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Relationships between Airline Sustainability and Consumer Behaviour: An assessment of the influence of environmental awareness on the decision-making process of European airline customers

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Abstract
The aviation industry increasingly contributes to the global share of carbon emissions and therefore also to increasing global average temperatures. Although forecasts for growing emissions and solutions to decrease CO2 by aircraft usage are well described in the extant literature, the debate has failed to address how aviation passengers feel influenced in their choice as consumers. The study investigates possible relationships between civil aviation environmental sustainability, passenger environmental awareness and consumer behaviour. We use the European airline industry as a geographical focus of the study. Five hypotheses are developed related to (i) environmental awareness by airline passengers, (ii) the influence of sustainability on ticket booking behaviour, (iii) the influence of Sustainable Aviation Fuel and carbon offsetting on consumer behaviour and (iv) the influence of environmental awareness on airline image and customer satisfaction. To test the hypotheses, a survey method is used to gather data from airline passengers. The results show that environmental awareness is indeed increasing among airline passengers and as such has an influence on consumer behaviour. Our data indicates that the image of the sector is declining due to a perceived lack of urgency by the airlines. At the same time consumers are willing to pay higher ticket prices is airlines invest into sustainability. However, it is found that, although environmental awareness and concern are growing amongst aviation consumers, price is yet the most important factor that influences ticket booking behaviour and passenger satisfaction.

Keywords: Sustainability, Airlines, Consumer behaviour, Environmental awareness.
Wordcount: 236

1.0 Introduction

Environmental sustainability is a dominant topic around the world. In 1990, the first environmental assessment report by the International Panel on Climate Change (IPCC) was provided (IPCC, 2020), followed by the assembly of the United Nations Framework Convention on Climate Change (UNFCCC) – a convention joined by 197 nation-states – as a response to global climate change (UNFCCC, 2020). The aviation industry is also gradually more part of the climate-discussion, as expert reports (e.g. Lee, et al., 2009) found that emissions from airlines contribute to the rise in global average temperatures. The industry amounts to 2.4% of all human-produced CO2 emissions (M. Klöwer, 2021), although its contribution is calculated to increase (Rupcic, et al., 2023). This is due to the rapid growth of the sector, which noted an increase in passengers per year from 1.0 billion in 1990 to 4.2 billion in 2018 (The World Bank Group, 2020).

To decrease the emissions from aircraft travel, aviation became part of the EU Emissions Trading Scheme (EU ETS) in 2012 (European Commission, 2020), followed by various additional directives to improve the industry's climate performance (European Commission, 2020). Subsequently, the focus became the modelling of emissions' pattern (FitzGerald & Tol, 2007) or on factors that influence emission production in civil aviation (Brueckner & Abreu, 2017).

Following a review of the extant literature and professional reports we identified a gap in the role of environmental sustainability on airline consumers. Environmental awareness is growing among the public and has rapidly increased over the past fifteen years (Cohen, 2015), which resulted in a rising demand for

environmental-friendly businesses (Gadenne, Kennedy, & McKeiver, 2009). Han et al. (2019) describe that due to the growing level of awareness, a pattern of environmental concern is now also present among airline customers. Although it is indicated that green products and environmental awareness in general affect consumer behaviour (McDonald & Oates, 2006), the affinity between consumer behaviour and environmental awareness is not regularly applied to the airline industry. The purpose of this research, therefore, is to investigate the influence of environmental awareness and sustainability on consumer behaviour for European airline passengers. Using a quantitative research methodology we survey-targeted civil aviation executives and airline passengers. Relationships between sustainability and consumer decision-making are drawn to add to the current body of knowledge.

2.0. Theoretical basis

In general, sustainability in civil aviation is based on the fact that aircraft usage contributes to the global production of CO2 emissions. Graver et al. (2019) indicate that flights contribute 2.4% of global CO2 emissions as result of fossil fuel to power aircraft engines. Civil aviation contributes the majority of the aviation industry's carbon footprint with 81% of the total CO2 emissions. Grimme (2008), suggests a decline in emissions is possible through efficiency improvements. However, sustainability is yet more often used by airlines as part of a strategy to gain commercial advantages rather than directly address sustainable concerns (Karaman & Akman, 2018). An explanation of this profit-led paradigm is that "sustainable governance always requires companies to integrate environmental factors with economic factors" (Salvioni, Gennari, & Bosetti, 2016). Nevertheless, Walker and Cook (2009) acknowledged that the expansion of flights in the industry is outgrowing overall efficiency improvements and which increases environmental impact (negative). In addition, progress in sustainable development in the sector faces structural delays due to technical uncertainty (Peeters, Higham, Kutzner, Cohen, & Gössling, 2016).

2.1. Developments in airline sustainability

In terms of environmental development, Grimme (2008) states that aircraft efficiency can be increased by improving aircraft and engine technology, the substitution of kerosene by biofuels and the optimization of air traffic management (ATM). European Union funded research concluded that emission-based ticket taxes on all flights to and from EU-member states can also result in lower CO2 emissions (Krenek & Schratzenstaller, 2016). From these options, various authors (e.g. Dray et al., 2010) believe that substituting kerosene with Sustainable Aviation Fuel (SAF) is the most advanced possibility to decrease carbon emissions. In 2011, the European Commission (EC) launched its Biofuel Flightpath Initiative (European Commission, 2020) and since then, the total number of flights executed on SAF amount to over 250,000 (ATAG, 2020). However, EASA (2020) expects the volume of SAF to remain limited in the short term. This is due to SAF's main disadvantage; high production costs.

