship to the attitude towards VCO.

The study of Brouwer et al. (2008) is assessing the awareness of the environmental impact of flights on the environment, which can be set equal to the perceived impact. They found differences in awareness among different nations and a slightly significant effect when it comes to the prediction of willingness to pay for VCO. A more detailed and more significant effect was measured by Choi et al. (2016) since they were discovering that the more people are convinced that their flights have an impact on the environment, the less they are motivated to pay for voluntary offsets and additionally have a more negative attitude towards the voluntary payment.

In a former study, Choi & Ritchie (2014) already have confirmed that the perceived impact of flights is a significant predictor for purchase intention and they pointed out that the percentage of participants agreeing that flights have an impact on the environment was relatively high.

Gössling et al. (2009) derive from their study that air travelers are knowing that the aviation sector is contributing to overall carbon emissions and climate change but that about a third of the participants of their survey are not seeing emissions caused by flying as their responsibility.

Taking the studies mentioned above into account, this study will integrate the perceived impact of flights on the environment as a more specific factor for predicting purchase intention and attitude.

Perceived credibility of the aviation industry in terms of carbon offsetting

The perceived credibility of the aviation industry in terms of carbon offsetting is a factor measured differently within literature. The most important study within this predictor was processed by Zhang et al. (2019a). Their whole approach was to find if the source credibility (in this case, the credibility of the airline industry) has a direct influence on the purchase intention and attitude of VCO. They found that trustworthiness has a positive and significant effect on purchase intention, whereas the perceived expertise of the airline is not significant. In this study, the construct of credibility is presented with one variable only due to complexity.

The study of Truong-Dinh (2023) is using trust as a mediator for the effect of perceived airlines' altruistic motives and social norms on the probability of consumers to pay for VCO. Higham et al. (2019) is stating that there is still a lack of credibility in VCO, which is holding air travelers back from opting in. This implies that there must be a significant relationship between purchase intention and the credibility of the aviation industry and carbon offset schemes.

A different approach is pursued by the study of Denton et al. (2020) as they are focusing more on the credibility of climate science rather than on the credibility of the aviation industry or the VCO scheme.

Finally, MacKerron et al. (2009) are presenting the results that the willingness to pay is much higher for certified VCO schemes than for ones without a certificate. Arguing that a certification raises the credibility of such a program, there must be a significant relation between credibility and purchase intention.

Since credibility is considered as a valuable predictor of purchase intention and attitude, this study is using it as an independent variable.

Perceived effectiveness of carbon offset programs

The perceived effectiveness of a carbon offset program is nearly used in all relevant research in the field of carbon offsetting and is integrated into this study as a direct predictor of purchase intention and attitude.

The research of Choi & Ritchie (2014) is assessing the overall perceived effectiveness of VCO. It turned out that only 33% of their respondents are convinced that they have an impact on the reduction of carbon emissions when participating in VCO. Furthermore, they found that perceived effectiveness is a relevant indicator for describing the willingness to pay.

In their mediation model, Choi et al. (2016) used perceived effectiveness as a variable within the factor of intermediate beliefs as well as a direct and significant predictor of purchase intention. However, they were not formulating any hypothesis regarding that relation.

Babakhani et al. (2017) are concluding from their study that the lack of perceived effectiveness is one reason for the low adoption rate of VCO, implying that perceived effectiveness has to have a significant effect on the purchase intention as well as on the attitude towards VCO. The same result got Rotaris et al. (2020) and Truong-Dinh et al. (2023) when investigating how the willingness to pay was influenced by the perceived effectiveness of the carbon offset program.

Knowledge and awareness

Knowledge and awareness in context with carbon offset schemes in the aviation sector have been used quite frequently by current research. The study by Lu & Wang (2018) found that there is a significant effect of subjective knowledge of consumers about the construct of voluntary carbon offsetting as well as about the environmental impact of flights on purchasing intention. Additionally, they measured the same effect but even with a stronger impact on the attitude towards carbon offsetting programs.

A different approach has been chosen by Gössling et al. (2009) who are assessing the overall knowledge and awareness of air travelers about carbon offsetting programs. Their results are that there is a lack of awareness and knowledge about carbon offsetting within their sample and only frequent flyers are familiar with it. They are claiming that after informing unaware people about carbon offsetting, more than two-thirds could imagine setting off carbon emissions in the future.

The importance of knowledge and awareness within carbon offsetting in the aviation sector gets confirmed by the study of Ritchie et al. (2020) and Segerstedt & Grote (2016), as they are using the construct of knowledge and awareness as a pre - determinant of purchasing intention of offsetting programs. As Ritchie et al. (2020) have discovered significant effects of knowledge and awareness on beliefs in effectiveness of carbon offsetting; Segerstedt & Grote (2016) claimed that knowledge is a pre-condition for air travelers to participate in carbon offsetting. Further studies are more focusing on the environmental knowledge (Mair, 2011) or the knowledge and education about climate change (DeMattio & Halawi, 2022) and are indicating a strong effect on desire and intention to purchase carbon offsetting.

In this study, the predictor of knowledge and awareness is therefore used to measure its direct effect on purchase intention and the attitude toward carbon offsetting schemes.

2.5 The conceptual model

The conceptual model (Figure 3) is then created based on the insights from former research (chapter 2.4) to ensure that the most relevant predictors of the dependent measure of purchase intention are used. These predictors are: *experience, frequency of flying, environmental concern, perceived impact of flights, perceived credibility, perceived effectiveness, knowledge and awareness.* The new value added to research is then that these variables have not yet been used all in one model as direct predictors of purchase intention in the carbon offset area. Additionally, some predictors have mainly been used as pre-determinants (*knowledge & awareness* and *perceived effectiveness),* for other predictors, there have been opposite findings (*frequency of flying* and *environmental concern)* and the factor of *experience* has never been investigated for its direct effects on purchase intention. Another value-adding fact is that this study uses all mentioned predictors also to describe the attitude toward carbon offsetting since there is only little research in this area and attitude is mainly used as another predictor of purchase intention or willingness to pay (Chen, 2013; Choi & Ritchie, 2014; Denton et al., 2020; Kim et al., 2016).

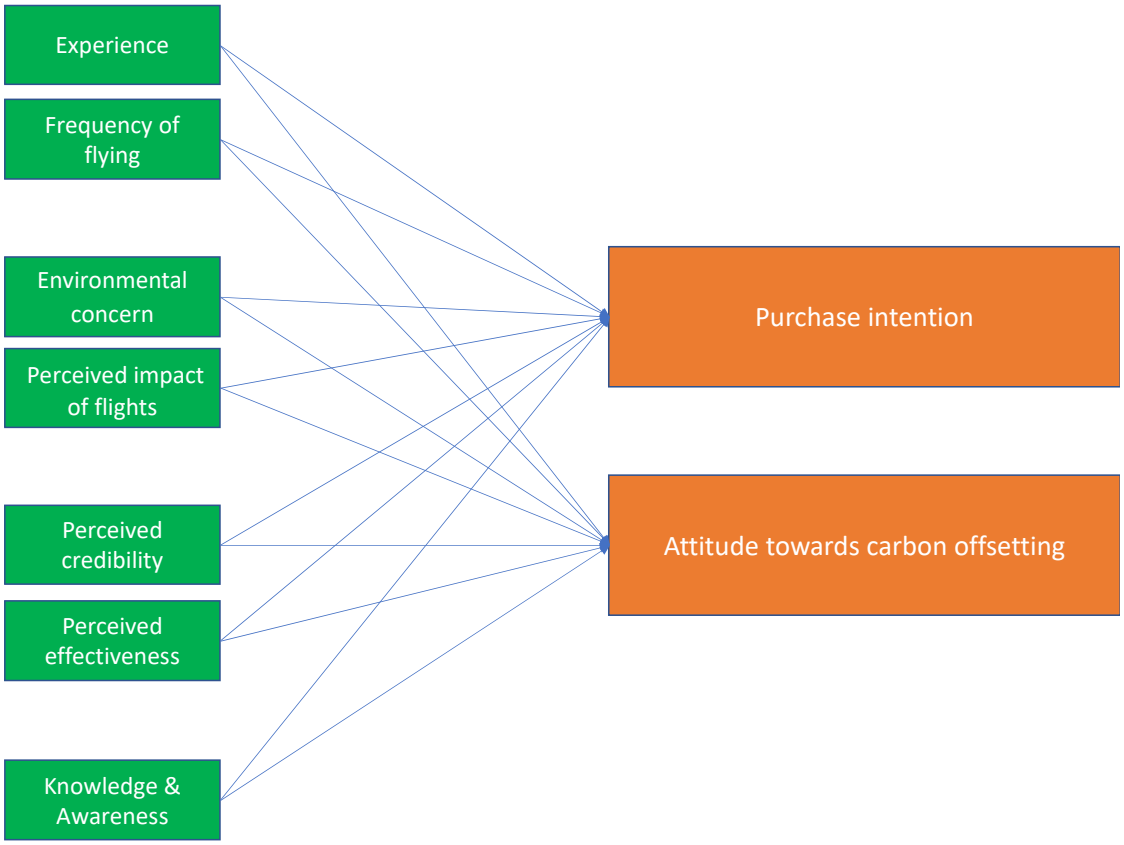

Figure 3: Conceptual model

Chapter 3: Methodology

3.1. Sample

To test the conceptual model, a survey (Appendix 1) was designed, which was conducted by 217 people in total. Out of these 217 people, only 159 valid answers could be collected, as the other 58 answers had to be discarded due to invalid responses and incompleteness.

