Air Travellers' Willingness to Pay for a Sustainable Offer: A Discrete Choice Experiment

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Master Thesis in Innovation Sciences

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ABSTRACT

Growing air travel demand requires for new sustainable solutions to be embraced by all players of the industry, including individual travellers. Due to the low adoption rates recorded for current voluntary carbon offset solutions, the level of success of sustainable aviation fuel (SAF) among travellers is difficult to predict, despite its potential to reduce up to 80% CO_2 emissions. Additionally, few studies address the large gap between individuals' attitude and behavior towards sustainability when travelling by air. Insights on 563 Dutch individuals' preferences were obtained from a survey, by integrating a Discrete Choice Experiment into the Motivation-Opportunity-Ability model. The MOA model helped conceptualize air travellers' consumption behavior, which in combination with DCE, allowed to determine individuals' preferences based on choices they made. Moreover, this framework integration gave the possibility for individuals to be exposed to realistic scenario derived from their personal booking experience. A conditional logit model was used to describe the relative influence of factors, looking at their estimates and significance. Results show that a sustainable option's price is the most influential factor for its adoption. The time efficiency provided by sustainable aviation fuel relative to 'tree planting' solutions also influenced the outcome. Regarding individual characteristics, air travellers' level of motivation towards taking sustainable action positively influenced their choice, however their financial abilities had no effect. Other respondent characteristics such as gender, previous compensation behavior and flight time also influenced the probability to choose a SAF option. We argue that the most influential factors contributing to the increase in probability SAF adoption should be considered when marketing a SAF product in order to trigger behavioral change.

Keywords: discrete choice experiment, MOA model, sustainable aviation fuel, behavioral change

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Content

1. INTRODUCTION

Scientists agree that the acceleration of global warming is linked to considerable amounts of greenhouse gas (GHG) emissions induced by human activity, for which aviation is a major contributor (MacKerron et al., 2009). It was reported that 2% of global human-induced emissions are directly caused by aviation (ATAG, 2017; Brouwer et al., 2008). Despite airlines' current efforts to reduce emissions, total emissions increased by 5.2% between 2018 and 2019 (Becken & Pant, 2019). With a predicted annual growth of 4% in air travel demand, absolute CO_2 emissions are not likely to be reduced as hoped (Noh et al., 2016). Therefore, airlines must take additional measures in order to reach the 'zero emissions by 2050' target set by the Intercontinental Panel for Climate Change (IPCC, 2018).

In response to these alarming observations, airlines have begun to implement voluntary carbon offset (VCO) offers, which are now available on most commercial airlines (Becken & Mackey, 2017; Gössling et al., 2007). Such offers consist in giving the opportunity for air travellers to voluntarily pay to compensate for their contribution to CO_2 emissions by 'neutralizing' them. The funds collected from these types of offers usually go to reforestation projects, such as planting trees in Nicaragua with Lufthansa or local wildlife protection with Qantas Airlines (Blasch & Farsi, 2014; Cheung et al., 2015). Despite the promising appeal of 'flying CO_2 neutral', reports show that among the 34 million passengers who traveled with KLM in 2018, only 2% purchased this offer, which resulted in a compensation of only 0.1% of total emissions (Brouwer et al., 2008).

VCO studies suggest that reasons for such results are linked to the lack of transparency and credibility from companies offering VCOs (Gössling & Peeters, 2007; Mair, 2011). From a social marketing viewpoint, the lack of awareness or conviction from travellers about the impacts of aviation on the environment may play a crucial role in their behavior in the context of Motivation-Opportunity-Ability model (Cheung et al., 2015; Maclnnis et al., 1991). Studies show that many travellers who purchase VCO offers do it more out of guilt than for environmental reasons and are not necessarily the most knowledgeable about the impact of aviation on climate change (Mair, 2011). Mair (2011) shows that 87.3% of travellers who are intrinsically inclined to behave more sustainably based on their beliefs do not choose to purchase them. Bindu (2013) and Babakhani et al. (2017) also observe a large gap between people's attitude towards environmental issues, and the lack of action related to it. Travellers' willingness to pay (WTP) also varies according to the type of project and its location; renewable energy projects seem to be more appealing, and local projects are preferred over ones overseas (Cheung et al., 2015).

In the last decade, airlines have been testing sustainable aviation fuel (SAF). If used, SAF could reduce up to 80% of CO_2 emissions, however SAF market prices are two to three times higher than regular jet fuel prices, which keeps airlines from fully subsidizing it. Currently, very few airlines offer air travellers the possibility to purchase SAF for their flight, which is likely to change within the next years. Due to the unpopularity of offsetting offers, it is difficult to determine how air travellers would react to a new type of sustainable offer. To date, there are no studies that examine customers' preferences towards a SAF offer relative to a VCO offer, which leads to the following question:

What factors influence air travellers' willingness to choose sustainable aviation fuel?

We will answer this question by performing a Discrete Choice Experiment towards Dutch air travellers who recently performed a booking online, after which the relative importance of these factors will be determined. The Motivation-Opportunity-Ability model will be incorporated to understand why travellers perceive these factors as more or less important.

In light of the global COVID-19 pandemic, the Dutch government pledged to provide financial aid to KLM provided visible sustainable efforts are made ("Kabinet zet financiële steun klaar voor KLM", 2020). This study would greatly contribute towards obtaining detectible results, proving that the airline is pursuing sustainable efforts efficiently. Understanding customer's attitude and behavior towards sustainable offers would reveal opportunities for exploiting the purchasing power of customers who are environmentally conscious and in demand (Gössling et al., 2009; Mair, 2011). If successful, this study would also inform airlines about appropriate offers that would encourage air travellers to make sustainable purchases, and thus help shape sustainable behavior. More generally, the study contributes greatly to society as a whole, since it can provide additional support to current global efforts towards reducing CO_2 emissions and reaching the 2050 target (IPCC, 2018).

Traditionally used to influence individual behavioral change, social marketing applications expand to contexts in which individuals face changes in their environment, to address broad issues such as climate change (Tweneboah-Koduah et al., 2020). The MOA model serves as a comprehensive tool to deal with complex issues involving behavioral change that have yet to be scrutinized in scientific literature (Thøgersen, 1995; Tweneboah-Koduah et al., 2020).
The study would uncover customer behavior towards biofuel, a technology that may be perceived as somewhat abstract or complex to the general public and has limited literature due to its recent appearance in the aviation industry.
Most of the studies regarding sustainable aviation give recommendations to policy makers, and point to the fact that educating air travellers about the negative impacts of aviation should be prioritized (Lu & Wang, 2018). To the best of our knowledge, little to no studies place the focus on the customer, nor has there been any attempts to discover why certain purchasing behaviors occur and how they can be changed, particularly for individuals whose habits are inconsistent with their environmental attitude. In this research, we would overcome this knowledge gap by integrating the DCE within the MOA model, which would allow to explore how travellers' stance on climate change may affect their purchasing behavior and the extent to which travellers with the necessary knowledge and awareness can adopt a sustainable travelling behavior. The following section of this paper elaborates on a framework that conceptualizes customer preferences. Section three discusses the research methodology utilized to tackle the research question.

2. THEORY

2.1. Sustainable aviation

Aviation emissions have contributed greatly to the growth of the VCO market (MacKerron et al., 2009). VCO projects present large differences in the way they are administered and operated (Gillenwater et al., 2007).
In this study, we choose to use tree planting as our reference - which we also refer to as reforestation - as it is the most commonly observed and established sustainable activity in the airline industry. Reforestation activities have been subject to criticism for their impracticality, counter productiveness, and used as an excuse for institutions to evade responsibility (Gillenwater et al., 2007; MacKerron et al., 2009). Notably, Gillenwater et al. (2007) and Monbiot (2006) point out the impermanence and emission efficiency issues observed in such projects, often discounted by VCO sellers.
In contrast, biofuel - i.e. sustainable aviation fuel (SAF) - has emerged as a new type of project within the VCO market, showing great potential to reduce CO_2 emissions massively. Biofuel can reduce between 30% and 90% life-cycle CO_2 emissions relative to fossil fuel depending on the feedstock it originates from, i.e. recycled cooking oil, algae, sugar and many other renewable sources (Noh et al., 2016). The perceived lack of support from governments and uncertainty about the true reduction of respective life-cycle emissions are some of the main obstacles to address in the commercialization of biofuel (Gegg et al., 2015). Biofuel production volumes currently cover less than 1% of total jet fuel demand, however experts predict that biofuel could represent around 5% of jet fuel consumption share by 2024 (Sgouridis et al., 2011). Its availability gives rise to new marketing opportunities, that when tested, can help clarify reasons for the low VCO adoption rates currently observed. In the next section, we discuss how customer behavior can be analyzed under these circumstances.