Looking at SAF-production methods, the International Energy Agency (IEA) (2019) stresses that currently only HEFA-produced fuels are technologically mature and therefore the preferred principal aviation biofuel. According to IATA (2019) and biofuel producers and suppliers (e.g. BP p.l.c., 2020; SkyNRG, 2020)., HEFA-type SAF achieves a reduction in emissions by up to 80%. However, Neste Oil (2020) adds that an 80% reduction can only be achieved if the HEFA-SAF is used in neat form, which, due to regulations, is not an option in the aviation industry (European Technology and Innovation Platform, 2020).

The downside of this production method is that HEFA-SAF encounters high production costs due to aircraft engines requiring only high-quality paraffinic biofuels (Chiaramonti, Prussi, Buffi, & Tacconi, 2014). As such the corresponding high production costs result in high fuel prices for airlines (Bittner, Wallace, & Zhao, 2015). Although price information is limited and kerosene prices fluctuate, the price of HEFA-fuel tends to be up to 60% higher than the price of kerosene (International Energy Agency, 2019; Energy Post, 2019). Therefore, Kim, Lee and Ahn (2019) note that the commercial transition to alternative fuel remains somehow slow, with some authors describing the market penetration of biofuels in the EU as negligible (Prussi, O'Connell, & Lonza, 2019).

3.2. Airline consumer behaviour

Not only is sustainability a type of development in the sector, it can also be a factor that influences airline consumer behaviour. Hwang and Lyu (2020) found that green image is an important predictor of positive consumer attitudes towards the desire of choosing an environmentally friendly airline. Moreover, Abdul Rashid et al. (2014) found that Environmental-CSR has a potential impact on customers' behavioural

response towards companies, with Park et al. (2015) elaborating that environmental responsibility – as well as economic and social responsibility – has a direct influence on airline customer satisfaction, which in turn shows a connection with behavioural intention. The significance of this influence is derived from a growing environmental concern among the public (Han, Yu, & Kim, 2019), causing a positive association between loyalty and social responsibility (Chen, Chang, & Lin, 2012).

However, there are more moderators of consumer behaviour in the airline industry, such as the price of a product (Dolnicar, Grabler, Grün, & Kulnig, 2011). Joseph (2020) describes that high prices are major barriers for environmental consumer behaviour and Rajaguru (2016) adds that perceived value for money and service quality are significant drivers of customer satisfaction and behavioural intention.

3.3. Consumer environmental awareness

As Han, Yu and Kim (2019) described earlier, a growing environmental concern is present among airline customers, as consumers are increasingly more aware of their impact on the environment (Yoo, Divita, & Kim, 2013). Furthermore, it is found that this type of awareness is present in multiple groups in society, regardless of factors such as level of income (Angelovska, Bilic Sotiroska, & Angelovska, 2012). In relation to growing environmental awareness, Gössling and Peeters (2009) note that to the public, the aviation industry does not seem to show a sense of seriousness regarding its contribution to global emissions. For instance, Graham and Shaw (2008) describe that European airlines with a low-cost business model do not account for the environmental damage that is caused, as this is not in line with their economic development. The level of concern among the public in relation to the climate impact of airlines in some cases even results in 'flight shame', which is derived from guilt associated with using air travel (Hasberg, 2019).

More recent research by Heikkinen (2020) elaborates that airline consumers are sceptical regarding the effectiveness of current sustainability developments, such as carbon offsetting by airlines, although he also states that people are willing to pay for flight carbon offsets, such as the usage of SAF or fuel-efficient aircraft. In addition, Kumar, Garg and Makkar (2012) found that people are willing to pay up to 20 per cent higher prices for green products in relation to non-green equivalents. However, regardless of consumer payments, Bhate (2001) states that environmental deterioration can only be halted if the environmental awareness of consumers is supplemented by governmental policies. According to Yang and Chen (2018), it is correct that the willingness of environmental investment by companies is altered by both environmental awareness and carbon taxes.

3.0. Methodology

The research philosophy is based on positivism, following best practice by other studies in the discipline (Burrell & Morgan, 2016). In addition, the paper uses a deductive approach towards the research, which develops one or more hypotheses based on existing theory (Nelson, et al., 2004; Wilson, 2014). The next paragraphs discuss a corresponding research strategy and data analysis method.

3.1. Research Strategy

To achieve the research objective, the research strategy is designed as single-method quantitative research, which incorporates a single research method to investigate the research subjects (Lewis-beck, Bryman, & Futing Liao, 2004). The quantitative approach is only a good fit with an interpretivist philosophy if the collected data is based on opinions (Saunders, Lewis, & Thornhill, 2019). Newman (2000) adds that a deductive approach, in general, fits a quantitative research strategy, as also stated by Wilson (2014). Therefore, a survey research strategy is the principal data collection method in this quantitative research. This strategy is used, as Saunders et al. (2019) state that the collected data from respondents can indicate relationships between variables. Singleton and Straits (2009) state that surveys are often used in describing human behaviour, with Ponto (2015) adding that surveys help to identify consumer patterns. The survey research strategy is executed through the distribution of questionnaires.