The majority of participants were from Germany (approx. 80%) and roughly 20% were from other nations. 90 out of 159 were students followed by fully or partly employed people. The sample is holding the balance in terms of gender, with 50% male and 49% female respondents (Figure 4).

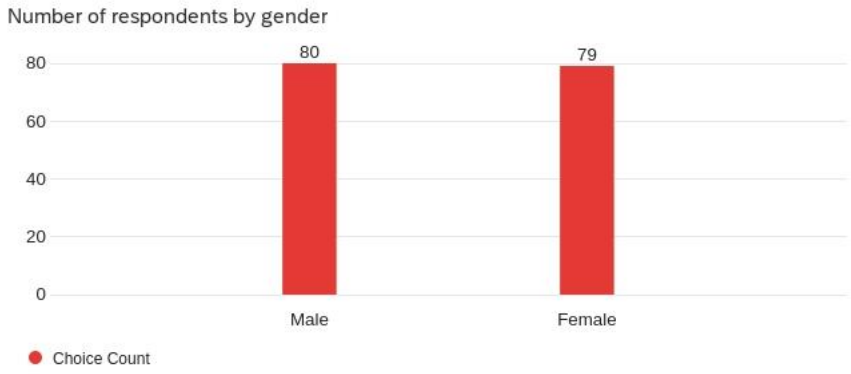

Figure 4: Gender sample

The average age of the sample is relatively young with 27.9 years. The oldest participant is 72 and the youngest is 18 (Figure 5).

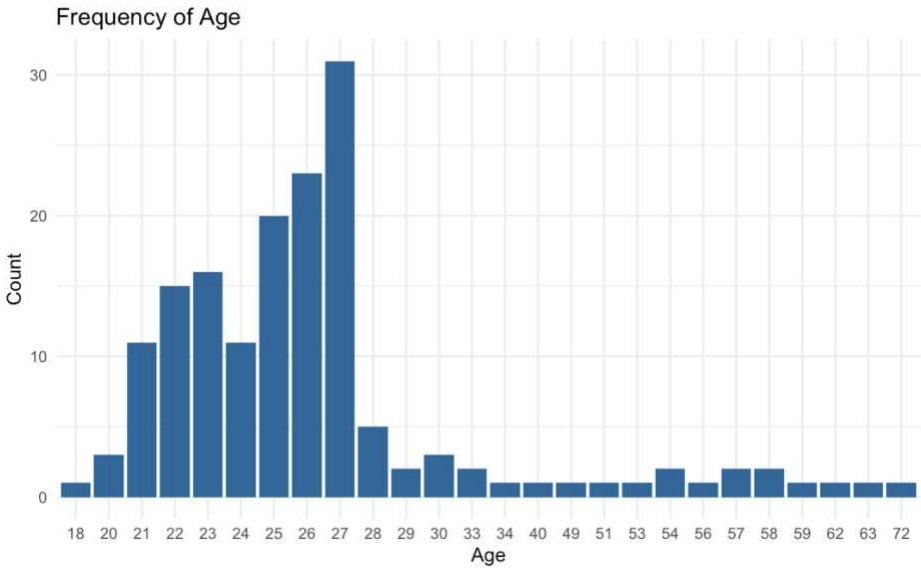

Figure 5: Age sample

A further demographic characteristic is the income before taxes during the last 12 months of the participants, which was measured within certain income ranges. Most respondents (approx. 53%) have a yearly income below 25.000€, which is corresponding with the great number of students who participated in the study. 30 participants have yearly earnings between 25.000€ and 50.000€, followed by 28 people earning between 50.000€ and 100.000€. Only twelve (7.5%) contributors have an income between 100.000€ and more than 200.000€, whereas five respondents preferred not to state their income (Figure 6).

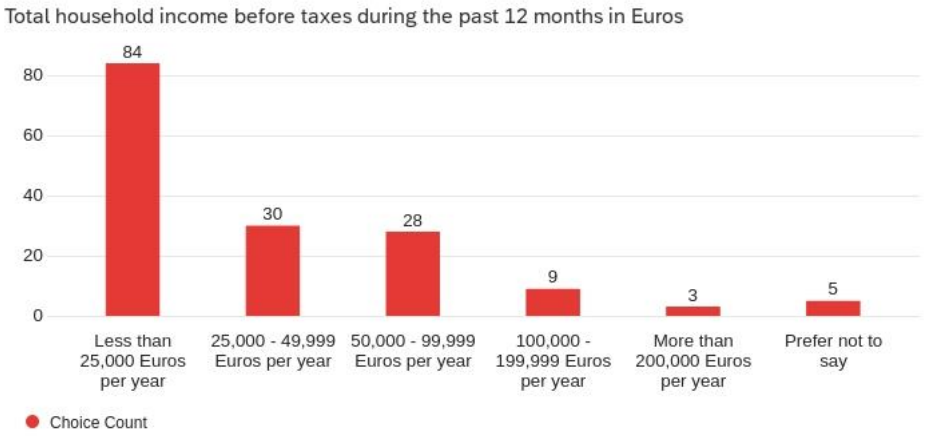

Figure 6: Income sample

The last demographic attribute is the educational level of the participants which was assessed by asking for the highest completed degree of education. More than half of the respondents (52%) have a Bachelor's degree, followed by 31% having a graduate or professional degree, whereas the remaining contributors are distributed along some secondary education, completed secondary education, vocational or similar education or some university education but without a degree (Figure 7).

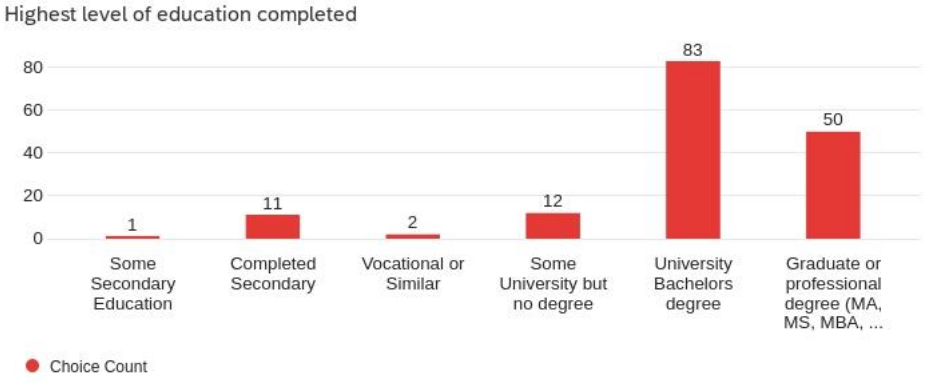

Figure 7: Education sample

3.2 Procedure

The survey was launched on the 26th of March 2023 and stayed open until the 02nd of April 2023. It was distributed via different social media platforms and pre-tested with ten participants to ensure a flawless conduction. The survey language was English for all participants and there was no restriction regarding any sociodemographic factor since air traveling is accessible for everyone. The statements in the matrixes utilized in the survey were randomized to ensure people were not biased by the order of the statements presented. The average time respondents took to answer the survey was 11.9 minutes.

3.3 Questionnaire design

This study consisted of an online administered questionnaire designed with the online-tool Qualtrics. In total, it applied six sections to access all the variables necessary for the analysis. The order of the questions was selected according to the framework of Leeuw et al. (2008), which is pointing out to start with warmup questions, then coming to the core questions and then ending the questionnaire with some cool-down questions.

The first section therefore asks for the sociodemographic data of the participants. These characteristics are assessed by certified questions coming from Qualtrics.

The second section is then investigating whether the participants are frequent flyers. First, the respondents have to rate themselves as either frequent flyers or not on a five-point Likert Scale (Segerstedt & Grote, 2016), then they have to indicate the number of journeys made by plane in the past 12 months (Gössling et al., 2009) and then they are asked if they were traveling by air in their most recent trip (McKercher et al., 2010).

The third section is covering the awareness and knowledge about carbon offsetting in general as well as the attitude towards carbon offsetting in air travel. Awareness is measured by letting the participants rating themselves two times on a five-point Likert Scale to what degree they consider themselves aware of (voluntary) carbon offsetting (Dodds et al., 2008). The level of subjective knowledge is measured by five statements used by (Lu & Wang, 2018), where the respondents had to agree or disagree along a five-point Likert Scale again. The attitude towards carbon offsetting was measured in the same matrix and along the same scale. The statements for that were taken from (Denton et al., 2020).

The fourth section of the questionnaire is another matrix, including the five-point Likert Scale, where participants had to provide their level of agreement. To assess the perceived effectiveness of carbon offsetting programs in air travel, three statements already used by (Ritchie et al.,

2020) were deployed with a slight adaptation. Within the same matrix, the perceived credibility (including aspects of trust) of carbon offsetting in the aviation industry was explored by listing in total six statements formerly established by (B. Zhang et al., 2019a).

Section five was looking into the perceived impact of flights on the environment as well as into the environmental concern of the participants. Three, respectively, five statements coming from (Choi et al., 2016; Gössling et al., 2009; McKercher et al., 2010) were presented together in a matrix with a five-point Likert Scale asking for the level of agreement.