2.2. Motivation-Opportunity-Ability model

Initially used by Maclnnis et al. (1991), the model conceptualizes consumer behavior based on three determinants: motivation, opportunity and ability (MOA). The framework was successfully applied in various studies dealing with individuals' travel intentions (Hung & Petrick, 2016) sustainable behavior (Thøgersen, 1995) and sustainable consumptions (Ukenna & Nkamnebe, 2017) to address behavioral change. Not only does our study also concern sustainable consumption, but the model applies when institutional efforts towards changing individual behavior are deemed ineffective (Tweneboah-Koduah et al., 2020). The behavioral gap and low sustainable consumption rates observed among travellers implies that there is a lack of effectiveness in the sustainable offers currently marketed, which can be addressed using the MOA model. Indeed, determining travellers' MOA contributes to understanding the factors that most influence the outcome. The model breaks down the processes associated with an individual's particular behavior. In the following sections, we define the three determinants and discuss how they are implemented in our study.

2.2.1. Motivation

Previous literature describes *motivation* as the driving force behind a person's decision-making process (Jepson et al., 2013), which Thøgersen & Ølander (1995) operationalize as the level of motivation an individual has towards achieving a goal for their benefit. Dillon & Gayford (1997) relate the notion to an individual's underlying convictions or beliefs with regard to a specific circumstance. Since individuals' beliefs and values are widely recognized as important factors determining human behavior towards the environment, we argue Dillon & Gayford's (1997) definition is the most compatible with our study. From this, we characterize motivation in our study as individuals' beliefs in climate change and the impacts of aviation on the environment. This is consistent with other interpretations of the term, such as willingness (Roberts & Maccoby, 1973) or "goal-directed arousal" (Moorman, 1990; Park & Mittal, 1985). These descriptions all suggest that, in the instance of external stimulation, an individual's readiness to participate may act as a catalyst to adopting a new behavior (Burnkrant & Sawyer, 1983).

2.2.2. Opportunity

Social marketing theorists define *opportunity* as facilitating conditions (Triandis, 1977, 1979) or the structure of available alternatives (Dholakia et al., 1983). It is also framed as the external constraints hampering an individual's participation in a certain activity (Nadirova & Jackson, 2000). We define opportunity as the characteristics nested in a sustainable activity, which constitute a potential offer for an airline to deliver to a customer during their booking. These characteristics concern the attributes that make up a sustainable offer. This interpretation is coherent with Rothschild's (1999) claims, that "lack of opportunity includes situations in which the individual wants to act but is unable do so because there is no environmental mechanism at hand" (p. 31). By associating opportunity with these attributes, we acquire the extent to which an individual perceives the sustainable offer as an opportunity.

2.2.3. Ability

Ability refers to a person's habits, skills or proficiencies that enable them to take part in a certain activity (Maclnnis et al., 1991). Binney et al. (2007) argue that despite high motivation, behavioral change may not occur if ability is low. In our context, a person's ability to purchase an offer is characterized by their financial ability to do so. If given the minimal amount of information necessary during booking, the consumer does not require any resource other than a monetary, in order to execute the desired behavior (Bandura, 1977).

Due to the undeniable economic, political and social disruption caused by the global COVID-19 pandemic, ability also concerns intrapersonal constraints on travelling in our study. Used by (Hung & Petrick (2016) to study people's travel intentions, intrapersonal constrains are defined as psychological constraints or individualized factors, such as safety fears, that may hinder leisure participation (Crawford et al., 1991).

Therefore, *ability* is conceptualized as the self-reported financial ability and pandemic-related intrapersonal constraints of an individual. In the next section, we review a theory from which the operationalization of opportunity and ability can be derived.

2.2.4. Rothchild's MOA framework

Rothschild (1999) shows that individuals can freely adopt a new behavior with marketing and education. He argues that individuals, especially when motivated, do not necessarily require legal intervention in order to change. Rather, they should be given the opportunity and/or ability to do so (Hung & Petrick, 2016). This suggests that airlines can resolve the attitude-behavior gap observed in VCO studies by empowering their customers with more appropriate offers (Bindu, 2013; Thøgersen, 1995).

Table 2.1.: Rothchild's MOA framework (Rothschild, 1999)

Motivation	**yes**		**no**	
Opportunity	**yes**	**no**	**yes**	**no**
Ability **yes**	(1) *Prone to behave*	(2) *Unable to behave*	(3) *Resistant to behave*	(4) *Resistant to behave*
no	(5) *Unable to behave*	(6) *Unable to behave*	(7) *Resistant to behave*	(8) *Resistant to behave*

Table 2.1. illustrates how Rothchild conceptualizes the relationship between the MOA determinants, from which he categorizes individuals who are prone, unable and resistant to behave. Cells 2, 5 and 6 represent the individuals who have the potential to change behavior without legal intervention. Rothchild's approach to the MOA model is particularly relevant under circumstances where governmental intervention is unreliable, which is one of the main challenges observed in the biofuel commercialization process. Using only three determinants, the model effectively helps explain human behavior generally. However, the model shows some limitation in clearly defining what Maclnnis et al. (1991) characterize as "executional cues", i.e. attributes that constitute *opportunity*. Due to the model's generalizability, ways of measuring the effects of these elements on individual outcome are ambiguous. In order for individuals to shift from "unable" to "prone", we must identify which attributes present in sustainable offers, constitute potential sources of *opportunity*, thus triggers of change for motivated individuals'. In the context of our study, another framework is necessary to quantitatively identify the most relevant attributes that make up these potential opportunities.

2.3. Random Utility Theory

Random Utility Theory (RUT) is a well-known and tested choice behavior theory, which describes the variables that contribute to explaining an individual's behavior (Carson et al., 1994; Louviere et al., 2010; Manski, 1977; Thurstone, 1927). The theory includes observable components, known as "systematic", as well as unobservable components, known as "latent". The latter encompasses the human nature of behavior, which lacks accuracy if explained with a strictly mathematical theory such as Conjoint Measurement (Green & Rao, 1971; Louviere et al., 2010; Luce & Tukey, 1964). The basic axiom of RUT is:

$$U_{in} = V_{in} + e_{in} \quad (1)$$

U_{in} is a latent component, which describes the unobserved utility that an individual *n* associates with choice alternative *i.* V_{in} is the systematic component of the utility that the individual *n* associates with choice alternative *i*. e_{in} is the random component related to individual *n* and choice alternative *i* (Louviere et al., 2010). In our case, this equation predicts the likelihood that an individual will choose a sustainable offer based on the set of attributes that compose it. The unit of analysis is the choice made by the air traveller, meaning that RUT assumes the traveller derives the highest utility from that choice (Manski, 1977; McFadden, 1973).

RUT is commonly used in real choice contexts, for which individuals' preferences are stated based on the choice they make. The axiom's random component accounts for bounded rationality through the random component, which is suitable in a purchasing context. In the next section, we define the attributes that make up an option. These attributes are based on previous VCO studies involving choice tasks, and observed differences in project characteristics between the two sustainable activities.

2.3.1 Attribute 1: Emission coverage

Emission coverage refers to the amount of emissions covered for a passenger's flight by virtue of one of the two sustainable activities.

When purchased by a passenger, current offers involving reforestation cover 100% of their flight emissions, meaning there is no variation in possible sustainable benefits. Rice et al. (2020) observe that customers are willing to pay more when there is a higher reduction in greenhouse gases, especially on longer flights. Testing varying amounts of emission coverage can help determine the extent to which passengers are willing to pay for the benefit of sustainability. Emission coverage is particularly relevant for new sustainable projects such as biofuel, since its sustainable benefits also affect CO_2 emissions by substituting the regular jet fuel industry cycle into a more sustainable one, which can result in an emission reduction to up to 80% once the cycle is complete.

Whether derived from emission compensation or reduction, we can measure the amount of emissions covered by a sustainable activity by referring to a traveller's flight length or distance. Attribute levels represent percentages that describe the relative to the amount of flight emissions covered by a sustainable activity. These levels are 10%, 25%, 50%, 75%, 100%, 150%, 200% for biofuel and tree planting.