3.2. Questionnaire

The questionnaire is indicated as a "self-complemented internet questionnaire" (Saunders, Lewis, & Thornhill, 2019), as it is only distributed online. Furthermore, the foundation of the questionnaire is based on the research objectives and the literature review. Only closed-type questions are used, as these are indicated by Saunders et al. (2019) to decrease the completion time for respondents. In addition, the questions are divided over five topics: consumer environmental awareness, consumer ticket booking, biofuel, consumer carbon offsetting and customer experience & product quality. Within these subjects,

both multiple-choice questions and Likert-scale questions are used, which uses a level of agreement scale in five points: (1) Strongly disagree; (2) Disagree; (3) Neither agree nor disagree; (4) Agree; (5) Strongly agree" (Watson, 2010).

A data requirements table (Appendix A) is created to increase quality assurance and ensure data integrity (Smadi, et al., 2015; Saunders, Lewis, & Thornhill, 2019), which shows 30 questions, including five general questions to structure respondents. At the start of the survey, the subject of research and privacy notices from Northumbria University are stated. Furthermore, the form is perfected by performing pilot tests, which resulted in adjustments regarding the clarity of the questionnaire structure and the descriptions of terms as carbon offsetting and Sustainable Aviation Fuel.

The data sample used included air travel consumers within the European aviation industry. For this research, a person is considered a European air travel consumer if that person uses air travel one or more times per year within the EU. Consumers are structured per air travel frequency, purpose of air travel, airline preference, age and gender. In total, 200 respondents were targeted and 150 responses were gathered using a non-probability sampling technique. This includes snowball sampling (Wilson, 2014) and the use of social media platforms & messaging application WhatsApp to distribute the questionnaires.

According to Saunders et al. (2019), the collected data is only representative of the target population if the percentage of non-biased responses is over 80 per cent. As all questions are designed as mandatory in the questionnaire, it is not possible to provide a non-response and a complete response of over 80 per cent is achieved.

3.3. Data Analysis

Blaikie (2003) states that the analysis of sample data is an important process in achieving research objectives. This paper uses descriptive statistics to analyse data, which are "brief descriptive coefficients that summarize a given data set," (Kenton, 2019). Earlier, it was established that a deductive approach creates hypotheses based on current theory (Wilson, 2014). As per Glen (2020), the results of a questionnaire can be used to assess the validity of hypotheses by applying statistical hypothesis testing. It is added that this form of testing assesses relationships within sample data (Saunders, Lewis, & Thornhill, 2019) and it also is a good method for quantifying questions and answers (Brownlee, 2020). In this research, statistical hypothesis tests are performed in Microsoft Excel.

The first step in hypothesis testing is by stating a null hypothesis (H_0), which is the opposite of the research hypothesis (Johnson, 1999). Others (Helmenstine, 2020; Hayes & Westfall, 2020) add that a null hypothesis states that there is no relationship between two measured variables. Opposed to H_0 is an alternative hypothesis (H_1), describing that a relationship does exist between variables and fits better with the research hypothesis (Blaikie, 2003). As a null hypothesis can only be disproved (Johnson, 1999), null hypotheses are either rejected or failed to reject by a hypothesis test (Wilson, 2014).

The statistical tool that is used in this paper is the one-sample t-test, which "tests the null hypothesis that the mean (μ) of the population sampled is a specific value against an alternative value" (Gastwirth & Rubin, 1971). In other words, the test "determines whether the sample mean is statistically different from a known or hypothesized population mean" (Kent State University, 2020). The t-value, which is the outcome of a t-test, is compared to the critical value of the sample data to reject or fail to reject a null hypothesis. Although this is debated widely in the literature, one-sample t-tests have been justified as appropriate and sufficient for correlation analysis and to reassure evidence for the null hypotheses of no differences between two measures (Phylactou, et al, 2025; Francis and Jakicic, 2022). The outcome of a t-test is the t-statistic, which includes the following two formulae (NCSS, 2020):

$$t = \frac{\bar{x} - \mu}{\sigma\bar{x}}$$

Equation 1: Formula to calculate t-statistic value (NCSS, 2020)

$$\sigma\bar{x} = \frac{\sigma}{\sqrt{n}}$$

Equation 2: Formula to calculate standard error of mean (NCSS, 2020)

Table 1 below shows the variables that are used in the calculation of the t-statistic.

Variable	Symbol
Sample mean	$\bar{x}$
Proposed constant for the population mean	μ
Sample size	n
Sample standard deviation	σ
Standard error of mean	$\sigma_{\bar{x}}$
Degrees of Freedom	df
Significance level	α

Table 1: Variables and symbols used in t-test related formulae

According to Brownlee (2020), a null hypothesis is rejected if the t-statistic is greater than the critical value of the sample data and a test fails to reject H_0 if t-statistic is equal or smaller than the critical value. The critical value of t is depending on the degrees of freedom (n-1) and the level of significance (Glen, 2020). Brownlee (2020) also indicates that a hypothesis can be rejected if the p-value is lower than the level of significance. The p-value "determines the probability of observing a more extreme test statistic in the direction of the alternative hypothesis" (The Pennsylvania State University, 2020). In addition, it is indicated that "the smaller the p-value, the stronger the evidence that the null hypothesis should be rejected" (Glen, 2020). Following the literature, two formulae are used to reject H_0:

- Reject H0 if t-statistic > critical value
- Reject H0 if p-value < α

To perform a statistical test, the sample data from the surveys are transformed. As per Frost (2020), the numerical coefficient of Likert scale data ascends from 1 (strongly disagree) to 2 (disagree), 3 (neutral), 4 (agree) and 5 (strongly agree). Furthermore, the proposed constant for the population mean and the level of significance maintain fixed values, as well as the null hypothesis and alternative hypothesis of all research hypotheses. A significance level of 0.05 is a desired value for academic research (Yale University, 2020; Lund Research, 2020), which is also used in this dissertation. Furthermore, the proposed constant for the population mean is set at 3, which is the mean of the five possible numerical Likert-scale answers in the questionnaire. Therefore, the null hypothesis and alternative for all research hypotheses are:

Hypotheses	
Null hypothesis (H0)	$\mu \leq 3.00$
Alternative hypothesis (H1)	$\mu > 3.00$

Table 2: The null hypothesis and alternative hypothesis for hypotheses testing

3.4. Hypotheses

Five research hypotheses are derived from the literature review and respectively correspond to the five questionnaire subjects earlier in the methodology. As indicated by Johnson (1999), a null hypothesis is the opposite of a research hypothesis and "states that there is no relationship between two measured variables" (e.g. Helmenstine, 2020). As a result, the five null hypotheses to be tested with corresponding alternative hypotheses are shown in Table 3.

Hypotheses 1-5	
$H1_0$	European airline consumers think that there is no relationship between increasing airline emissions and rising global average temperatures
$H2_0$	There is no relationship between environmental ticket-booking factors, such as flight taxes and ecolabels, and the behavioural intention of consumers to book a flight ticket
$H3_0$	There is no relationship between the behavioural intention of consumers to pay a higher price for a flight ticket and the use of biofuel instead of kerosene by airlines
$H4_0$	There is no relationship between the behavioural intention of consumers to pay a higher price for a flight ticket and the applicant of carbon offsetting options on flight tickets
$H5_0$	There is no relationship between growing environmental awareness among European airline consumers and the image & quality perception of airlines

Table 3: The null hypotheses used for hypothesis testing

3.5. Conceptual Framework

An expectation of the research findings is derived from the literature review and is expressed through a conceptual framework (Figure 1), which is used "to explain the relationships between the main variables in the study" (Adom, Hussein, & Agyem, 2018). The variables describe the relationship between 'Environmental Sustainability Factors' and 'Airline Consumer Behavioural Intention'. It is expected that the influence of sustainability factors on consumer behaviour is positively moderated by consumer environmental awareness and is negatively moderated by non-environmental factors such as ticket price. Furthermore, it is expected that the research finds that customer satisfaction and airline image are both mediating variables with a positive effect on the environmental sustainability-consumer behaviour relationship.

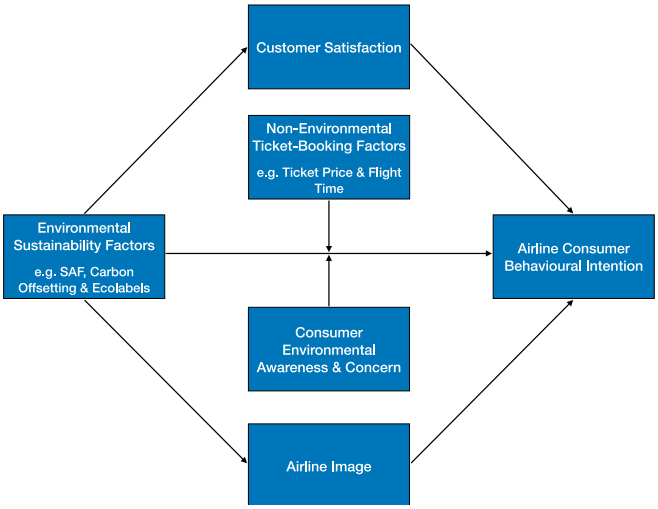

Figure 1: Conceptual framework of research variables from theory & literature review

4.0. Results

The results from research are elaborated upon in two sections; the survey results and the results from hypothesis testing.

4.1. Survey Results

The methodology describes five questionnaire subjects, which respectively correspond to the five research hypotheses. The survey results are first provided according to these subjects, which are:

1) Environmental awareness
2) Environmental sustainability during ticket booking
3) Sustainable Aviation Fuel
4) Carbon offsetting
5) Influence of sustainability on customer satisfaction and airline image

Environmental Awareness

Q1: Statement: Carbon emissions contribute to rising global average temperatures.
Q2: Statement: Environmental awareness is growing among the general public.
Q3: Statement: Airlines contribute to the increase of global carbon emissions and therefore the rising global average temperatures.
Q4: Statement: Airlines understand the seriousness of rising global average temperatures and carbon emissions
Q5: Statement: The development of greener aviation is progressing fast enough

Answers	Question 1	Question 2	Question 3	Question 4	Question 5
Strongly Agree (%)	39%	23%	26%	7%	3%
Agree (%)	44%	59%	53%	40%	10%
Neutral/Not Sure (%)	13%	13%	14%	33%	30%
Disagree (%)	3%	5%	6%	18%	43%
Strongly Disagree (%)	1%	1%	1%	2%	15%
Total (%)	100%	100%	100%	100%	100%

Table 4: Answers to survey questions 1-5 (%)

Environmental Sustainability during Ticket Booking

Q6: What factors are important to you when booking a ticket? (multiple answers possible)
Q7: If an airline is known for its contribution to environmental sustainability, would that affect your decision to book a ticket with them?
Q8: If tickets would have product ecolabels, would this influence your choice of ticket?
Q9: Statement: Implementing ticket taxes would decrease airline carbon emissions.
Q10: Statement: Flight tax should be added to flight tickets.