The last and sixth section was then constituted by a multiple choice question asking if the respondents have ever actively participated in a carbon offset program offered by an airline which was used in the study of (Choi & Ritchie, 2014) and by three statements adapted from (Denton et al., 2020) exploring the intention to purchase carbon offsetting for air traveling in the future presented in a matrix with a five-point Likert Scale asking for the level of agreement.

3.4 Validity

The validity of the answers has been checked first of all on completeness and that all respondents have finished the survey within a reasonable amount of time (> 4 minutes), which can be confirmed for the 159 answers for the analysis of this study following in chapter 4.

To measure the independent variables *knowledge, awareness, perceived credibility, perceived effectiveness, environmental concern* and *perceived impact of flights* as well as the dependent variables *purchase intention* and *attitude,* validated measures form the literature were used (see Chapter 3.3). Therefore, it can be expected to have good reliability for all mentioned variables in terms of assessing the construct and the true attributes and opinions of the respondents properly. To check how closely related the groups of items per variable are and to see their internal consistency, the corresponding Cronbach alphas were calculated. As the table below is showing, all alphas are above the 0.7 border saying that there is acceptable consistency or better within all constructs. The alphas of *perceived credibility, environmental concern, purchase intention* and *attitude* are even above 0.8 as well as the overall alpha (0.86), demonstrating a good internal consistency (Table 2).

Construct	Items	Cronbach's Alpha
Knowledge	5	0.77
Awareness	2	0.71
Perceived credibility	6	0.86

Perceived effectiveness	3	0.76
Environmental concern	5	0.86
Perceived impact of flights	3	0.77
Purchase intention	3	0.9
Attitude	4	0.83
Overall	**31**	**0.86**

Table 2: Cronbach alpha

In addition to the internal consistency check, a confirmatory factor analysis was done in order to investigate whether the observed data has a good fit to the theory-derived measurement model/factor structure previously defined in literature.

Construct	CFI	TLI	RMSEA
Knowledge	0.94	0.88	0.13
Awareness	N/A	N/A	N/A
Perceived credibility	0.94	0.9	0.13
Perceived effectiveness	1	1	0
Environmental concern	0.96	0.92	0.13
Perceived impact of flights	1	1	0
Purchase intention	1	1	0
Attitude	1	1	0

Table 3: Confirmatory factor analysis

As table 3 is revealing all variables used in the conceptual model of the study, have a good fit to the data collected. The fit indices CFI (Comparative Fit Index), TLI (Tucker Lewis Index) and RMSEA (Root Mean Square Error of Approximation) for *perceived effectiveness, perceived impact of flights, purchase intention* and *attitude* are even proving a perfect fit, whereas for *knowledge, perceived credibility* and *environmental concern* the fit is good regarding the CFI and TLI index. The RMSEA for these three measures is indicating a mediocre fit, but it must be seen in the context with two indices showing a good fit. The analysis was not applicable to *awareness* since it is measured by two items only.

The independent variables *experience* and *frequency of flying* were gauged by one straightforward question ensuring a clear understanding among the participants as well as a

great validity and are therefore not applicable for the Cronbach Alpha calculation and the confirmatory factor analysis.

3.5 Preliminary data analysis

In the following, the applicable parametric tests are executed to check whether the baseline assumptions for quantitative data analysis are met to make accurate conclusions about reality later.

Merging of variables

In order to apply parametric multivariate data analysis methods, which are used to proceed with the conceptual model and to answer the stated research questions of this study, it first has to be mentioned that the variables used in both regressions are sums of the means of the single variables which are reflecting one statement asked in the questionnaire. These variables are marked with the addition "total" (*intention_total, concern_total, impact_total, attitude_total, credibility_total, effectiveness_total, knowledge_total, awareness_total).* The following function (example with *concern_total*) was executed in R-studio to create the new variable constructs:

mydata_3$concern_total <- rowMeans(mydata_3[, c("Concern_1", "Concern_2", "Concern_3", "Concern_4", "Concern_5")])

Only the variables *experience* and *fr_flyer* are obtained directly from the dataset derived from the survey since they are only measured by one question of the questionnaire.

Test for multicollinearity

Furthermore, the correlations between the used variables (predictors and dependent measures) were tested by conducting a correlation matrix to avoid multicollinearity (Figure 8). The figure reveals that there is no major multicollinearity within the individual variables, which would be reached at a correlation level of +/- 0.7 (Field et al., 2012).

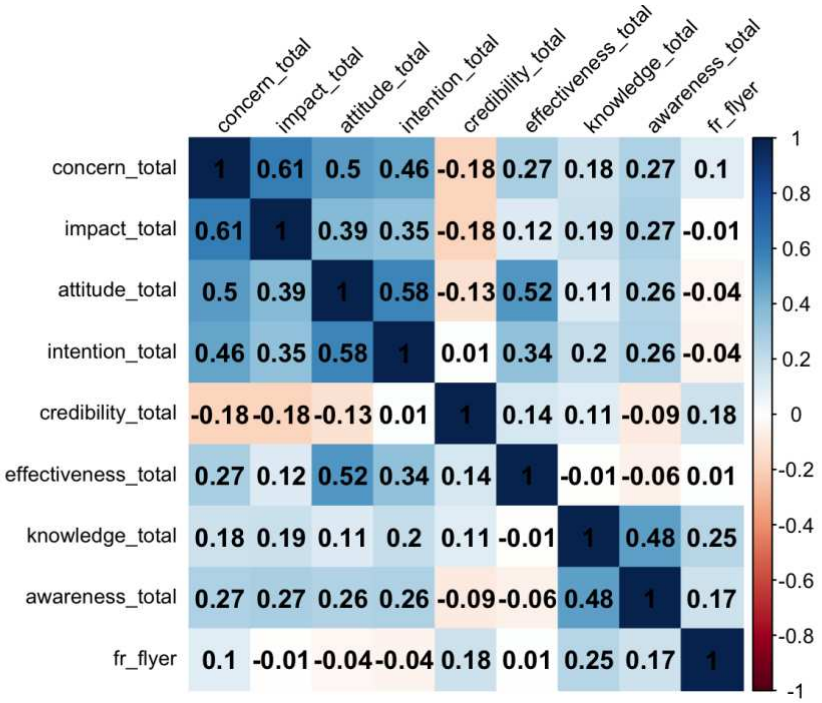

Figure 8: Correlation plot

Test for normal distribution of the variables

Shapiro-Wilk tests were conducted to assess the normality of the data distribution for all variables included in the analysis. However, none of the variables exhibited a normal distribution ($p < 0.05$), indicating non-normality of the data. Various methods were attempted to transform the variables in order to achieve a normal distribution. However, all attempts were unsuccessful except for the variable *knowledge_total,* which was transformed using the logarithmic function, resulting in a normal distribution of the data. The variable is therefore called *knowledge_log* in the following analysis.

Due to the robustness of the ordinary least square method used in the linear models estimates planned to test our predictions (particularly in the case of larger samples), we still proceeded with a parametric data analysis. Additionally, the models were also tested for the normal distribution of the residuals. The results of these tests are reported in the results section.

Test for homogeneity

Due to the quantitative nature of the explanatory variables, the Levene test could not be executed.

Outliers

The boxplots in figure 13 are revealing that there could be potential outliers for the variables *environment_total, impact_total, credibility_total* and *attitude_total.* Since all of these

variables are Likert scale variables and are therefore discrete, the interpretation of outliers is less straightforward (Norman & Streiner, 2008). That is why there is no further pursuit of the potential outliers in this study.

Chapter 4: Analysis and results

4.1 Understanding the respondents

In the following, the most important insights of the questionnaire are highlighted by interpreting the means of each measured construct. The order of the variables within this chapter is chosen according to the order of the questions in the survey.

Frequent flyer

The first variable under investigation is the frequency of flying which has an overall mean of 3.30 (Table 12) and a median of 4.00 (Table 12) within the five-point Likert Scale, indicating that respondents consider themselves as moderate to relatively frequent flyers. This gets confirmed by having 40% of the contributors rating themselves on level four out of five for being frequent flyers (Figure 9).

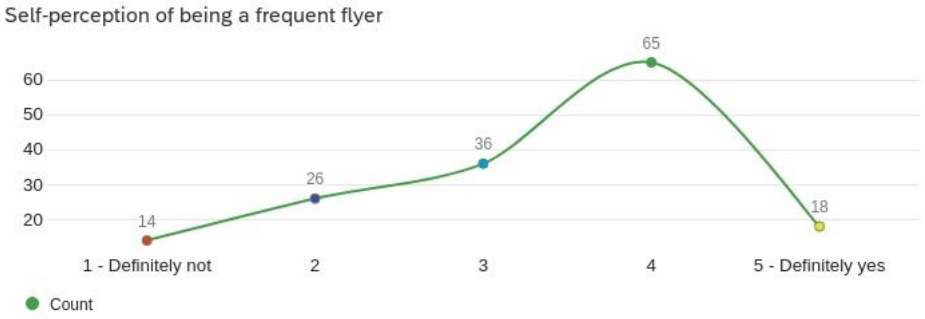

Figure 9: Self-perception of being a frequent flyer

The tendency to frequent flying within the sample is becoming more obvious when conducting the number of journeys made by plane in the past twelve months. Figure 10 is showing that 53% of the sample have made six or more journeys by plane within the last year and even 16% were traveling twelve or more times using an airplane. This fits the trend of rising air traveler numbers mentioned in chapter 2.2 and indicates that the adoption of voluntary carbon offset programs is urgently needed in order to reduce CO2 emissions in general and to reach the goals of the Paris climate agreement within the expected time frame (*UNFCCC*, 2016).