2.3.2. Attribute 2: Impact Time

Impact time corresponds to the amount of time taken until a flight's CO_2 emissions are mitigated by a sustainable activity.

Although unexplored in Cheung et al.'s (2015) study, respondents perceived impact time as a rather relevant factor. In our case, impact time shows great importance, since reforestation and biofuel activities raise significant differences in impact time ranges. On the one hand, biofuel usage takes place in the industry cycle of production, transportation and consumption. Depending on availability and market prices, airlines may engage in this cycle at different times, thus fulfilling the activity subsequently. On the other hand, it takes roughly 20 years for a planted tree to make up for CO_2 emissions caused by an air traveller. Considering the efficiency of the biofuel solution relative to reforestation, and the urgency to fight against climate change, travellers might derive a higher utility towards an offer that they perceive as more efficient.

Based on this, attribute levels are 6 months, 1 year, 2 years, 4 years and 20 years for biofuel, and 20 years for tree planting.

2.3.3. Attribute 3: Price increase

The *price increase* attribute denotes the percentage extra a traveller would pay based on their flight ticket price if they were to opt for a particular sustainable option. Price increase was previously used by Rice et al. (2020) to study people's willingness to contribute to sustainable aviation based on their ticket price.

Due to the price sensitivity of the industry, flexibility in price adjustments become a necessity in order to understand air travellers' true willingness to pay for a sustainable offer like biofuel (Araghi et al., 2016). Currently, planting one tree costs approximately 3€, and 1L biofuel costs around 1€ (IATA, 2014). As a result, using biofuel roughly costs 30 times more than a reforestation project to cover the same amount of CO_2 emissions. As the biofuel market expands, the industry is likely to follow the commonly observed 'learning curve' from emerging technologies, which would result in a decrease in biofuel prices over time (Epple et al., 1991). Moreover, a study confirmed by MacKerron et al. (2009) reveals that among European travellers, 75% are willing to pay €25 per ton of CO_2, which is significantly higher than the €12 per ton of CO_2 offered on average (Brouwer et al., 2008). These observations suggest that the demand function for sustainable activities in exchange for the sustainable benefit of emission coverage has yet to be explored through varying prices, together with the possibility to overcompensate.

In order to make the scenarios realistic, price increase levels hinge on market prices. For biofuel, price increase levels are 5%, 10%, 15% and 20%. For tree planting, the price increase is fixed at 2.5%, approximating the current price increase observed among airlines for a full compensation, i.e. 100% emission coverage. Table 2.1. summarizes the attributes and their respective levels.

Table 2.1.: Attribute table and attribute levels

Attribute 1	Attribute 2		Attribute 3	
Emission coverage	**Impact time**		**Price increase**	
Biofuel **Tree planting**	**Biofuel**	**Tree planting**	**Biofuel**	**Tree planting**
10%	6 months	20 years	5%	5%
25%	1 year		10%	
50%	2 years		15%	
75%	4 years		20%	
100%	10 years		25%	
150%	20 years		30%	
200%				

2.3.4. Framework Integration

To conclude, the complete framework offers a deep theoretical understanding of consumer behavior and is relevant in the context of an emerging market like biofuel. The integration of RUT within the MOA model allows us to better understand customers' willingness to participate in a sustainable activity based on their initial motivation, the extent to which they perceive an option as an opportunity, and their ability to make the purchase. Depicted as V_{in} in equation 1, the three attributes - *emission coverage*, *impact time,* and *price increase* - constitute offers which customers perceive as more or less of an *opportunity*. Largely influenced by the price offered, customers' *ability* to purchase a sustainable offer is settled in the choice they make to pay for a sustainable offer.

3. METHODS

3.1. Discrete Choice Experiment

Derived from RUT, a Discrete Choice Experiment (DCE) comprises a series of choice tasks usually in the form of a survey (Louviere et al., 2010; Louviere & Woodworth, 1983). Each task contains a set of several options derived from realistic hypothetical scenarios (Kjær, 2005). Each option is made of fixed attributes. The Discrete Choice Experiment gives the opportunity for individuals to demonstrate which attribute they derive the highest utility from by choosing their preferred options from a series of choice sets.

Relative to other choice task methods, DCEs present several advantages that are suitable for our study. Firstly, when contemplating several options, the respondent must make trade-offs in order to make their decision. This yields to a measure of influence of each attribute level that is superior to other forms of preference measurements such as rankings or ratings, thus providing the data necessary to answer the research question (Ben-Akiva et al., 1992). Secondly, DCEs make studies about stated preferences possible, which differ from revealed preferences in the sense that customer preferences are shown before a product or service is introduced to the market (Kjær, 2005). For research involving emerging technologies that may be unknown, or perceived as complex by individuals such as biofuel, the method is particularly appropriate.

3.2. Experimental Design

In order to come near an actual purchasing situation, respondents will be asked to reminisce the last flight they booked online for themselves and/or other passengers. Individuals' opportunity is evaluated through a series of choice tasks, which will include realistic price increase rates.

3.2.1. Choice task: measuring opportunity

The choice tasks constitute the first part of the survey. Each DCE will consist of four options: one biofuel option, one tree planting option, one option if they choose not to purchase anything, and a fourth option if they would have decided not to travel at all. The second option simulates the offer they were given at the moment of their purchase. The third "none" option reduces the likelihood that a respondent chooses an option they would not actually purchase. Attribute levels will vary between options and sets in such a way that each attribute level is equally represented. Assuming individuals' answers are independent from one set to the next, the order of sets will be randomized (Louviere & Woodworth, 1983). To this end, the tasks vary according to an orthogonal experimental design (Louviere & Woodworth, 1983). Figure 3.1 shows an example of a choice task, and Table 3.1. displays attribute descriptions and practical examples.

Figure 3.1.: Example of a choice task

Imagine you were given the following options when you booked your €300 ticket, please select the option you would have chosen.

Attribute	Option 1: Biofuel	Option 2: Tree planting	Option 3
Emission coverage	10%	100%	I would not have chosen any option
Impact time	6 months	20 years	
Price increase	30€*	15€*	
Your choice:	☐	☐	☐

**Actual price rates are displayed based on the price the respondent paid for their ticket. In this case, the respondent paid €300; price increase rates are then 10% and 5% for option 1 and option 2 respectively.*

Table 3.1.: Attribute descriptions and examples of attribute level interpretations

Attribute	Description	Example
Emission coverage	Amount of emissions covered by a sustainable activity relative to the emissions produced by a passenger on a specific flight.	An emission coverage of 50% implies that 50% of the emissions produced by the passenger are covered by the given option.
Impact time	Amount of time taken until a passenger's flight emissions are covered by the sustainable activity.	An impact time of 6 months implies that it will take 6 months for the emission coverage specified above to be completed.
Price increase	Price rate increase on the flight ticket price for a given option. Any additional paid option (e.g. seat selection, insurance) is excluded.	A price increase of 10% implies that the passenger would pay 10% extra on their price ticket for the emission coverage and impact time mentioned above.

3.2.2. Measuring motivation and ability

The purpose of the second part of the survey is to define the level of motivation and ability perceived by respondents. Measuring these variables allows us to categorize respondents according to Rothschild's (1999) framework, draw valid conclusions from DCE results, and thus answer our research question accurately.

For *motivation*, respondents are asked to unveil their stance on climate change and the impacts of aviation on the environment. In their studies, Cheung et al. (2015) and MacKerron et al. (2009) collect this type of data by asking respondents to evaluate their climate change concerns and perceived significance of aviation on the environment on three and five-point scales, which successfully helped better understand people's willingness to pay for VCOs.
For financial *ability*, respondents indicate their income level and household composition, which has been used in previous studies to examine the relationship between VCO purchases and price (Cheung et al., 2015; MacKerron et al., 2009). Intrapersonal constraints, which have shown to negatively influence travel intentions, will be evaluated in the context of the COVID-19 pandemic on a five-point scale by respondents (Hung & Petrick, 2016). Table 3.2. summarizes the operationalization of motivation and ability.

In terms of preliminary analysis, a principal component analysis was performed on variables concerning *motivation* with one factor to be fitted. The variable "*Global warming is greatly exaggerated*" yielded to a value of 0.812 and was therefore excluded from the *motivation* variable. The remaining variables were used in a composite rating scale for *motivation* based on their means. For *opportunity*, preliminary analysis shows lower Bayesian Information Criterion (BIC) and Akaike Information Criterion (AIC) values continuous variables relative to factor variables. Continuous variables were then chosen for analysis. *Emission coverage* coefficients displayed a linear pattern, suggesting that the attribute did not require any transformation. On the other hand, the coefficients obtained for *price increase* and *impact time* attributes revealed a curvilinear shape, which could be improved with a logarithmic transformation. Since the dimensions involved in the variables constituting *ability* differ greatly, i.e. intrapersonal constraints and financial ability, these variables were not gathered on a composite scale.