Answers	Question 6 (nr.)	Question 6 (%)
Ticket price	138	92%
Airline preference	65	43%
Airline image	35	23%
Service quality	71	47%
Previous experiences	91	61%
Amenities included in your ticket	22	15%
Sustainability of airlines	22	15%
Flight time/layover or direct flight	113	75%

Table 5: Answers to survey questions 6

Answers	Question 7	Question 8	Questions 9	Question 10
Strongly Disagree (%)	n/a	n/a	10%	10%
Disagree / No (%)	23%	27%	23%	15%
Neutral / Not sure (%)	8%	7%	31%	23%
Agree / Yes, but not significantly (%)	54%	48%	27%	33%
Strongly Agree / Yes, significantly (%)	15%	18%	9%	19%
Total (nr.)	100%	100%	100%	100%

Table 6: Answers to survey questions 7-10 (%)

Sustainable Aviation Fuel

Q11: Did you know that biofuel emits up to 80 per cent less CO2 compared to the current jet kerosene?
Q12: Did you know that airlines are already using biofuel on some flights?
Q13: Statement: Biofuel fuel should be used more often by airlines.
Q14: Are you willing to pay a higher ticket price if a flight uses biofuel instead of kerosene?
Q15: Would you choose an airline because it uses more biofuel than other airlines do?

Answers	Question 11	Question 12	Question 13	Question 14	Question 15
No, I do not believe it / Strongly Disagree	6%	n/a	3%	n/a	n/a
No, I did not know before / No / Disagree	63%	49%	1%	19%	29%
Neutral / Not sure	6%	8%	15%	9%	25%
Yes (Q1,2,5) / Yes, but up to 10% higher / Agree	n/a	43%	43%	49%	47%
Strongly Agree / Yes (Q4)	25%	n/a	39%	23%	n/a
Total	100%	100%	100%	100%	100%

Table 7: Answers to survey questions 11-15 (%)

Carbon Offsetting

Q16: Do you use carbon offsetting options when booking a ticket?
Q17: Statement: Letting consumers pay for carbon offsetting is an effective method in decreasing airline emissions.
Q18: Do you think paying for carbon offsetting should be voluntary or mandatory for customers?
Q19: Are you willing to pay a higher ticket price if mandatory carbon offsetting is included?

Q20: Would you be more willing to pay for carbon offsetting if you know how your payment is used by airlines?

Answers	Question 16	Question 17	Question 18	Question 19	Question 20
Strongly Disagree (%)	n/a	11%	n/a	n/a	n/a
Disagree / No / Voluntary (%)	61%	24%	38%	26%	10%
Neutral / Not sure (%)	11%	37%	15%	5%	21%
Agree / Yes, Sometimes / Mandatory / Yes, but up to 10% higher / Yes (Q5) (%)	19%	22%	47%	49%	69%
Strongly Agree / Yes, Always / Yes (Q4) (%)	9%	6%	n/a	20%	n/a
Total (%)	100%	100%	100%	100%	100%

Table 8: Answers to survey questions 16-20 (%)

Influence of Sustainability on customer satisfaction and airline image

Q21: Statement: Environmental Sustainability by airlines has an influence on my customer satisfaction.
Q22: Statement: The price of a flight ticket has an influence on my customer satisfaction.
Q23: Statement: I believe airlines that claim to run a CO2 neutral operation.
Q24: Statement: The image of airlines is decreasing because of growing environmental awareness.
Q25: Statement: I experience a feeling of guilt in taking a flight.

Answers	Question 21	Question 22	Question 23	Question 24	Question 25
Strongly Agree (%)	10%	28%	1%	11%	6%
Agree (%)	39%	62%	18%	48%	20%
Neutral/Not Sure (%)	30%	9%	30%	20%	18%
Disagree (%)	17%	1%	40%	20%	38%
Strongly Disagree (%)	5%	1%	11%	1%	18%
Total (%)	100%	100%	100%	100%	100%

Table 9: Answers to survey questions 21-25 (%)

4.2. Hypothesis Testing Results

The research methodology describes that the indicated hypotheses are tested by performing statistical t-tests. The data used to perform these tests is derived from the survey results and are divided per questionnaire subject/hypothesis. However, not every question within a subject is applicable to the corresponding hypothesis. Therefore, the count (n) used to calculate the t-statistic varies per hypothesis.

As seen in the hypotheses testing dataset in Table 10, Hypotheses 1 & 4 use the answers of all questions, accumulating of a total count (n) of 750 each. The second and fifth hypothesis both use a count of 600, as respondents were able to provide multiple answers to question 6 and the topic of question 22 does not comply with the topic of the last hypothesis. The lowest count is used for Hypothesis 3, because the first two questions only tested the knowledge of the respondents and answers are therefore left out of the dataset.