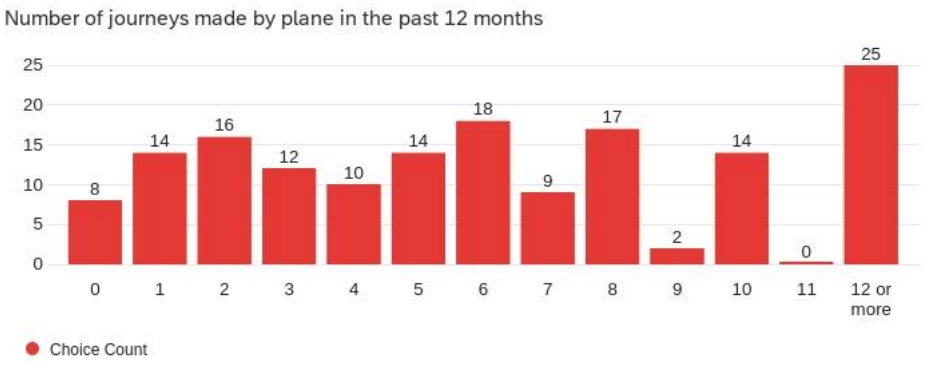

Figure 10: Number of journeys made by plane in the past 12 months

The importance of flying (either for leisure or business) for the sample of this study becomes more apparent when inspecting figure 11, showing that 66% of the respondents have used the plane on their most recent trip. This proves that air travel is still one of the most used ways of transportation and verifies the trend of growing emissions caused by the aviation sector, as discussed in chapter 2.1.

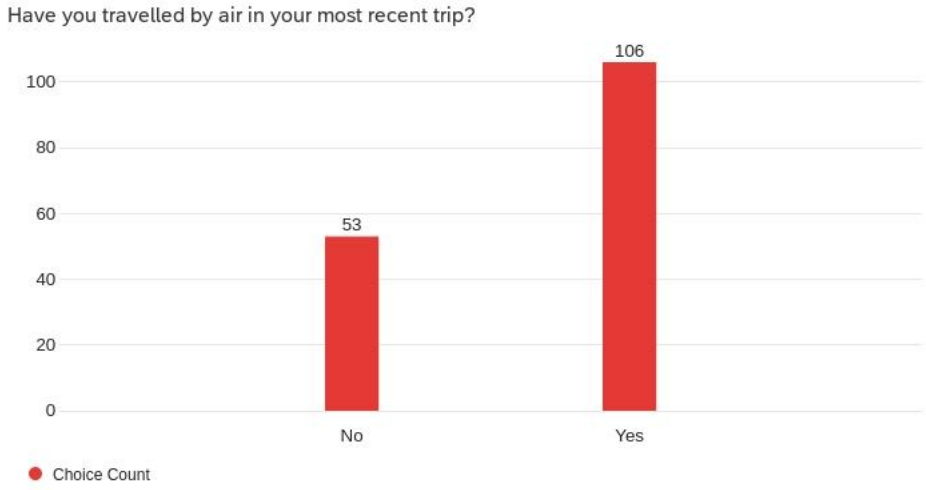

Figure 11: Air travel in the most recent trip

Knowledge and awareness

The construct of awareness was assessed by two items where participants had to rate their subjective awareness on the five-point Likert scale. The results of the study are revealing that the sample has a relatively moderate awareness of carbon offsetting and its voluntary component. This is supported by the overall mean of 3.23, which is slightly above the mid-point of the five-point Likert scale (Table 12) and the median of 3.00 (Table 12). From that, one can derive that overall, the respondents have heard about carbon offsetting before and that

there is a certain awareness, but they consider themselves not as fully aware. It is interesting to see when comparing the means of both awareness variables individually that people tend to have more awareness about carbon offsetting in general than about **voluntary** carbon offsetting (Table 4).

Variable	Statement	Mean	Standard Deviation
Aware_1	To what degree do you consider yourself aware about carbon offsetting?	3.42	1.04
Aware_2	To what degree do you consider yourself aware about voluntary carbon offsetting?	3.03	1.18

Table 4: Overview awareness variables

The subjective knowledge about carbon offsetting schemes within the sample of this study is relatively low. The construct was measured with five statements and concluded into one overall knowledge variable, which mean (2.55 – Table 12) is one of the lowest (below the mid-point of the scale) in comparison to the remaining variables within the conceptual model. That is additionally reflected by figure 13, revealing the boxplot of knowledge at the lower end of the five-point Likert scale, meaning that people tend to disagree with the statements measuring knowledge.

Looking into the single knowledge variables, the evidence for an overall low knowledge about carbon offsetting within the sample grows since the means of the knowledge variables 2-5 are not exceeding the value of 2.5 (Table 5).

Variable	Statement	Mean	Standard Deviation
Know_1	I can explain the environmental impacts caused by air transportation	3.44	1.09
Know_2	I can explain where the voluntary carbon offset funds go and how the voluntary carbon offset funds will be used for	2.01	1.14
Know_3	I can explain the voluntary carbon offset programs and their benefits	2.38	1.14

Know_4	I know what channel can be accessed to calculate carbon emissions from air travel	2.47	1.25
Know_5	I know what channel can be used to purchase carbon offsets	2.48	1.25

Table 5: Overview knowledge variables

Attitude toward carbon offsetting programs

The attitude variable was measured by four statements where participants had to disagree or agree on the five-point Likert Scale, where 1 reflects strong disagreement and 5 strong agreement. To get an overall impression of the attitude toward carbon offsetting programs, the four variables were merged to the variable *attitude_total.* Consolidating table 12, the mean of attitude is relatively high, with 3.64 (above the mid-point of the scale) in the overall comparison to the other variables of the conceptual model. The boxplot of attitude in figure 13 with a median of 3.75 is underlining the somewhat positive attitude of participants.

A more detailed insight into the participants' attitude provides the results of the four single statements used in the questionnaire. When conducting the counts per scale point for statement one, it is interesting that nearly 70% of the contestants respond with 4 or 5 on the Likert scale, proving a strong agreement that the general idea of carbon offsetting is appreciated. (Table 6).

Variable	Statement	Mean	Standard Deviation
Att_1	I like the idea of offsetting carbon emissions when I travel	3.79	1.14
Att_2	I have a favourable attitude toward offsetting carbon emissions	3.46	1.07
Att_3	Offsetting carbon emissions when I travel would be worthwhile	3.76	1.04
Att_4	Offsetting carbon emissions when I travel would be rewarding	3.55	1.08

Table 6: Overview attitude variables

Perceived effectiveness of carbon offsetting programs

The perceived effectiveness consisted of three items merged into the variable *effectiveness_total.* For each statement, the five-point Likert Scale was used to gauge the level

of agreement of the respondents. The variable has a score of 3.30 for the mean, revealing (Table 12) that the perceived effectiveness of carbon offsetting programs is slightly above the mid-point of the scale. This indicates that the contributors of this study still have diverse perceptions in terms of effectiveness of the offset schemes.

Watching the means of each individual variable, it becomes evident that there is a trend of a decreasing mean score from statements one to three (Table 7). For the first statement, 58% of the sample answered 4 or 5 on the Likert scale showing agreement that carbon offsets are effective in terms of fighting against global warming. A lower level of agreement can then be observed at the third statement, which is the most direct in terms of effectiveness of VCO. One-third of the respondents have replied 1 or 2 on the Likert scale, demonstrating their disagreement and a further 24% are only scoring a 3.

Variable	Statement	Mean	Standard Deviation
Eff_1	Voluntary carbon offsets will provide a better world for me and future generations	3.61	1.12
Eff_2	Voluntary carbon offsets will help people have a better quality of life	3.28	1.12
Eff_3	Voluntary carbon offsets will reduce carbon emissions	3.03	1.30

Table 7: Overview effectiveness variables

Perceived credibility of the aviation industry in terms of carbon offsetting

The missing credibility of the airline industry and carbon offsets was stated in the literature as one of the main reasons for the low adoption rate of VCO (Kim et al., 2016).

In this study credibility was measured by six statements and one concluding variable was created to display the overall perceived credibility within the sample. The mean of 2.41 and the median of 2.33 are the lowest figures compared to the other variables used in the conceptual model and are clearly below the mid-point of the scale (Table 12), confirming that there is also a lack of credibility within the sample of this study. The boxplot of figure 13 visualizes that for the summed credibility variable, the data is not spread out but moves mainly within the scale points of 2 or 3.

Diving into more detail of the individual credibility statements, it is getting obvious that there is low trust in the airline industry when it comes to carbon offsetting (Statement 1), with 70% scoring on 1 or 2 on the scale. A similar trend can be observed in the honesty of the airline industry when it comes to carbon offsetting (Statement 3) where 66% replied with 1 or 2 on the scale. A slight shift to more replies on scale points 2 and 3 (around 75% of respondents) can be found for variables *Cred_2, Cred_4, Cred_5* and *Cred_6* signifying still rather a disagreement than an agreement.