Table 3.2.: Operationalization table for measuring respondents' motivation and ability

Variable	Dimension	Indicator(s)	Measurement scale
Motivation	Belief in climate change	- The earth will warm up in the future - Global warming is largely caused by humans - Global warming is greatly exaggerated - Global warming can be slowed down by humans - Global warming needs to be tackled	Ordinal 5-point scale
Motivation	Perceived impacts of aviation on the environment	- We should all fly less - It is important that everyone has the opportunity to fly - People should be able to fly as much as they want - The aviation industry emits too much greenhouse gas - Planting trees is a good solution to make flying more sustainable - Using biofuel to fly is a good solution to make flying more sustainable - The only good solution to make flying more sustainable is to fly less	Ordinal 5-point scale
Ability	Financial ability	- Flying is too cheap	Ordinal 5-point scale
		• Household income	Interval
Ability	Intrapersonal constraint	- When the COVID-19 crisis is over, I will fly as much as before	Ordinal 5-point scale

3.3. Data collection

The data was collected using the online survey from Multiscope. The survey was run on the platform for approximately 8 weeks, reaching a sample size of 680 Dutch respondents, of which 563 completed the DCE tasks. The large sample size maximizes the generalizability of the study at the national level. The survey was provided in Dutch in order to reach the highest response rate possible. The panel allowed to specifically target Dutch individuals who have personally booked a flight online in the last 8 months. The timeline limit ensured that respondents were able to effortlessly reminisce their purchasing history, thus maximizing the accuracy of the data self-reported.

3.3.1 Descriptive statistics

Table 3.3 describes the means and standard deviations of respondents who completed the survey, which is fairly representative sample of the Dutch population overall. The means age was 56.75 years and the percentage of female respondents was 42.5%. The amount of people who compensated for their last flight was overrepresented, since 13% respondents compensated on their last flight relative to the 1% conversion rate observed in among airlines. This can be explained by the fact that respondents were able to abandon the survey after its introduction. Respondents purchased 2.19 tickets on average, for which 94.41% were for a leisure travel. Figure 3.2. describes descriptive statistics provided by respondents regarding climate change, the impacts of aviation on the environment. 52.1% respondents think we should all fly less, and 58.5% think that the aviation industry emits too many greenhouse gases. A majority believe that planting trees and biofuel are good solutions for flying more sustainably, with 58,2% and 53.7% agreeing respectively. Table 3.4. shows the correlation matrix.

Table 3.3.: Descriptive statistics

Variable	Description	Observations (N)
Mean age (SD)	56.75 (3.77)	563
Gender	Male: 57.2% Female: 42.5 % Other: 0.3%	563
Household size	1 person: 25.04% 4 people: 9.23% 2 people: 53.11% 5+ people: 3.73% 3 people: 8.88%	563
Household income	≤ €30,000: 21.05% €30,000-80,000: 58.58% > €80,000: 20.37%	437
Education level	No university degree: 34.99% University degree: 65.01%	563

Table 3.3.: Descriptive statistics (continued)

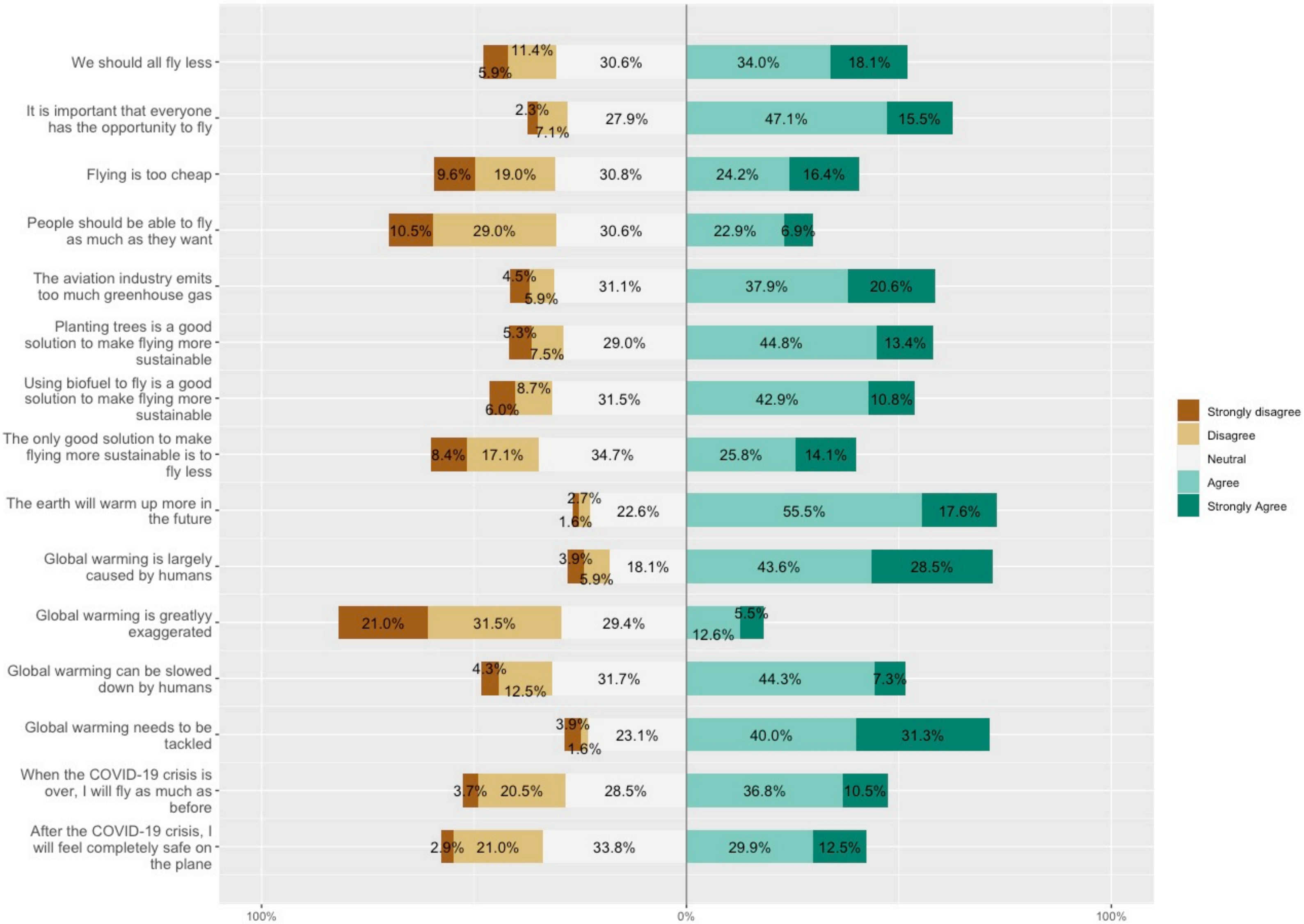
Variable	Description		Observations (N)
Ticket price	€0-200: 25.23% €200-400: 25.08% €400-700: 20.6%	€700-1000: 8.71% €1000-2000: 12.46% €2000+: 7.96%	666
Mean number of tickets purchased (SD)	2.19 (1.45)		680
Travel class	Economy: 94.26% Business 4.41% First: 1.32%		680
Travel purpose	Leisure: 94.41% Business: 5.59%		680
Compensated with CO_2 offset	Yes: 13.06% No: 67.95% Not sure: 18.99%		666

Table 3.4: Correlation matrix

		1	2	3	4	5	6	7	8	9
1	**Age**									
2	**Gender**	-0.204								
3	**Household size**	-0.293	-0.027							
4	**Household income**	0.020 *	-0.025	0.136						
5	**Education level**	-0.040 **	-0.040 **	-0.008	0.120 ***					
6	**Ticket price**	0.103 ***	-0.040 **	0.061 ***	0.080 ***	0.040 **				
7	**Tickets purchased**	-0.072 ***	-0.037 **	0.263 ***	0.047 ***	-0.090 ***	0.338 ***			
8	**Travel class**	-0.021	-0.091 ***	0.049 ***	-0.032 **	-0.021	0.265 ***	-0.038 **		
9	**Travel purpose**	-0.002	-0.021	0.022	0.084 ***	0.131 ***	-0.018	-0.138 ***	-0.035 **	
10	**CO_2 compensation**	0.109 ***	-0.018	-0.007	-0.016 *	-0.021	-0.030 *	0.016	-0.066 ***	0.028 *