Hypothesis	Coefficient	Data measurement detail	Answers (Nr.)
Hypothesis 1	1	Strongly Disagree	28
	2	Disagree	112
	3	Neutral	153
	4	Agree	310
	5	Strongly Agree	147
	Count (n)	**Total**	**750**
Hypothesis 2	1	Strongly Disagree	42
	2	Disagree / No	131
	3	Neutral / Not sure	104
	4	Agree / Yes, but not significantly	244
	5	Strongly Agree / Yes, significantly	79
	Count (n)	**Total**	**600**
Hypothesis 3	1	Strongly Disagree	4
	2	Disagree / No	72
	3	Neutral / Not sure	74
	4	Agree / Yes, but up to 10% higher / Yes (Q5)	207
	5	Strongly Agree / Yes (Q4)	93
	Count (n)	**Total**	**450**
Hypothesis 4	1	Strongly Disagree	16
	2	Disagree / No / Voluntary	239
	3	Neutral / Not sure	135
	4	Agree / Yes, Sometimes / Mandatory / Yes, but up to 10% higher / Yes (Q5)	308
	5	Strongly Agree / Yes, Always / Yes (Q4)	52
	Count (n)	**Total**	**750**
Hypothesis 5	1	Strongly Disagree	53
	2	Disagree	172
	3	Neutral	147
	4	Agree	187
	5	Strongly Agree	41
	Count (n)	**Total**	**600**

Table 10: Dataset per hypothesis for hypothesis testing

Using the sample data in Table 10 and the formulae indicated earlier in the methodology, the t-tests and hypothesis tests for the five hypotheses are performed in Microsoft Excel. The outcome and values off all tests are described in Table 11 below.

	Hypothesis Test 1	Hypothesis Test 2	Hypothesis Test 3	Hypothesis Test 4	Hypothesis Test 5
Null hypothesis (H0)	$\mu <= 3.00$	$\mu <= 3.00$	$\mu <= 3.00$	$\mu <= 3.00$	$\mu <= 3.00$
Alternative hypothesis (H1)	$\mu > 3.00$	$\mu > 3.00$	$\mu > 3.00$	$\mu > 3.00$	$\mu > 3.00$
Mean ($\bar{x}$)	3.58	3.31	3.70	3.19	2.99
Standard deviation (σ)	1.08	1.16	1.00	1.03	1.11
Count (n)	750.00	600.00	450.00	750.00	600.00
Standard error of mean ($\sigma\bar{x}$)	0.04	0.05	0.05	0.04	0.05
Degrees of freedom (df)	749.00	599.00	449.00	749.00	599.00
Hypothesized mean (μ)	3.00	3.00	3.00	3.00	3.00
Significance level (α)	0.05	0.05	0.05	0.05	0.05
t Critical one-tail	-1.65	-1.65	-1.65	-1.65	-1.65
t-Statistic	14.78	6.60	14.75	5.01	-0.33
p-Value	6.90E-44	4.45E-11	9.82E-41	3.48E-07	0.37
Reject H0 if t-statistic > t critical	**Rejected**	**Rejected**	**Rejected**	**Rejected**	**Rejected**
Reject H0 if p-value < α	**Rejected**	**Rejected**	**Rejected**	**Rejected**	**Failed to reject**

Table 11: t-Test and hypothesis test corresponding to the five null hypotheses

As seen in the t-tests above (Table 11), the t-statistical values of all five hypothesis tests are higher than the respective t-critical values. According to the data analysis methodology described earlier (e.g. Brownlee, 2020), this means that each null hypothesis can be rejected and that relationships between variables are present. However, the methodology also describes the use of the p-value to reject or fail to reject a hypothesis. Looking at these values, it is noted that not every null hypothesis can be rejected, as the p-value of H5 is higher than significance level. Because of this difference, it can be concluded that relationships are present between variables, but also that this relationship is not significant. Therefore, null hypothesis 5 cannot be rejected. An overview of the five hypothesis tests performed in this chapter is provided in Table 12 below.

Conclusion of Hypotheses Testing	
H1	European airline consumers think that there is a significant relationship between increasing airline emissions and rising global average temperatures
H2	There is a significant relationship between environmental ticket-booking factors, such as flight taxes and ecolabels, and the behavioural intention of consumers to book a flight ticket
H3	There is a significant relationship between the behavioural intention of consumers to pay a higher price for a flight ticket and the use of biofuel instead of kerosene by airlines
H4	There is a significant relationship between the behavioural intention of consumers to pay a higher price for a flight ticket and the applicant of carbon offsetting options on flight tickets
H5	There is no relationship between growing environmental awareness among European airline consumers and the image & quality perception of airlines

Table 12: Conclusion from five hypothesis tests

5.0. Discussion

The findings of the research are discussed by the key findings from the survey results and the hypotheses testing and are compared with the literature review. Both the questionnaire and the research hypotheses are structured according to the five main subjects. In accordance with these subjects, five key statements are made, starting with environmental awareness among consumers in the European airline industry.

Environmental awareness is present among airline consumers

Hypotheses testing statistically proved that European airline consumers think that increasing airline emissions correlate to rising global average temperatures. Researchers (Owen, Lee, & Lim, 2010; Graver, Zhang, & Rutherford, 2019) earlier indicated that CO_2 emissions from airlines increasingly contribute to rising global average temperatures. The questionnaire, moreover, showed that 83 per cent of the respondents (strongly) agree that carbon emissions contribute to rising global average temperatures and 79 per cent (strongly) agrees with the contribution of airlines. A vast majority of the respondents (82 per cent), on the other hand, also (strongly) agrees that environmental awareness is growing among the public, which confirms statements by various authors (Yoo, Divita, & Kim, 2013; Han, Yu, & Kim, 2019). However, less than 50 per cent of the sample believes that airlines share this environmental awareness and only few people (13 per cent) think that sustainable development in aviation is progressing fast enough. These findings confirm statements (Gössling & Peeters, 2009) that the aviation industry does not seem to recognise a sense of environmental importance. However, as 33 and respectively 30 per cent of the people remained neutral, it is possible that the sample did not have enough knowledge to make an informed decision (TalentMap, 2020), which could be solved by environmental education (Zsóka, Szerényi, Széchy, & Kocsis, 2013).