Variable	Statement	Mean	Standard Deviation
Cred_1	I trust the airline industry as a whole with carbon offsetting	2.11	0.97
Cred_2	The airline industry as a whole makes truthful claims about carbon offsetting	2.41	0.92
Cred_3	The airline industry as a whole is honest about carbon offsetting	2.18	1.00
Cred_4	The airline industry as a whole has a large amount of experience with carbon offsetting	2.62	0.92
Cred_5	The airline industry as a whole is skilled in what they do with carbon offsetting	2.57	0.93
Cred_6	The airline industry as a whole has great expertise with carbon offsetting	2.58	0.96

Table 8: Overview credibility variables

Perceived impact of flights on the environment

The variable of the overall perceived impact of flights on the environment has one of the highest means (4.18 – Table 12) and medians (4.33 – Table 12), explaining that the majority of the sample is aware about the fact that flying and the emissions caused are having a harming impact on the environment. The construct was measured by three variables which means were merged to create the *impact_total* variable.

A look at each item of the construct is expressing an increase in the means from the first to the third variable of about 0.3 points (Table 9). The percentage of participants answering 4 or 5 on the scale and agreeing to the statements is 73% or more for each item.

Variable	Statement	Mean	Standard Deviation
Impact_1	My flights contribute to climate change	4.06	1.10
Impact_2	Air travel has a harmful effect on our environment	4.14	1.06
Impact_3	Air travel causes a lot of carbon emissions	4.33	0.86

Table 9: Overview impact variables

Environmental concern

The five items gauging the environmental concern of the participants of this study were merged into the overall variable *concern_total.* Table 12 and figure 13 exhibit that the environmental concern within the study is considerably high, having a mean of 4.25 and a median of 4.40 which are the highest figures compared to the other variables assessed by this study.

The agreement with each of the individual statements measuring the environmental concern is consequently firm, which can be acquired when looking at the means of each variable individually (Table 10).

Variable	Statement	Mean	Standard Deviation
Concern_1	I am worried about climate change	4.32	0.93
Concern_2	I am concerned that changes in environment will affect my life	4.11	0.97
Concern_3	I am concerned about climate change caused by carbon emissions	4.22	0.94
Concern_4	Global warming and climate change is a major concern over the next 12 months	4.11	1.18
Concern_5	Global warming and climate change is a major concern over the next 5 years	4.50	0.87

Table 10: Overview concern variables

Experience

The construct of experience should reveal whether respondents have already participated in an offset program of an airline. It was measured by the question shown in figure 10. The result fits the low adoption rate of the offset schemes mentioned already in chapter 1.1 (McLennan et al., 2014) since two-thirds of the sample have not yet participated in such a program. However,

two-thirds of the sample traveled by plane in their most recent trip and more than 50% have undertaken six or more journeys by air travel in the last twelve months.

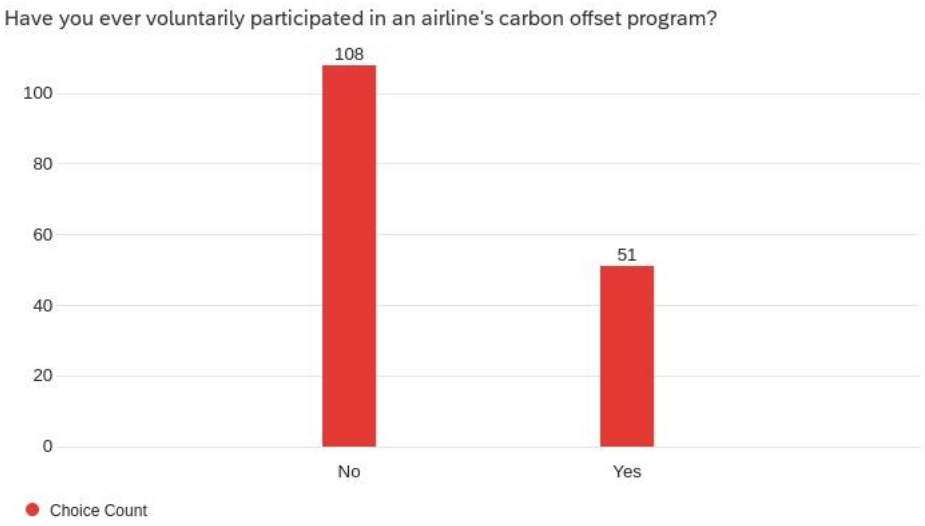

Figure 12: Score of experience variable

Purchase intention

The last construct this study investigates is the purchase intention of carbon offsetting schemes. At the same time, it is, together with the attitude towards VCO, the dependent measure of the conceptual model of this study. The purchase intention was computed by three items merged into one variable called *intention_total.* Conducting table 12 and figure 13, one is able to derive that the overall purchase intention is rather moderate, with a mean of 3.26 being slightly above the mid-point of the scale and meaning that people have a moderate intention to purchase carbon offsetting

This is also revealed when analyzing the three statements individually since there is quite a considerable variance among all three variables regarding counts per scale point. This means there is nearly a normal distribution of the scores with a concentration on score points 3 and 4, indicating a slight tendency towards agreeing to make a future purchase of carbon offset programs. The decrease of means (Table 11) reflects that the stronger the statement is phrased towards a purchase, the less agreeing people are, which is then showing that there might be a gap between the consideration of buying and the actual purchase.

Variable	Statement	Mean	Standard Deviation
Int_1	I will consider buying carbon offsets when I travel in the future	3.50	1.19
Int_2	I expect to purchase carbon offsets when I travel in the future	3.26	1.11
Int_3	I definitely want to purchase carbon offsets when I travel in the future	3.01	1.20

Table 11: Overview intention variables

Summary

Overall, one can summarize that the sample is environmentally concerned and understands that flights have an impact on the environment. The attitude towards carbon offset schemes is moderately positive, alongside a moderate intention to purchase the offset schemes. Knowledge and awareness about the schemes are relatively low within the sample as well as the perceived credibility of the airlines in terms of the carbon offset programs. Furthermore, the offset schemes are perceived as moderately effective and on average, the participants consider themselves as frequent flyers. The means and boxplots for each variable are visualized in figures 11 and 12. The variable *experience* is categorical and cannot be displayed in the following figures.

Variable	Number of observations	Mean	Standard Deviation	Median
Fr_flyer	159	3.30	1.14	4.00
Awareness_total	159	3.23	0.98	3.00
Knowledge_total	159	2.55	0.86	2.40
Attitude_total	159	3.64	0.88	3.75
Effectiveness_total	159	3.30	0.98	3.33
Credibility_total	159	2.41	0.73	2.33
Impact_total	159	4.18	0.84	4.33
Concern_total	159	4.25	0.79	4.40
Intention_total	159	3.26	1.07	3.33

Table 12: Summary of main variables

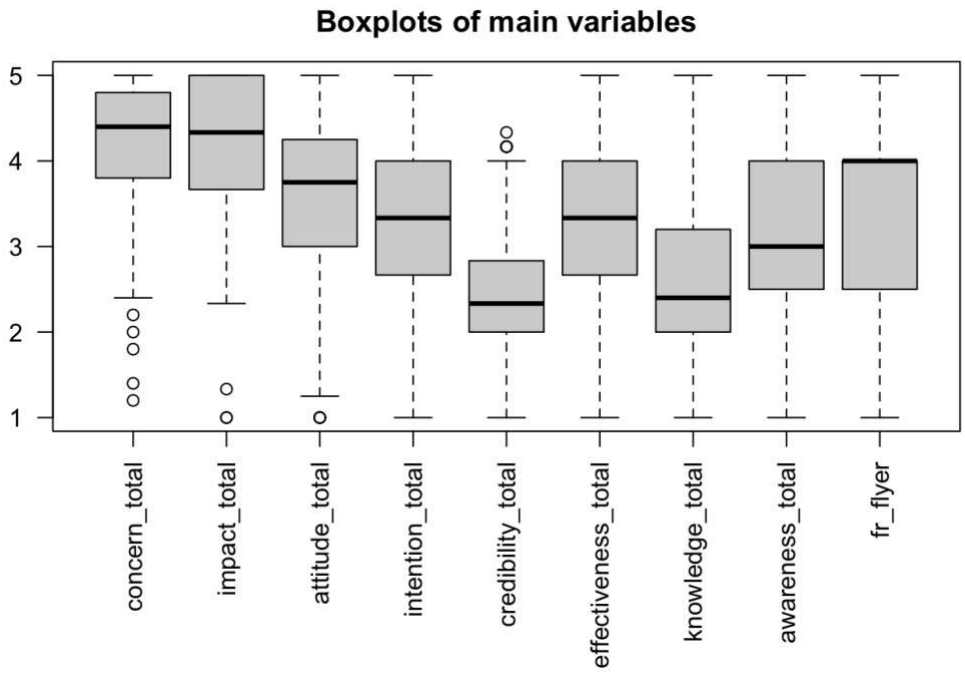

Figure 13: Boxplots of main variables

4.2 Explaining the respondents' behaviors

In the following chapter, the statistical test to execute the conceptual model and to predict the behaviors of the respondents of this study are presented alongside their results.