*Significance: $p < 0.001$ '***', $p < 0.01$ '**', $p < 0.05$ '*'*

Figure 3.2.: Descriptive statistics of ordinal scale variables



3.4 Data analysis

DCE data was analyzed using a conditional logit regression model, which approximates aggregate choice results (Luce, 2012). Self-reported motivation and ability data from the second part of the survey interacted with opportunity and ability derived from the DCE data. As a result, we can determine what attributes help individuals who are motivated to shift closer to the "prone to behave" cell of Rothchild's framework, where individuals are motivated, perceive sustainable opportunity and are able to behave. We are also able to determine what attributes constitute the

largest contributors to obtaining individuals' maximum willingness to pay, since one option's gain is another option's loss.
Data analysis was conducted using Rstudio with data in long format. The clogit() function from the survival package was used, where the strata was defined as the survey version given to the respondent. The dependent variable *biofuel* was coded with 1 when the biofuel chosen and 0 when it is not chosen.

The variable *ticket price*, defining the average ticket price paid per passenger given the ticket price range selected by the respondent, was used as a controlled control variable. Indeed, each respondent was given an actual price in the DCE tasks based on their ticket price, instead of the *price increase* percentage. Since the *ticket price* variable does not change throughout the experiment, controlling for it allowed the assessment of the influence of a price increase based on this starting ticket price.

To further understand the relative importance of attributes, willingness to pay (WTP) was calculated using the estimate of the variable describing the total price, i.e. ticket price with the price increase, and the estimate of the *emission coverage* attribute from the DCE as a continuous variable. Marginal WTP for a discrete change in the emissions covered was calculated using the price increase estimate and the following equation (Nieboer et al., 2010):

$$WTP_a = -\left(\frac{\beta_a}{\beta_{total\,price}}\right) \tag{2}$$

BIC and AIC were used for model fit and selection. When used together, the criteria allowed us to select an appropriate model by penalizing underfitting and overfitting respectively. In a context where a complex model can easily be achieved with a large number of parameters, parsimony was prioritized.

4. RESULTS

In this section, we describe the results obtained for the conditional logit model analysis. Table 4.1. summarizes these results with five conditional logit models.

Model 1 - Opportunity
Model (1) describes *opportunity* with the attribute variables, controlled for the *ticket price* paid per passenger by the respondent, yielding to an AIC of 2830.788 and a BIC of 2854.926. *Emission coverage* has a significant yet slight influence on biofuel choice, which insinuates that travellers do not derive much utility from the amount of emissions covered by the sustainable option. *Impact time* negatively influences the outcome, meaning that a biofuel option with a short-term environmental impact is more likely to be chosen by travellers. This implies that a traveller derives utility from the speed at which the impact can be observed. The estimates reveal that there is a strong and significant influence of *price increase* on the choice for a biofuel option. An increase in price reduces the likelihood that a traveller will purchase biofuel and is the most influential attribute for *opportunity*.

Model 2 - Motivation
Model (2) describes *opportunity* and *motivation*, controlled for the *ticket price*, with an AIC of 2520.938 and a BIC of 2554.524. We observe that people's motivation has a strong and significant influence on the outcome. People who generally believe in climate change and the impact of aviation on the environment are more likely to choose to purchase biofuel. This is consistent with Maclnnis et al.'s (1991) theory, where it is argued that an individual's motivation contributes greatly to consumption behavior and should be evaluated for behavioral change.

Model 3 - Ability
Model (3) describes *opportunity* and *ability* controlled for the ticket price, displaying an AIC of 2615.22 and a BIC of 2668.997. With regards to the financial dimension of *ability*, estimates show that air travellers' level of belief that flying is too cheap does not significantly influence the outcome. Household income shows a weak estimate with a slight significance, which means individuals with higher incomes are not necessarily more likely to purchase biofuel. This result differs from Brouwer et al.'s (2018) observation that income significantly influences willingness to pay. For the *ability* dimension addressing intrapersonal constraints, people's travelling intentions after the COVID-19 crisis does not influence their willingness to choose biofuel. The lack of significant influence of *ability* variables on the outcome imply that people's choice not to opt for biofuel cannot be explained by their financial ability or intrapersonal constraints.

Models 4, 5 – Individual characteristics
Model (4) gathers *opportunity*, *motivation* and *ability* variables, showing a significant improvement with an AIC of 2492.245 and a BIC of 2554.619. Model (5) includes *motivation*, *opportunity* and *ability* variables, as well as individual characteristics, resulting in an AIC of 2430.035 and a BIC of 2516.398. Individual characteristics that were consistently relevant in previous studies contributed to a significant improvement in the model fit. Cheung et al. (2015) observe that an air traveller's *level of education* has an effect on willingness to pay for a VCO, which we also observe for the choice of biofuel. In addition, they stated that women were generally

more willing to pay the additional ticket price compared to men. Rice et al. (2020) confirmed this conclusion, adding that shorter domestic flights and long-haul flights also had an effect. As an additional insight in the study, we also observe that *gender* has a strong and significant influence, where women are more likely to opt for biofuel. However, the interaction term shows that an increase in price decreases the effect of gender on the outcome, which insinuates that women are also more price sensitive. *Flight time* estimates show that longer flights also increased the likelihood for a traveller to choose biofuel, which confirms Brouwer et al.'s (2008) results. In line with Mair's (2011) observations, the significant negative estimate for *CO_2 compensation* reveals that air travellers who are already willing to contribute to VCOs were also more likely to choose biofuel.

Willingness to pay

Calculations for marginal WTP show that for one percentage level increase in flight emissions covered by biofuel, people are willing to pay €13.59 extra on average.

Table 4.1: Conditional logit model

	Dependent variable: Biofuel				
	(1) O	(2) M-O	(3) O-A	(4) M-O-A	(5) Full model
Emission_coverage	**0.007*****	-0.008	**0.008*****	-0.007	-0.006
Impact_time	**-0.208*****	**-0.231*****	**-0.220*****	**-0.232*****	**-0.240*****
Price_increase	**-1.137*****	**-1.231*****	**-2.137*****	**-2.195*****	**-1.249****
Motivation		**1.177*****		**1.083*****	**1.219*****
Gender					**1.080*****
Education_level					**-0.121*****
CO2_compensation					**-0.395*****
Flight_time					**0.127*****
Ticket_price	0.0002	0.0004	0.0003	0.0004	0.0001
Emission_coverage:motivation		**0.004*****		**0.004****	**0.004****
Household_income			**-0.075***	-0.061	-0.042
Fly_cheap			-0.164	**-0.404****	**-0.347***
Covid_fly			0.166	**0.340***	**0.453****
Price_increase:Fly_cheap			**0.271*****	**0.272*****	**0.259*****
Price_increase:Ticket_price	**-0.0003*****	**-0.0003*****	**-0.0003*****	**-0.0003*****	**-0.0004*****
Price_increase:Gender					**-0.577*****
Price_increase:Household_income			0.027	0.026	0.028
Price_increase:Covid_fly			-0.080	-0.074	-0.110
Observations	5,836	5,620	5,620	5,620	5,620
R^2	0.088	0.123	0.109	0.129	0.140
Max. Possible R^2	0.438	0.439	0.439	0.439	0.439
Log Likelihood	-1,410.394	-1,253.469	-1,297.110	-1,233.123	-1,197.018
Wald Test	427.830*** (df = 5)	526.430*** (df = 7)	468.190*** (df = 11)	531.600*** (df = 13)	549.470*** (df = 18)
LR Test	539.160*** (df = 5)	737.652*** (df = 7)	650.370*** (df = 11)	778.345*** (df = 13)	850.555*** (df = 18)
Score (Logrank) Test	517.320*** (df = 5)	682.731*** (df = 7)	592.657*** (df = 11)	701.745*** (df = 13)	753.823*** (df = 18)

*Significance: $p < 0.001$ '***', $p < 0.01$ '**', $p < 0.05$ '*'*

Table 4.2: Willingness to pay estimate for emissions coverage

Attribute	Parameter	WTP
Emissions coverage	-0.007***	13.59***

*Significance: p < 0.001 '***', p< 0.01 '**', p < 0.05 '*'*

5. CONCLUSION

This study examined air travellers' attitude and behavior towards sustainable aviation by addressing the question: "*What factors influence air travellers' willingness to choose sustainable aviation fuel?"* Using individuals' personal travelling scenario*,* the research aimed to provide insights on how air travellers behave when they are given the opportunity to fly more sustainably with sustainable aviation fuel. To this end, a discrete choice experiment was conducted among Dutch air travellers. Conditional logit regression models were used to capture air travellers' preferences and individual characteristics, allowing for conclusions to be drawn from the estimates.