Sustainable ticket booking factors influence behavioural intentions

Applying environmental awareness to airline products, relationships between environmental ticket booking factors and consumer behavioural intention to purchase tickets were statistically demonstrated. However, the level of influence of sustainability is debatable. Although it was described that green image has a positive effect on consumers' attitudes (Hwang & Lyu, 2020), the questionnaire showed that only 22 respondents marked sustainability in general as an important factor to book a ticket. To put this in contrast, 138 people marked price as an important influencer, followed by flight time. Although price seems to be rated much more highly, as reported earlier (e.g. Dolnicar et al. , 2011), 69 per cent of the respondents did also (strongly) agree that sustainability by airlines does have an influence. On the other hand, people are not sure about the application of flight taxes on tickets. Although reports state that taxes can decrease aviation emissions (e.g. Krenek & Schratzenstaller, 2016), people largely answered 'not sure' when provided a comparable

statement and only 52 per cent think that taxes should be implemented. Although people are unsure and might need additional environmental education (Zsóka et al. , 2013), this again shows that people share an environmental concern and want aviation to take actions. However, it also shows that the level of influence of sustainability on customers is different per specific ticket booking factor.

Airline consumers value the possibility of biofuel use by airlines

The environmental awareness among the public is also resembled in relation to the use of Sustainable Aviation Fuel by airlines. According to the corresponding hypothesis test, relationships are present between the intention to pay a higher ticket price and the use of SAF. Reports agree that SAF can emit up to 80 per cent less CO_2 than kerosene (SkyNRG, 2020), which is a statistic that the respondents (63 per cent) were unaware of. In relation to the earlier indicated environmental concern of the sample, 81 per cent of the people think that alternative fuel should be used more often by airlines. However, the fact that respondents believe that airlines should use SAF more often does not mean that the use of biofuel positively influences consumers' decision to book a ticket. Zeng et al. (2019), describe that environmental awareness by companies can be perceived by consumers as taking environmental responsibility. The very high benefits of 80 per cent less CO_2 in combination with a growing public environmental concern could trigger the valuation of SAF-use as a necessity rather than it being an amenity.

Nevertheless, people are still willing to pay higher prices to compensate for the high cost of production of SAF (e.g. International Energy Agency, 2019). Kumar, Garg and Makkar (2012) indicated that consumers are willing to pay up to 20 per cent higher prices for green products, but only 26 per cent of the respondents agree with that statement. A majority of 54 per cent states to be willing to pay higher ticket prices, but only up to 10 per cent higher. Here, it shows that the environmental concern of the people is weighed up against the earlier measured differences in importance in favour of ticket price against sustainability.

Airline consumers in theory value transparent carbon offsetting

Carbon offsetting practices by airlines are a method to decrease emissions in relation comparable to the use of SAF. However, the respondents are less convinced of the current effectiveness of the method. Statistically, tests described relationships between the intention to pay higher ticket prices for a ticket with carbon offsetting, but this is dependent on different aspects. First of all, people largely indicated to not use carbon offsetting options during ticket booking and also do not think that it is an effective method to decrease emissions, which was also described in the literature review earlier by Heikkinen (2020).

However, Heikkinen (2020) also elaborated that customers would be willing to pay higher ticket prices to offset the carbon of a flight. The survey results showed that 49 per cent of the respondents are willing to pay higher prices up to 10 per cent higher and that 20 per cent would be willing to pay over 10 per cent higher prices. Once again, this statistic resembles the environmental awareness and concern that was noted earlier. Moreover, as a solution to the current low number of customers that use carbon offsetting, 69 per cent of the people stated to be more willing to pay for carbon offsetting options if it is known how the payments are used by airlines. This way, the consumers' scepticism towards airlines' investment in environmental sustainability, as reported by Gössling and Peeters (2009), can be decreased.

Environmental Awareness does not significantly alter image and quality

The last research hypothesis proved to be interesting, as tests could not find significant relationships between environmental awareness and the image and quality perception of airlines, although it did state that relationships could be present. First, the differences in importance to consumers between price and sustainability were noted again, as 48 per cent of the respondents stated that customer satisfaction is affected by sustainability and 90 per cent indicated that this was influenced by price. Although Park et al. (2015) described that satisfaction is affected by (the lack of) environmental sustainability, only a minority of the respondents agrees with that statement. The latter could also relate to consumers' scepticism towards airlines, as only 19 per cent of the people (strongly) agree to believe airlines that claim to be CO_2 neutral.

The image of airlines, on the other hand, is affected more heavily by environmental awareness than by customer satisfaction. Almost 60 per cent of the people think the image of aviation is decreased by environmental awareness, which relates to the demonstrated growing public environmental concern. However, the image is not as bad that the majority of the people associates flying with a sense of guilt or "flight shame" (Hasberg, 2019). Only 16 per cent of the respondents agree to feel a sense of guilt, with a fast majority disagreeing with the statement. The results of this questionnaire subject do not elaborate that both airline image and quality perception are decreased by environmental awareness. Respondents are

found to primarily believe that image is decreased by awareness, but that customer satisfaction is mainly affected by factors such as price. Therefore, as only one of two aspects of the hypothesis could be proven, significant relationships could not be determined by the statistical test.