Prediction of purchase intention

To analyze the effects of the predictors mentioned in the conceptual model of this study on purchase intention of carbon offsetting schemes, a stepwise hierarchical regression in blocks with two predictors added for each new model was conducted. The order in which the predictors were added to the model is according to how well-known their effects on purchase intention are and how often they have been used by former research (Field et al., 2012). This means that less-known predictors are tested in a way that, if they account for purchase intention, it is because they have something to add on top of all the most well-known variables.

First, the variables of perception *effectiveness_total* and *credibility_total* are added to the model since they are used quite frequently by former research to describe purchase intention. Then the environmental-related variables *conern_total* and *impact_total* were added to the model, followed by the variables focused on the understanding of carbon offsetting *knowledge_log* and *awareness_total.* In the last step, the behavioral-related variables *experience* and *fr_fyler* were added.

	Dependent variable:			
	intention_total			
	(1)	(2)	(3)	(4)
credibility_total	-0.058	0.089	0.066	0.160
	(0.110)	(0.103)	(0.104)	(0.098)
effectiveness_total	0.380***	0.247***	0.273***	0.288***
	(0.083)	(0.079)	(0.079)	(0.073)
concern_total		0.457***	0.403***	0.420***
		(0.122)	(0.121)	(0.113)
impact_total		0.161	0.113	0.046
		(0.110)	(0.109)	(0.102)
knowledge_log			0.278	0.288
			(0.243)	(0.230)
awareness_total			0.148*	0.070
			(0.086)	(0.082)
Experience.2				0.743***
				(0.155)
fr_flyer				-0.107*
				(0.062)
Constant	2.143***	-0.391	-0.708	-0.420
	(0.363)	(0.551)	(0.559)	(0.527)
Observations	159	159	159	159
R2	0.119	0.279	0.312	0.421
Adjusted R2	0.107	0.260	0.285	0.390
Residual Std. Error	1.007 (df = 156)	0.917 (df = 154)	0.901 (df = 152)	0.832 (df = 150)
F Statistic	10.499*** (df = 2; 156)	14.902*** (df = 4; 154)	11.510*** (df = 6; 152)	13.645*** (df = 8; 150)
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 13: Stargazer purchase intention

The stargazer table (Table 13) reveals that model 1 has an adjusted R^2 of 0.107, meaning it already describes 10.7% of the variance of *intention_total.* The variable *credibility_total* has a negative association with *intention_total,* but the association is not statistically significant. *Effectivness_total* on the contrary, has a positive and statistically significant association with *intention_total* ($p<0.01$).

Model 2 additionally includes the variables *concern_total* and *impact_total. Concern_total* has a positive association with *intention_total* and is statistically significant at the $p<0.01$ level, whereas *impact_total* has a positive but not statistically significant association with *intention_total.* As a result, the adjusted R^2 of the model increases to 0.26.

Model 3 includes then the variables *knowledge_log* and *awareness_total* in addition to the variables of model 2. Both variables have a positive association with *intention_total,* but only *awareness_total* is slightly statistically significant ($p<0.1$). The adjusted R^2 increases to 0.285.

Model 4 additionally includes the variables *experience* and *fr_flyer.* While *experience* is statistically significant at the highest level and has a positive association with *intention_total,* the variable *fr_flyer* is only significant at the $p<0.1$ level and has a negative association with *intention_total.* The adjusted R^2 rises to 0.39.

The variables *effectiveness_total* and *concern_total* keep their positive and statistically significant association with *intention_total* until model 4. *Awareness_total,* which was only slightly significant in model 3, loses its significance level in model 4.

Focusing on the adjusted R^2 change from model to model, it becomes evident that there is a steady increase of the adjusted R^2 value meaning that the description of variance of *intention_total* is improving by adding up predictors. The change of the adjusted R^2 from model 1 to model 2 amounts to 0.16. As model 1 was already describing 10.7% of the variance of *intention_total* by implementing the variables *effectiveness_total* and *credibility_total*, model 2 already describes 26% of the variance of *intention_total* indicating that the addition of the predictors *concern_total* and *impact_total* is very significant for explaining the purchase intention of air travelers. The change of the adjusted R^2 from model 2 to model 3 then is 0.025, revealing that *knowledge_log* and *awareness_total* have only a small influence in describing the variance of *intention_total*. The variables *experience* and *fr_flyer,* which are added in model 4, are leading to a rise of the adjusted R^2 of 0.105 from model 3 to model 4. This manifests that both variables enhance the description of the variance of *intention_total* tremendously.

To further validate the fit of the overall model for predicting purchase intention and to confirm the findings of the adjusted R^2 change, an ANOVA table (Table 14) was plotted to take the F-statistic into account. The F-statistic for model .2 is 20.79, implying that adding *concern_total* and *impact_total* significantly improved the fit of the model compared to model 1. The F-statistic for model 3 is only 4.3, showing that adding *knowledge_log* and *awareness_total* improved the model slightly but still significantly. For model 4, the F-statistic is then 14.1, which is again a highly significant improvement of the model by adding *experience* and *fr_flyer.*

To test for the normal distribution of the residuals of the final model (Model 4), the Shapiro-Wilk test was applied (Judd et al., 2009). Since the p-value is greater than the commonly used alpha level of 0.05, we can fail to reject the null hypothesis that the residuals come from a normally distributed population. Therefore, we can assume that the residuals are normally distributed, indicating that the regression model is appropriate for the data.

	Res.Df	RSS	Df	Sum of Sq	F	Pr(>F)	
1	156	158.24					
2	154	129.44	2	28.8026	20.7877	1.075e-08	***
3	152	123.45	2	5.9864	4.3206	0.01498	*
4	150	103.92	2	19.5334	14.0979	2.452e-06	***

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Table 14: ANOVA table purchase intention

Prediction of attitude

To analyze the effects of the predictors mentioned in the conceptual model of this study on attitude towards carbon offsetting schemes, another stepwise hierarchical regression in blocks with two predictors added for each new model was conducted. The order in which the predictors were added to the model is equivalent to the process of the prediction of purchase intention expressing again that less known predictors are tested in a way that, if they account for attitude, it is because they have something to add on top of the more well-known variables.

	Dependent variable:			
	attitude_total			
	(1)	(2)	(3)	(4)
credibility_total	-0.249***	-0.140*	-0.134*	-0.106
	(0.081)	(0.076)	(0.076)	(0.077)
effectiveness_total	0.496***	0.404***	0.426***	0.427***
	(0.061)	(0.058)	(0.057)	(0.057)
concern_total		0.292***	0.252***	0.264***
		(0.089)	(0.088)	(0.089)
impact_total		0.166**	0.136*	0.116
		(0.080)	(0.080)	(0.080)
knowledge_log			-0.063	-0.037
			(0.177)	(0.181)
awareness_total			0.174***	0.161**
			(0.063)	(0.064)
Experience.2				0.154
				(0.122)
fr_flyer				-0.055
				(0.049)
Constant	2.598***	0.708*	0.408	0.523
	(0.266)	(0.403)	(0.408)	(0.415)
Observations	159	159	159	159
R2	0.311	0.437	0.467	0.479
Adjusted R2	0.302	0.423	0.446	0.451
Residual Std. Error	0.738 (df = 156)	0.671 (df = 154)	0.657 (df = 152)	0.655 (df = 150)
F Statistic	35.210*** (df = 2; 156)	29.909*** (df = 4; 154)	22.234*** (df = 6; 152)	17.212*** (df = 8; 150)
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 15: Stargazer attitude

The stargazer table (Table 15) reveals that model 1 has an adjusted R^2 of 0.302, meaning it already describes 30.7% of the variance of *attitude_total.* The variable *credibility_total* is negatively associated with *attitude_total* and is highly statistically significant.

Effectiveness_total then has a positive but also statistically significant association with *attitude_total* ($p<0.01$).

Model 2 additionally includes the variables *concern_total* and *impact_total. Concern_total* and *impact_total* have a positive association with *attitude_total* and are statistically significant. The adjusted R^2 of the model increases to 0.423.

Model 3 includes then the variables *knowledge_log* and *awareness_total* in addition to the variables of model 2. While *knowledge_log* is not significant and has a negative coefficient, *awareness_total* has a positive effect on *attitude_total* and is statistically significant at the $p<0.01$ level. The adjusted R^2 increases to 0.446.

Model 4 additionally includes the variables *experience* and *fr_flyer*. Both variables are not statistically significant and have a positive and a negative influence on *attitude_total,* respectively. The adjusted R^2 rises to 0.451.

The variables *effectiveness_total* and *concern_total* keep their positive and statistically significant association with *attitude_total* until model 4. *Awareness_total* loses one level of significance from model 3 to model 4, whereas *credibility_total* loses its total significance in model 4.

Focusing on the adjusted R^2 change from model to model, it becomes evident that there is a steady increase of the adjusted R^2 value meaning that the description of variance of *attitude_total* is improving by adding up predictors. The change of the adjusted R^2 from model 1 to model 2 amounts to 0.121. As model 1 was already describing 30.2% of the variance of *attitude_total* by implementing the variables *effectiveness_total* and *credibility_total*, model 2 then describes 42.3% of the variance of *attitude_total* indicating that the addition of the predictors *concern_total* and *impact_total* is again significant for explaining the attitude towards VOC of air travelers. The change of the adjusted R^2 from model 2 to model 3 is 0.023 revealing that *knowledge_log* and *awareness_total* have only a small influence in describing the variance of *attitude_total*. The variables *experience* and *fr_flyer* which are added in model 4 are leading to a rise of the adjusted R^2 of only 0.005 from model 3 to model 4. This manifests that both variables are not relevant for the description of the variance of *attitude_total*.