Based on the models we conclude that an option's extra cost on the ticket price is the most influential factor for choosing to purchase sustainable aviation fuel. Additionally, air travellers derive more utility from the time taken until the impact is made, rather than the amount of emissions covered by the sustainable option. Moreover, further results show that significant preference in the impact time noes not occur between 6 months and 4 years, but rather beyond those levels, i.e. 10 years and 20 years. Since VCOs, such as tree planting, typically offer high emission coverage and impact time, and since high SAF market prices constrain to offering lower emission coverage options, we can expect for sustainable aviation fuel to generate more revenue than tree planting. Indeed, early tracking results from Lufthansa's Compensaid platform show that air travellers are willing to pay more for sustainable aviation fuel than for a traditional VCO.

The use of Dillon & Gayford's (1997) interpretation of motivation helped identify motivated individuals from Rothschild's (1999) framework, present among a majority of respondents. Results show that an air traveller's intrinsic motivation is an essential factor for their willingness to choose sustainable aviation fuel, successfully verifying previous results for VCOs from Lu & Wang (2018), Lera-López et al. (2014) and Kim et al. (2014). However, while the *motivation* factor was present among individuals, *ability* factors did not help explain why individual travellers chose not to purchase a voluntary offer.

Individual characteristics also showed some influence on the outcome. Despite being more price sensitive, women were more likely to choose biofuel. Therefore, we expect to observe a higher biofuel adoption rate from women compared to men provided the price increase is not too high. Individuals who had already offset flight were also more likely to choose biofuel. The latter implies that in the context of Rothchild's framework, a consumer's behavioral change from choosing an existing offset option to choosing a biofuel option is more likely than a behavioral change from no compensation to a biofuel compensation. Individuals with longer flight hauls were also more willing to choose this option, which could be justified by the following. First, since longer flights emit more CO_2 emissions and cannot be substituted by another mean of transport, air travellers might be more willing to compensate for it. Second, travellers might not carry out longer flight as frequently as shorter flights, meaning that their booking behavior is less of an intuitive habit.

6. DISCUSSION

This study contributes to literature on sustainable options in aviation in several ways. First, by describing individuals' preferences regarding sustainable aviation fuel, the research introduces a new technology in the VCO literature. To this end, the study contributes to the lack of social marketing literature by addressing complex issues regarding sustainable innovations in aviation (Thøgersen, 1995; Tweneboah-Koduah et al., 2020). This was achieved through the integration a DCE within the MOA model using comparable characteristics, which allowed for a complex emerging technology to be juxtaposed to an offset demand curve that was understood for. Second, the combination of the MOA model and DCE allowed us to collect new insights about travellers based on their individual characteristics. Indeed, previous VCO studies with DCEs categorized travellers based on their travelling behavior solely. Our approach was particularly relevant under the COVID-19 crisis, since air travellers' general behavior changed significantly relative to the previous year. In contrast, individual characteristics were less likely to change in the short term. Third, the study expanded on Gillenwater et al.'s (2007) and Monbiot's (2006) criticism over the lack of efficiency in current CO_2 offset programs. The study's descriptive intention allowed for airlines and other VCO sellers to contemplate appropriate marketing, accustomed to their consumers' characteristics and preferences, putting forward the short-term benefits of the biofuel solution.

Despite the literature gaps being addressed, the research also included some limitations. First, since the purpose of the research involved describing the influence of variables on the probability of choice, the number of variables included in the model was minimized. A better model fit could have been reached if more attributes and interactions had been included. As a result, the predictive power of the model and the accuracy of its estimates would have been increased. Second, the series of choice tasks in the DCE ensured high internal validity. However, since the research was conducted at the national level, less focus was placed on external validity. Repeating the experiment across new geographical areas would help address this limitation, test the generalizability of the framework, as well as validate WTP estimates. Third, although the experiment was designed to recreate personalized travelling scenarios, it depicted simplified versions by excluding steps from the booking experience, e.g. extra costs for luggage and seats, or realistic representations of VCOs by visual means. Moreover, a majority of respondents who chose biofuel only opted for the option once out of the ten choice tasks, suggesting that ideal conditions needed to be met. To this end, further qualitative research on behavioral design and customer experience would complement our insights by identifying new influential attributes and testing prototypes.

The study leads to implications regarding the role of SAF in the "zero emissions by 2050" target. In view of the market price gap between SAF relative and fossil fuel, learning-by-doing economies of scale are insufficient to reach this ambitious target. Policy frameworks such as opt-in schemes and mandates would serve as a gap-filler to ensure that SAF production reaches self-sustaining profitability and scalability. For instance, Norway was among the first countries to introduce a 0.5% SAF mandate in 2018, resulting in a €3 million in additional jet fuel costs (Karagiannopoulos, 2019). Such policy frameworks are essential for SAF technologies to scale up and lead to a learning curve. In this respect, the study provides a relevant incentive for policy makers; results on air travellers' *ability* and WTP estimates imply that introducing a mandate below 2% would likely not disturb individual travellers' flying frequency and willingness to fly.

APPENDIX 1: ABBREVIATIONS

AIC: Akaike information criterion

BIC: Bayesian information criterion

DCE: discrete choice experiment

GHG: greenhouse gas

MOA: motivation opportunity ability

RUT: random utility theory

SAF: sustainable aviation fuel

VCO: voluntary carbon offset

WTP: willingness to pay

APPENDIX 2: SURVEY

<u>DEEL 1 - Uw laatste boeking</u>

We vragen u zich de laatste ticket (of tickets) in herinnering te brengen die u heeft gekocht voor uzelf, iemand anders of derden. Beantwoord de vragen voor de laatste aankoop, zelfs wanneer de vlucht is geannuleerd of onderbroken vanwege de Covid-19-crisis.

In welke maand hebt u dit ticket gekocht?

- o Augustus 2019
- o September 2019
- o Oktober 2019
- o November 2019
- o December 2019
- o Januari 2020
- o Februari 2020
- o Maart 2020
- o April 2020
- o Mei 2020
- o Juni 2020
- o Juli 2020

Voor hoeveel personen heeft u tickets gekocht? _____

Wat was het doel van uw reis?

- o Vrije tijd / vakantie
- o Zakelijk

Welke reisklasse hebt u geboekt?

- o Economy
- o Business
- o First

Wat was ongeveer de ticketprijs zonder extra kosten (bijv. verzekering, speciale stoelen, extra bagage etc.)? Waren er meer dan 1 passagiers, tel dan de kosten van alle tickets bij elkaar.

- o €0-€100
- o €100-€200
- o €200-€300
- o €300-€400
- o €400-€500
- o €500-€600
- o €600-€700
- o €700-€800
- o €800-€900
- o €900-€1000
- o €1000-€1500
- o €1500-€2000
- o €2000-€2500
- o €2500-€3000
- o > €3000

Hoe lang was uw vlucht?

- ○ 0-1uur
- ○ 1-2 uren
- ○ 2-3 uren
- ○ 3-4 uren
- ○ 4-5 uren
- ○ 5-6 uren
- ○ 6-7 uren
- ○ 7-8 uren
- ○ 8-9 uren
- ○ 10-11 uren
- ○ > 11 uren
- ○ Weet ik niet meer

Heeft u een CO_2-compensatieoptie gekocht die werd aangeboden toen u de ticket(s) kocht?

- ○ Ja
- ○ Nee
- ○ Weet ik niet meet

Is de vlucht doorgegaan?

- ○ Ja
- ○ Nee
- ○ Nog onbekend

Wat is uw land van vertrek? _____

Wat is uw land van aankomst? _____

Bent u van plan om de toekomst weer te gaan vliegen?

- ○ Ja
- ○ Nee

<u>DEEL 2 – Duurzame Opties</u>

• Stelt u zich dat u uw laatste vliegticket opnieuw zou kopen, en dat er geen beperkingen zijn vanwege Covid-19.