6.0. Conclusion

Respondents were provided with a questionnaire that was structured according to five subjects – environmental awareness, ticket booking, SAF, carbon offsetting and consumer satisfaction & airline image – corresponding to the five research hypotheses. The relationships between variables in the five research hypotheses are tested using a statistical t-test. It is concluded that environmental awareness is present among airline consumers. A vast majority of the respondents of the questionnaire (strongly) agree that emissions cause global average temperatures to increase (83 per cent) and that airlines are contributing to this problem (79 per cent). Moreover, people do not agree that airlines understand the seriousness of climate change, which is in line with statements by Gössling and Peeters (2009).

Furthermore, environmental ticket booking factors are regarded by respondents to influence their ticket booking behaviour, but it is not the most important factor. For instance, 92 per cent of the sample indicate price as an important factor, with only 15 per cent marking sustainability. Therefore, it is concluded that there is a relationship between sustainability and consumer ticket booking behaviour, but also that other factors are more important to consumers. The level of significance, however, is based on the type of sustainable factor, as the research found that consumers prefer the application of ecolabels over fight ticket taxes.

The results to the hypotheses related to SAF and carbon offsetting showed similarities in the results from the questionnaire. After receiving information on the environmental benefits of SAF, a majority of the respondents (strongly) agreed that airlines should use biofuel more often and that they would pay a higher ticket price for the use of SAF. Carbon offsetting, on the other hand, received a similar response regarding additional payments. However, respondents also largely stated to not use and not believe in the effectiveness of carbon offsetting. The latter form of trust can be increased, as noted by the people, if airlines are clearer about the use of additional consumer payments. Moreover, the majority also indicated to be willing to pay a maximum additional amount of 10 per cent of the ticket price, which is different than the 20 per cent as described by the literature. It is concluded that a present environmental awareness, as determined earlier, is resembled in the willingness of consumers to pay a higher ticket price if airlines use SAF or carbon offsetting, but that the level of willingness is depending on the level of trust in airlines to use additional customer payments for the development of environmental sustainability.

The only relationship from the research hypotheses that is not proven as significant, is the relationship between environmental awareness and the image and quality of airlines. The literature elaborated that the image of the industry is decreasing because of environmental awareness, of which 59 per cent of the respondents (strongly) agree with. However, consumers also indicate that price is more important to influence customer satisfaction than environmental sustainability, which was also found in earlier results. Moreover, it is also indicated that people do not trust airlines that claim to take environmental responsibility. These results conclude that the relationship between both the image and quality perception of airlines and environmental awareness is not significant, as respondents value price over sustainability in terms of customer satisfaction. However, it is also concluded that image itself is affected by environmental awareness.

6.1. Conclusion Overview

The objective of this paper was to identify and assess relationships between consumer behaviour and environmental awareness & sustainability from the perspective of European airline consumers using quantitative research. An overview of the conclusion to the research objective is provided in Table 13 below.

Conclusion Overview
Environmental *concern* and awareness are increasingly present among European Airline consumers.
The price of a ticket is the most important factor to influence consumer behaviour, although consumers do value environmental sustainability by airlines.
Consumers are willing to pay higher ticket prices for the use of sustainable aviation fuel and carbon offsetting options by airlines, although the level of willingness is affected by the level of trust in an airline.
The image of airlines is decreasing due to increasing environmental awareness, but this does not significantly influence customer satisfaction regarding airlines.

Table 13: Overview and summary of the research conclusion

6.2. Recommendations to Aviation Industry

In the research, three components influence the conclusion: environmental awareness, environmental sustainability and ticket price. A combination of the three can be used to provide solutions to the industry regarding sustainable development. It is recommended to the industry to install a flight ticket tax on all flights from and to Europe to a maximum of 10 per cent of the ticket price. As the research found, the production of SAF is more expensive than kerosene. The income from ticket taxes can be used by the European Commission to subsidize sustainable fuel production, which decreases the utilization costs for airlines. Therefore, it becomes more economically attractive for airlines to use, increasing SAF-utilization and decreasing aviation emissions. Figure 3 below shows an ongoing development cycle corresponding to this recommendation.

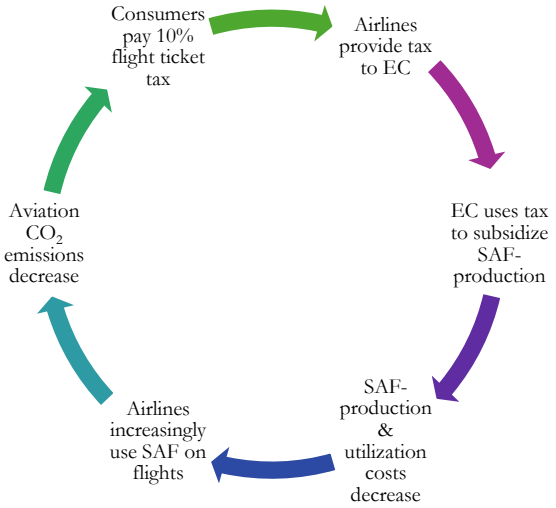

Figure 2: Recommended SAF-development cycle in aviation

However, to make the additional payment attractive to the consumer, it is recommended to provide more clarity on the sustainable developments that are made in the industry. People need to be informed on the use of the additional ticket tax, and the EC needs to provide information on the development of SAF-use.

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