To further validate the overall model for predicting the attitude and to confirm the findings of the adjusted R^2 change, an ANOVA table (Table 16) was plotted to take the F-statistic into account. The F-statistic for model 2 is 18.15 implying that adding *concern_total* and

impact_total significantly improved the fit of the model compared to model 1. The F-statistic for model 3 is 4.35 showing that adding *knowledge_log* and *awareness_total* only improved the model slightly but still significantly. For model 4 the F-statistic is then 1.61 without any significance which cannot be considered as an improvement.

To test for the normal distribution of the residuals of the final model (Model 4) the Shapiro-Wilk test was applied (Judd et al., 2009). Since the p-value is greater than the commonly used alpha level of 0.05, we can fail to reject the null hypothesis that the residuals come from a normally distributed population. Therefore, we can assume that the residuals are normally distributed, which is an indication that the regression model is appropriate for the data.

	Res.Df	RSS	Df	Sum of Sq	F	Pr(>F)	
1	156	84.973					
2	154	69.409	2	15.5639	18.1532	8.705e-08	***
3	152	65.683	2	3.7261	4.3459	0.01463	*
4	150	64.302	2	1.3809	1.6106	0.20320	

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Table 16: ANOVA table attitude

Summary

Overall, one can summarize that the conceptual model is able to describe 39% of the variance of purchase intention by having an adjusted R^2 of 0.39 in the final model with all predictors being added. The change of the adjusted R^2 from model to model examines that especially models 2 and 4 are improving the prediction. The variables *effectiveness_total, concern_total* and *experience* are statistically significant and have a positive association with *intention_total* whereas *fr_flyer* is statistically significant with a negative association. The predictors credibility_total, knowledge_log, awareness_total and *impact_total* are not statistically significant.

For describing the variance of the attitude towards VCO the conceptual model can claim a percentage of 45.1% by having an adjusted R^2 of 0.451 in the final model with all predictors being added. The change of the adjusted R^2 from model to model examines that especially models 1 and 2 are improving the prediction. The variables *effectiveness_total*, *concern_total* and *awareness_total* are statistically significant with a positive association with *attitude_total*. The predictors *credibility_total, knowledge_log, impact_total, experience* and *fr_flyer* are not statistically significant.

Chapter 5: Discussion

5.1 Conclusion and comparison to literature

The purpose of this study and the corresponding research questions was to add additional understanding to what is influencing the purchase intention and the attitude of air travelers in terms of carbon offsetting programs offered by airlines since the number of consumers adhering to VCO is low and their perception of these services is still relatively unknown (chapter 1.2).

A conceptual model with in total nine predictor variables (experience, frequency of flying, environmental concern, perceived impact of flights, perceived credibility, perceived effectiveness, knowledge and awareness) and two dependent measures (purchase intention and attitude) was constituted (chapter 2.5). To test the conceptual model, survey research was conducted and two multiple hierarchical regressions were performed.

Comparing the results of chapter 4.2 with what has been found about the chosen predictors by literature (chapter 2.4) different findings are occurring: Since the predictor of former experience was not used by literature to directly determine purchase intention and attitude, this study adds new value to research in the field of VCO by revealing that it has a significant effect on purchase intention but no effect on attitude. Regarding the predictor of frequency of flying this study can confirm the findings that there is a significant effect on purchase intention although it has a negative association coming close to the results of Ritchie et al. (2021). For the prediction of attitude, the construct is not showing any effect which is providing a new insight to research.

The results for the factor of environmental concern within this study are fully confirming the claims of Choi et al. (2016) that being environmentally concerned is significantly influencing both dependent measures. Regarding the perceived impact of flights, the findings of this research surprisingly are not showing any impact on purchase intention and attitude although former studies proved a significant effect (Brouwer et al., 2008; Choi & Ritchie, 2014).

Another unexpected outcome is that the perceived credibility of the aviation industry in terms of carbon offsetting is neither significant for purchase intention nor for attitude especially as former research presented opposite findings (Gössling et al., 2007; Higham et al., 2019; B. Zhang et al., 2019a). The effect of perceived effectiveness as a predictor for purchase intention and attitude can be confirmed as statistically significant by the findings of this study and is in line with the discoveries of literature (Babakhani et al., 2017; Rotaris et al., 2020; Truong-Dinh et al., 2023).

The predictor of knowledge and awareness was found several times by literature affecting both purchase intention and attitude (Lu & Wang, 2018; Ritchie et al., 2020; Segerstedt & Grote, 2016). This research can confirm their claims only partly keeping in mind that the results of the regression only show an impact of awareness on attitude. The construct of subjective knowledge is surprisingly not significant at all for both dependent measures.

5.2 Managerial implications

Another aim of this study was to give recommendations to airlines, governments and program builders to increase the uptake of VCO since these programs carry a high potential to address the mitigation of carbon emissions within the aviation sector (chapter 1.2). In the following, the results of the two multiple regressions are interpreted to derive managerial implications.

Maximize perceived effectiveness

Since perceived effectiveness is a very significant predictor with a positive association for purchase intention and attitude it is important for airlines to increase the perceived effectiveness of their VCO programs. This can be done by showing the exact CO2 amount which is compensated by the VCO program within the booking process and what that means in practice in a non-technical discourse. Furthermore, they should explain at which point in time the emissions are compensated. To stress the effectiveness of these programs in another way airlines could reveal how many emissions are caused by the aviation sector every year and how the VCO schemes could prevent the consequences of climate change. All these information should be placed on a page before the payment options within the booking process of the airline websites. An approach that KLM, Air France and Lufthansa (chapter 2.3) are already pursuing is to further innovate in terms of VCO programs by now implementing SAF, which is even more effective in terms of reducing carbon emissions, as an alternative to classic climate protection projects.

Lock-in consumers

Having purchased a VCO option before has a very significant effect on purchase intention meaning that the probability of participating in a VCO scheme of an airline is much higher for someone who has already experience with these programs. This is very important information for the airlines since if they manage to lock in consumers in their VCO programs they are very unlikely to leave.

To fertilize the repeat purchase of VCO programs airlines should integrate the offset options always in their booking process. It would be best if institutions could manage that the offset

option is selected by default in every booking process so that people are nudged into a purchase. That way the purchasing process for the VCO would also be convenient and seamless for the consumer.

To then lock in air travelers who have bought a VCO option, the airlines could send personalized feedback to each consumer to inform them about the progress of the climate projects and the achieved reduction of emissions. This feedback should be as tangible as possible by illustrating it with concrete examples indicating what the carbon compensation contributed to the environment. Another approach could be to use a rewards and incentive system. Consumers who offset their emissions should receive discounts on future flights and get into a loyalty program.

Another nudging idea could be to put social pressure on air travelers by revealing numbers of how many consumers already have purchased a VCO option (during the booking process) so that they feel encouraged to follow the norms of society. This could be combined by using persuasive messaging and pop-up windows.

Increase environmental concern

The predictor environmental concern is statistically significant for describing purchase intention and attitude and has a positive association with both constructs from what we can conclude that people who are environmentally concerned have a much higher probability to participate in VCO programs. This gets confirmed by the data of the survey showing that people who have already participated in VCO before having a very high environmental concern (mean above the mid-point (3) of the scale). That is why airlines but in particular institutions and governments have to make people more concerned about climate change and its consequences so that they feel the need to participate in VCO. This only could work by presenting the topic frequently in the media and by educating people early and in all possible scenarios.

Treat frequent flyers

The self-perception of being a frequent flyer has an effect on purchase intention but this effect is negatively associated. From that, it could be said that frequent flyers need to be treated in a different way than occasional flyers since the more they fly the less they have an intention to participate in a VCO of an airline. Airlines should therefore reward frequent flyers with additional miles, priority boarding, class upgrades or access to lounges when they participate in a VCO program.

Rise awareness

The factor of awareness about VCO programs is only significantly influencing the attitude towards VCO. This could mean that although for this sample knowledge about VCO does not affect purchase intention there is still some need to rise and spread awareness about this possibility to create a favorable attitude towards the schemes which then could lead to a future purchase. In particular, to target occasional flyers the rise of awareness could help to increase their participation in VCO programs.

Do not waste time and money

It was not expected that the credibility of the airline industry in terms of carbon offsetting, the perceived impact of flights on the environment and the knowledge about offsetting schemes have no significant effect on purchase intention and attitude since former research found evidence for that. Concretely this means that airlines should not spend money on expensive certification programs of their VCO schemes since they are convincing air travelers only partly and are at least not a main decision criterion when it comes to the purchase intention. This could be explained if there is low credibility of the airline industry in general. Furthermore, chapter 4.1 shows that people tend to know that their flights are having an impact on the environment so airlines should not waste time and money to convince people that their flights are contributing to climate change. It is more important to show that the VCO programs are working effectively as mentioned earlier in this chapter. Lastly, it is important for airlines to know that providing detailed information and creating great education campaigns about the VCO schemes is less important than showing the effectiveness of the programs to the consumers.