• We zijn benieuwd naar uw belangstelling voor twee verschillende methoden om uw vlucht te verduurzamen: het planten van bomen en het vliegen op biobrandstof.

Door bomen te planten kunnen nieuwe bossen worden gecreëerd. Op de lange termijn slaan deze nieuwe bomen koolstof op waardoor CO_2 in the atmosfeer wordt verminderd. Bomen planten is een optie die vaak wordt aangeboden bij vliegtickets als een vorm van CO_2-compensatie.

Biobrandstof is een soort duurzame vliegtuigbrandstof die wordt geproduceerd uit biologische bronnen, zoals gewassen, algen of gerecyclede bakolie. Het gebruik van biobrandstof in vliegtuigen in plaats van gewone vliegtuigbrandstof compenseert de CO_2-uitstoot.

• We laten u 10 keuzetaken zien. In elke keuzetaak kan uw ticket worden uitgebreid met de verschillende manieren tot verduurzamen. Wij vragen u onder elke keuzetaak de optie te selecteren die u zou kiezen op basis van het ticket dat u het laatst heeft gekocht.

• De keuzetaken varieren op 3 aspecten: 1) emissiedekking, 2) tijd tot compensatie 3) extra kosten. Deze aspecten worden nu uitgelegd. Tijdens het beantwoorden van de vragen blijft deze uitleg beschikbaar.

Karakteristieken van de opties	Niveaus
Emissiedekking Het percentage broeikasgasemissies dat wordt gecompenseerd. *Voorbeeld: 50% emissiedekking betekent dat 50% van de emissie die de passagier produceert wordt gecompenseerd. Een emissiedekking van 200% betekent dat u de uitstoot van uw eigen aankoop dubbel compenseert.*	• 10% • 25% • 50% • 75% • 100% • 150% • 200%
Tijd tot compensatie De tijd die nodig is om de broeikasgasemissies van uw aankoop te compenseren. *Voorbeeld: een tijd van 6 maanden wil zeggen dat het 6 maanden duurt voordat de emissiedekking zoals hierboven beschreven staat, is voltooid.*	• 6 maanden • 1 jaar • 2 jaren • 4 jaren • 20 jaren
Extra kosten De extra kosten bovenop de ticketprijs om de broeikasgasemissies te compenseren. Andere extra betaalde opties zijn uitgesloten (bijv. stoel selectie, verzekering, etc.). *Voorbeeld: Kosten van 5€ betekent dat het hierboven vermelde emissiedekkingspercentage de keuze vliegticketprijs met 5€ verhoogt.*	• €5 • €15 • €30 • ….

<u>DEEL 3 – Keuzetaken</u>

Nu volgen de keuzetaken. Stelt u zich voor dat deze opties beschikbaar zijn wanneer u uw laatste ticket(s) opnieuw zou kopen. Hierbij kunt u er vanuit gaan dat er geen restricties zijn vanwege COVID-19. Wij zijn ons bewust van het feit dat vanwege de COVID-19-crisis zijn sommige mensen anders gaan denken over vliegen.

Stelt u zich voor dat u uit de volgende opties kan kiezen tijdens het boeken van uw vlucht. Welke optie zou u kiezen?

DEEL 4

Tot slot vragen wij u de volgende vragen te beantwoorden.

Wat is uw leeftijd? _____

Wat is uw geslacht?

- Man
- Vrouw
- Anders

Wat is het jaarinkomen van uw huishouden vòòr belastingen? (uw gegevens blijven vertrouwelijk)

- Geen inkomen
- < €10,000
- €10,000-€20,000
- €20,000-€30,000
- €30,000-€40,000
- €40,000-€50,000
- €50,000-€60,000
- €60,000-€70,000
- €70,000-€80,000
- €80,000-€90,000
- €90,000-€100,000
- €100,000-€150,000
- €150,000-€200,000
- > €200,000
- Weet ik niet/wil ik niet zeggen

Uit hoeveel personen bestaat uw huishouden?

- 1
- 2
- 3
- 4
- 5+

Wat is de hoogste opleiding die u heeft gevolgd?

- Bassisschool
- VMBO
- MBO
- HAVO
- HBO bachelor
- HBO master
- VWO
- WO bachelor
- WO master
- PhD / MBA
- geen opleiding

Hoeveel vluchten heeft uw gemaakt in 2019? Elke overstap telt als een losse vlucht.

- < 2
- 2-5
- 5-10
- 10-15
- > 15

Deze vragen gaan over uw mening over vliegen. Geen aan in hoeverre u het eens bent met elke stelling.

	Sterk mee oneens	**Oneens**	**Neutraal**	**Eens**	**Sterk mee eens**
We moeten met zijn allen minder vliegen.	○	○	○	○	○
Het is belangrijk dat iedereen de mogelijkheid heeft om te vliegen.	○	○	○	○	○
Vliegen is te goedkoop.	○	○	○	○	○
Mensen moeten zoveel vliegen als ze willen.	○	○	○	○	○
De luchtvaartindustrie stoot te veel broeikasgassen uit.	○	○	○	○	○
Het planten van bomen is een goede oplossing om vliegen duurzamer te maken.	○	○	○	○	○
Het planten van bomen is een goede oplossing om vliegen duurzamer te maken.	○	○	○	○	○
Het gebruik van biobrandstoffen om te vliegen is een goede oplossing om vliegen duurzamer te maken.	○	○	○	○	○
De enige goede oplossing om vliegen duurzamer te maken is minder te vliegen.	○	○	○	○	○
In de toekomst zal de aarde verder opwarmen.	○	○	○	○	○
De opwarming van de aarde wordt voor een groot deel door de mens veroorzaakt.	○	○	○	○	○

	Sterk mee oneens	Oneens	Neutraal	Eens	Sterk mee eens
De opwarming van de aarde wordt sterk overdreven.	○	○	○	○	○
De opwarming van de aarde kan nog door de mens afgeremd worden.	○	○	○	○	○
De opwarming van de aarde moet aangepakt worden.	○	○	○	○	○
Als de COVID-19-crisis voorbij is vlieg ik evenveel als daarvoor.	○	○	○	○	○
Na de COVID-19-crisis voel ik me volkomen veilig in het vliegtuig.	○	○	○	○	○

Heeft u verder nog opmerkingen? ____

REFERENCES

Araghi, Y., Kroesen, M., Molin, E., & Van Wee, B. (2016). Revealing heterogeneity in air travelers' responses to passenger-oriented environmental policies: A discrete-choice latent class model. *International Journal of Sustainable Transportation*, *10*(9), 765–772.

ATAG. (2017). Flying in formation... *Quality*, 44.

Babakhani, N., Ritchie, B. W., & Dolnicar, S. (2017). Improving carbon offsetting appeals in online airplane ticket purchasing: testing new messages, and using new test methods. *Journal of Sustainable Tourism*, *25*(7), 955–969.

Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychological Review*, *84*(2), 191.

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

Becken, S., & Pant, P. (2019). *Airline Initatives to Reduce Climate Impact*. Amadeus. https://amadeus.com/en/insights/white-paper/airline-initiatives-to-reduce-climate-impact

Ben-Akiva, M., Morikawa, T., & Shiroishi, F. (1992). Analysis of the reliability of preference ranking data. *Journal of Business Research*, *24*(2), 149–164.

Bindu, N. (2013). A Study on The Attitudes And Buying Behavior Of Air Travellers In Contributing To A Sustainable Environment. *International Journal of Engineering Management Sciences*, *4*(1).

Binney, W., Hall, J., & Oppenheim, P. (2007). The MOA framework and behavioural response. *ANZMAC 2007: 3Rs, Reputation Responsibility Relevance: Proceedings of the 2007 Australian and New Zealand Marketing Academy Conference*, 1144–1151.

Blasch, J., & Farsi, M. (2014). Context effects and heterogeneity in voluntary carbon offsetting– a choice experiment in Switzerland. *Journal of Environmental Economics and Policy*, *3*(1), 1–24.

Brouwer, R., Brander, L., & Van Beukering, P. (2008). "A convenient truth": air travel passengers' willingness to pay to offset their CO 2 emissions. *Climatic Change*, *90*(3), 299–313.

Burnkrant, R. E., & Sawyer, A. G. (1983). Effects of involvement and message content on information-processing intensity. *Information Processing Research in Advertising*, *12*(2), 46–64.