5.3 Limitations and further research

The literature showed that there is research about product attributes of carbon offsetting and about certain consumer preferences and how they are affecting the purchase intention which are not included in this study since that would have exceeded the scope. These product attributes could be the type of offsetting programs, number of offsetting choices offered and the convenience and ease of purchase (Ritchie et al., 2021).

This dissertation has a focus on the more psychological side regarding carbon offsetting because of the better fit to the Thesis seminar of *Corporate Social Responsibility and Perceived Trust*. Moreover, there would have been a form of experimental research needed to access these product-related factors. In addition to that, there have been fewer studies combining all the important psychological aspects so far.

There are as well several studies about socio-demographic profiles and determinants regarding carbon offsetting and the willingness to pay / purchase intention (Ritchie et al., 2021) but a further investigation would have been again out of the scope of this dissertation.

Further limitations of this study are that the survey mostly reached younger people (students) coming from Germany and having a small monthly income indicating that the sample is not representative to display the variety of air traveler types.

Additionally, this study was not investigating whether participants of the survey have been exposed to marketing or communication strategies of VCO before which could be an interesting topic for further research. Further research then could include different kinds of marketing strategies used by airline companies and program builders so far, since this study only looks into how the VCO programs are offered on the airline websites. A marketing-related variable which might influence the purchase intention and attitude could be the price of VCO programs,

Another topic worthwhile for further research would be reviewing policy and regulatory frameworks related to VCO schemes, meaning how international agreements, governmental regulations and standards within the aviation industry might influence the future of VCO schemes and carbon emissions in the aviation sector in general.

Appendix

1. Questionnaire

Start of Block: Introduction

Thank you for participating in this survey.

My name is **Richard David Heitmann** and I am a Master student in International Management at Católica Lisbon School of Business & Economics. I would like to encourage you to complete the questionnaire below, which is an important part of the research I am conducting for my Master Thesis in the **field of carbon offsetting in air travel**. Please answer the questions as accurately and honestly as possible. Before starting please know:

(1) Your participation in this survey is **voluntary and anonymous.**
(2) There are **no right or wrong answers** and all opinions are valid and important.
(3) The survey will take approximately **5-7 minutes.**

If you have any questions or concerns regarding this survey, please feel free to contact me at: **s-rheitmann@ucp.pt**

Your help is much appreciated!

End of Block: Introduction

Start of Block: Consent Form

By clicking "Agree" I confirm that my data can be recorded and used for the indicated research purpose of this survey.

- ○ Agree (1)
- ○ Disagree (2)

End of Block: Consent Form

Start of Block: Sociodemographics

nationality Where are you from?

▼ Afghanistan (1) ... Zimbabwe (1357)

gender How do you describe yourself?

- ○ Male (1)
- ○ Female (2)
- ○ Non-binary / third gender (3)
- ○ Prefer to self-describe (4) _____
- ○ Prefer not to say (5)

age How old are you?

_____

income What was your total household income before taxes during the past 12 months in Euros?

- ○ Less than 25,000 Euros per year (1)
- ○ 25,000 - 49,999 Euros per year (2)
- ○ 50,000 - 99,999 Euros per year (3)
- ○ 100,000 - 199,999 Euros per year (4)
- ○ More than 200,000 Euros per year (5)
- ○ Prefer not to say (6)

education What is the highest level of education you have completed?

- ○ Some Primary Education (1)
- ○ Completed Primary (2)
- ○ Some Secondary Education (3)
- ○ Completed Secondary (4)
- ○ Vocational or Similar (5)
- ○ Some University but no degree (6)
- ○ University Bachelors degree (7)
- ○ Graduate or professional degree (MA, MS, MBA, PhD, JD, MD, DDS etc.) (8)
- ○ Prefer not to say (9)

occupation What best describes your employment status over the last three months?

- ○ Working full-time (1)
- ○ Working part-time (2)
- ○ Unemployed and looking for work (3)
- ○ A homemaker or stay-at-home parent (4)
- ○ Student (5)
- ○ Retired (6)
- ○ Other (7)

End of Block: Sociodemographics

Start of Block: Frequency of flying

fr_flyer To what degree do you consider yourself a frequent flyer?

	1	2	3	4	5	
	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	
Definitely not	○	○	○	○	○	Definitely yes

n_journeys Please indicate the approximate number of journeys you've made by plane in the past 12 months:

▼ 0 (0) ... 12 or more (12)

air_trav_rec Have you travelled by air in your most recent trip?

○ No (1)

○ Yes (2)

End of Block: Frequency of flying

Start of Block: Awareness & knowledge about and attitude towards carbon offsetting

Aware_1 To what degree do you consider yourself aware about carbon offsetting?

	1	2	3	4	5	
	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	
Not aware at all	○	○	○	○	○	Very aware

Aware_2 To what degree do you consider yourself aware about **voluntary** carbon offsetting?

	1	2	3	4	5	
	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	
Not aware at all	○	○	○	○	○	Very aware

Know_Att Please read the following statements and indicate your level of agreement

	1 - Strongly disagree (1)	2 (2)	3 (3)	4 (4)	5 - Strongly agree (5)
I can explain the environmental impacts caused by air transportation (Know_1)	○	○	○	○	○
I can explain where the voluntary carbon offset funds go and how the voluntary carbon offset funds will be used for (Know_2)	○	○	○	○	○
I can explain the voluntary carbon offset programs and their benefits (Know_3)	○	○	○	○	○
I know what channel can be accessed to calculate carbon emissions from air travel (Know_4)	○	○	○	○	○

I know what channel can be used to purchase carbon offsets (Know_5)	○	○	○	○	○
I like the idea of offsetting carbon emissions when I travel (Att_1)	○	○	○	○	○
I have a favorable attitude toward offsetting carbon emissions (Att_2)	○	○	○	○	○
Offsetting carbon emissions when I travel would be worthwhile (Att_3)	○	○	○	○	○
Offsetting carbon emissions when I travel would be rewarding (Att_4)	○	○	○	○	○

End of Block: Awareness & knowledge about and attitude towards carbon offsetting

Start of Block: Perceived effectiveness & credibility of carbon offsets in air travel

Eff_Cred Please read the following statements and indicate your level of agreement

	1 - Strongly disagree (1)	2 (2)	3 (3)	4 (4)	5 - Strongly agree (5)
Voluntary carbon offsets will provide a better world for me and future generations (Eff_1)	○	○	○	○	○
Voluntary carbon offsets will help people have a better quality of life (Eff_2)	○	○	○	○	○
Voluntary carbon offsets will reduce carbon emissions (Eff_3)	○	○	○	○	○
I perceive the carbon offset programs of the airline industry as a whole as transparent (Trans_1)	○	○	○	○	○
I feel well informed by the airline industry as a whole about their carbon offset programs (Trans_2)	○	○	○	○	○

I trust the airline industry as a whole with carbon offsetting (Cred_1)	○	○	○	○	○
The airline industry as a whole makes truthful claims about carbon offsetting (Cred_2)	○	○	○	○	○
The airline industry as a whole is honest about carbon offsetting (Cred_3)	○	○	○	○	○
The airline industry as a whole has a large amount of experience with carbon offsetting (Cred_4)	○	○	○	○	○
The airline industry as a whole is skilled in what they do with carbon offsetting (Cred_5)	○	○	○	○	○
The airline industry as a whole has great expertise with carbon offsetting (Cred_6)	○	○	○	○	○

End of Block: Perceived effectiveness & credibility of carbon offsets in air travel

Start of Block: Perceived climate impacts of flights and environmental concern

Impact_Concern Please read the following statements and indicate your level of agreement

	1 - Strongly disagree (1)	2 (2)	3 (3)	4 (4)	5 - Strongly agree (5)
My flights contribute to climate change (Impact_1)	○	○	○	○	○
Air travel has a harmful effect on our environment (Impact_2)	○	○	○	○	○
Air travel causes a lot of carbon emissions (Impact_3)	○	○	○	○	○
I am worried about climate change (Concern_1)	○	○	○	○	○
I am concerned that changes in environment will affect my life (Concern_2)	○	○	○	○	○
I am concerned about climate change caused by carbon emissions (Concern_3)	○	○	○	○	○

Global warming and climate change is a major concern over the next 12 months (Concern_4)	○	○	○	○	○
Global warming and climate change is a major concern over the next 5 years (Concern_5)	○	○	○	○	○

End of Block: Perceived climate impacts of flights and environmental concern

Start of Block: Past experience with carbon offsetting & future purchase intention

Experience Have you ever voluntarily participated in an airline's carbon offset program by paying a fee to offset the carbon emissions generated by your flight?

○ No (1)

○ Yes (2)

Intention Please read the following statements and indicate your level of agreement

	1 - Strongly disagree (1)	2 (2)	3 (3)	4 (4)	5 - Strongly agree (5)
I will consider buying carbon offsets when I travel in the future (Int_1)	○	○	○	○	○
I expect to purchase carbon offsets when I travel in the future (Int_2)	○	○	○	○	○
I definitely want to purchase carbon offsets when I travel in the future (Int_3)	○	○	○	○	○

End of Block: Past experience with carbon offsetting & future purchase intention

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