Carson, R. T., Louviere, J. J., Anderson, D. A., Arabie, P., Bunch, D. S., Hensher, D. A., Johnson, R. M., Kuhfeld, W. F., Steinberg, D., & Swait, J. (1994). Experimental analysis of choice. *Marketing Letters*, *5*(4), 351–367.

Cheung, J., Kragt, M., & Burton, M. (2015). *The awareness and willingness of air travellers to pay for voluntary carbon offsets and their co-benefits*.

Crawford, D. W., Jackson, E. L., & Godbey, G. (1991). A hierarchical model of leisure constraints. *Leisure Sciences*, *13*(4), 309–320.

Dholakia, R. R., Dholakia, N., & Firat, A. F. (1983). From social psychology to political economy: A model of energy use behavior. *Journal of Economic Psychology*, *3*(3–4), 231–247.

Dillon, P. J., & Gayford, C. G. (1997). A psychometric approach to investigating the environmental beliefs, intentions and behaviours of pre-service teachers. *Environmental Education Research*, *3*(3), 283–297.

Epple, D., Argote, L., & Devadas, R. (1991). Organizational learning curves: A method for investigating intra-plant transfer of knowledge acquired through learning by doing. *Organization Science*, *2*(1), 58–70.

Gegg, P., Budd, L., & Ison, S. (2015). Stakeholder views of the factors affecting the commercialization of aviation biofuels in Europe. *International Journal of Sustainable Transportation*, *9*(8), 542–550.

Gillenwater, M., Broekhoff, D., Trexler, M., Hyman, J., & Fowler, R. (2007). Policing the voluntary carbon market. *Nature Climate Change*, *1*(711), 85–87.

Gössling, S., Broderick, J., Upham, P., Ceron, J.-P., Dubois, G., Peeters, P., & Strasdas, W. (2007). Voluntary carbon offsetting schemes for aviation: Efficiency, credibility and sustainable tourism. *Journal of Sustainable Tourism*, *15*(3), 223–248.

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

Gössling, S., & Peeters, P. (2007). 'It does not harm the environment!'An analysis of industry discourses on tourism, air travel and the environment. *Journal of Sustainable Tourism*, *15*(4), 402–417.

Green, P. E., & Rao, V. R. (1971). Conjoint measurement-for quantifying judgmental data. *Journal of Marketing Research*, *8*(3), 355–363.

Hung, K., & Petrick, J. F. (2016). *Investigating the role of motivation, opportunity and ability (MOA) on travel intentions: An application of the MOA model in cruise tourism*.

IATA. (2014). *Report on Alternative Fuels* (Issue December). https://www.iata.org/publications/Pages/alternative-fuels.aspx

IPCC. (2018). Summary for Policymakers SPM. *Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change,* 32. https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_SPM_version_report_LR.pdf

Jepson, A., Clarke, A., & Ragsdell, G. (2013). Applying the motivation-opportunity-ability (MOA) model to reveal factors that influence inclusive engagement within local community festivals: The case of UtcaZene 2012. *International Journal of Event and Festival Management*, *4*(3), 186–205.

Kim, Y., Yun, S., & Lee, J. (2014). Can companies induce sustainable consumption? The impact of knowledge and social embeddedness on airline sustainability programs in the US. *Sustainability*, *6*(6), 3338–3356.

Kjær, T. (2005). *A review of the discrete choice experiment-with emphasis on its application in health care*.

Lera-López, F., Sánchez, M., Faulin, J., & Cacciolatti, L. (2014). Rural environment stakeholders and policy making: Willingness to pay to reduce road transportation pollution impact in the Western Pyrenees. *Transportation Research Part D: Transport and Environment*, *32*, 129–142.

Louviere, J. J., Flynn, T. N., & Carson, R. T. (2010). Discrete choice experiments are not conjoint analysis. *Journal of Choice Modelling*, *3*(3), 57–72.

Louviere, J. J., & Woodworth, G. (1983). Design and analysis of simulated consumer choice or allocation experiments: an approach based on aggregate data. *Journal of Marketing Research*, *20*(4), 350–367.

Lu, J.-L., & Wang, C.-Y. (2018). Investigating the impacts of air travellers' environmental knowledge on attitudes toward carbon offsetting and willingness to mitigate the environmental impacts of aviation. *Transportation Research Part D: Transport and Environment*, *59*, 96–107.

Luce, R. D. (2012). *Individual choice behavior: A theoretical analysis*. Courier Corporation.

Luce, R. D., & Tukey, J. W. (1964). Simultaneous conjoint measurement: A new type of fundamental measurement. *Journal of Mathematical Psychology*, *1*(1), 1–27.

MacKerron, G. J., Egerton, C., Gaskell, C., Parpia, A., & Mourato, S. (2009). Willingness to pay for carbon offset certification and co-benefits among (high-) flying young adults in the UK. *Energy Policy*, *37*(4), 1372–1381.

Maclnnis, D. J., Moorman, C., & Jaworski, B. J. (1991). Enhancing and measuring consumers' motivation, opportunity, and ability to process brand information from ads. *Journal of Marketing*, *55*(4), 32–53.

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

Manski, C. F. (1977). The structure of random utility models. *Theory and Decision*, *8*(3), 229.

McFadden, D. (1973). *Conditional logit analysis of qualitative choice behavior*.

Monbiot, G. (2006). Selling indulgences. *The Guardian*, *18*.

Moorman, C. (1990). The effects of stimulus and consumer characteristics on the utilization of nutrition information. *Journal of Consumer Research*, *17*(3), 362–374.

Nadirova, A., & Jackson, E. L. (2000). Alternative criterion variables against which to assess the impacts of constraints to leisure. *Journal of Leisure Research*, *32*(4), 396–405.

Nieboer, A. P., Koolman, X., & Stolk, E. A. (2010). Preferences for long-term care services: Willingness to pay estimates derived from a discrete choice experiment. *Social Science & Medicine*, *70*(9), 1317–1325.

Noh, H. M., Benito, A., & Alonso, G. (2016). Study of the current incentive rules and mechanisms to promote biofuel use in the EU and their possible application to the civil aviation sector. *Transportation Research Part D: Transport and Environment*, *46*, 298–316.

Park, C. W., & Mittal, B. (1985). A theory of involvement in consumer behavior: problems and issues. Research in Consumer Behavior. *J. Sheth. Greenwich, CT, JAI*, *1*, 210–231.

Rice, C., Ragbir, N. K., Rice, S., & Barcia, G. (2020). Willingness to pay for sustainable aviation depends on ticket price, greenhouse gas reductions and gender. *Technology in Society*, *60*, 101224.

Roberts, D. F., & Maccoby, N. (1973). Information processing and persuasion: Counterarguing behavior. *New Models for Mass Communication Research*, *2*, 269–307.

Rothschild, M. L. (1999). Carrots, sticks, and promises: A conceptual framework for the management of public health and social issue behaviors. *Journal of Marketing*, *63*(4), 24–37.

Sgouridis, S., Bonnefoy, P. A., & Hansman, R. J. (2011). Air transportation in a carbon constrained world: Long-term dynamics of policies and strategies for mitigating the carbon footprint of commercial aviation. *Transportation Research Part A: Policy and Practice*, *45*(10), 1077–1091.

ThØgersen, J. (1995). Understanding of consumer behaviour as a prerequisite for environmental protection. *Journal of Consumer Policy*, *18*(4), 345–385.

Thøgersen, J., & Ølander, C. F. (1995). Perceptions of waste and recycling. A qualitative analysis. *The 20th Annual Colloquium of IAREP, The International Association for Research in Economic Psychology August 1995 Frontiers in Economic Psychology*

Norwegian School of Economics and Business Administration. Bergen, August.

Thurstone, L. L. (1927). A law of comparative judgment. *Psychological Review*, *34*(4), 273.

Triandis, H C. (1977). *Interpersonal behavior. Monterey, CA: Brooks/Cole. Triandis, HC (1979). Values, attitudes, and interpersonal behavior*. Nebraska.

Triandis, Harry C. (1979). Values, attitudes, and interpersonal behavior. *Nebraska Symposium on Motivation*.

Tweneboah-Koduah, E. Y., Mann, V. E., & Adams, M. (2020). Using Motivation, Opportunity, and Ability Model in Social Marketing to Predict "Galamsey" Behavior in Ghana. *Social Marketing Quarterly*, *26*(1), 28–46.

Ukenna, S. I., & Nkamnebe, A. D. (2017). Sustainable consumption behavior in Sub-Saharan Africa: a conceptual framework. *Thunderbird International Business Review*, *59*(1), 33–50.