Ministry of Infrastructure and Water Management

Flying in the face of climate change

The role of information to induce voluntary behavioural change

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Flying in the face of climate change

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by

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Preface

It always seems impossible until it's done – Nelson Mandela

This quote exactly describes how I feel about the journey of writing a master thesis. In the beginning, it is quite scary. You have the feeling you are drowning in all the possibilities that research offers you. Finding your own path is what made writing a master thesis for me most challenging. I'm very glad that I succeeded in finding this path and very proud that I can now present my thesis to you.

This thesis *Flying in the face of climate change - the role of information to induce voluntary behavioural change* is written in fulfilment of the degree of Master of Science in Transport, Infrastructure & Logistics at the faculty of Civil Engineering and Geosciences and forms the final step of completing seven years of studying at Delft University of Technology. Writing this thesis has been a learning experience unlike all educational experiences before.

My thesis would not have been of the quality it is now without the help of my supervisors. I want to thank Gabrielle and Toon for the challenging discussions we had, the constructive feedback you gave me and for all the time you invested in this project. Thank you Maarten for the time you made available to be my daily supervisor and to give feedback on all my work. I experienced the meetings as pleasant and helpful in focussing on the bigger picture instead of the little details that were, when looking back, not always that important. Furthermore, my gratitude goes to Oded, especially for his concern for students wellbeing and his monthly organised catch-up meetings with other master students writing their thesis. Last but not least, I want to thank Jan-Anne for being there when he needed to be there.

A special mention goes to all the colleagues at the KiM Netherlands Institute for Transport Policy Analysis for giving me the opportunity to write my thesis at their institute and for helping me to stay positive, even in the face of personal setbacks.

Finally, I'm grateful for the support of my family, roommates and friends during this last year. A special thanks to Steven for always being there in times that I needed you the most.

Sanne Meijneke
Delft, December 5, 2022

Summary

This study examines the role of information as a means to raise awareness about the impact of flying on climate change and, in turn, to make people voluntarily reduce their intended flying. The Ministry of Infrastructure and Water Management looks into the possibility of raising the awareness of Dutch citizens as policy measure to encourage travellers to travel in a more conscious and more climate-friendly manner. The scientific literature, however, shows contradictory results on the effectiveness of this measure. There is an ongoing academic discussion on to what extent making people aware about the consequences of their behaviour could stimulate a desirable change in that behaviour. This research tries to get a thorough understanding of the relation between information about the impact of flying on climate change and the intention to fly for leisure purposes, and, therefore, examines via which causal pathway of socio-psychological factors information and awareness run to the intention to fly. This has led to the following research question:

What is the effect of receiving information about the relative impact of air travel on climate change compared to other travel- and household activities on the attitudes towards flying and the intention to fly of Dutch leisure travellers?

To answer this question, structural equation modelling is used. This modelling technique allows for answering questions that involve multiple regression analysis of latent variables. In this research, these variables are complex socio-psychological constructs. Additionally, structural equation modelling allows for estimating indirect effects between these different latent variables. A conceptual causal model based on a devised theory is constructed in advance, as this modelling technique is not able to confirm the directions of causation between factors. Therefore, a thorough systematic literature review has been performed resulting in a path model that maps the way in which air travel behaviour is formed and the way in which information aiming at raising awareness about the impact of flying on climate change links to this formation of behaviour.

Based on the latent variables incorporated in the constructed path model, a survey is designed and conducted among members of the MPN panel. 2030 members completed the survey of which 1976 were left in the data set after cleaning the data. The respondents formed a good representation of the Dutch population. They gave scores to various statements representing the many facets of the latent variables. These scores are used as input to construct the latent variables by performing confirmatory factor analysis. The gathered data together with the pre-defined conceptual causal model and constructed factors served as input for the path model and measurement model, which together create the structural equation model.

Since the information about the relative impact of air travel on climate change is operationalised in two different ways, two structural equation models are estimated. The results of both models show that there is no direct or indirect effect from the information about the impact of flying on climate change to the attitudes towards flying or the intention to fly. It is deemed likely that this result is caused by the already high current awareness found among Dutch citizens, as the information provided could only raise awareness and, in turn, affect the attitudes and intended flying behaviour when this information is ‘new’ to people.

Significant relationships are found when looking at the current awareness about the impact of flying on climate change itself and its effect on justifications, attitudes and the intention to fly. A higher current awareness of the impact of flying on climate change among Dutch citizens results in a higher environmental concern and a higher tendency to justify their intended flying behaviour. However, these effects do not work through to the intention to fly, i.e. people’s intended flying behaviour does not change. The results suggest that people will change their attitude rather than their behaviour to

solve the unease felt when acting against their environmental concern. So, an attitude-behaviour gap is present in the context of air travel behaviour.

The main conclusion that can be drawn from this research is that becoming aware about the relative impact of flying on climate change is not enough to change people's intended flying behaviour. Awareness only serves as pre-condition for behavioural change; other complementary, and most likely 'harder', measures are necessary to actually reduce the flying frequency among Dutch citizens.

The most common reason given by Dutch citizens to keep flying even when they are concerned about climate change is that there is no suitable alternative present to get where one wants to go for leisure purposes. This is in line with the high explained variance of the intention to fly found by the perceived behavioural control, which shows that people find it very hard to reduce their flying distance or flying frequency for leisure purposes. As developing an even faster and more reliable train network as alternative for flying will take significant time and effort, future research should look into the effectiveness of other short-term solutions, like promoting destinations nearby.

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Glossary

Attitudes towards flying (ATF): the individual's overall appraisal of flying as either positive or negative (adapted from Ajzen (1991)).

Awareness of Consequences (AoC): being aware that performing (or not performing) the particular behaviour has certain consequences (adapted from Schwartz (1977); De Groot en Steg (2009)).

Awareness of Need (AoN): being aware of an environmental issue that requires a behavioural response (Dütschke et al., 2022).

Behaviour-specific self-identity: the extent to which an individual perceives him or herself to be the sort of person who would engage in the behaviour under investigation (Morten et al., 2018)

Climate change & Global warming: used interchangeable, defined as "the change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer" (Masson-Delmotte et al., 2018, p. 544).

General environmental attitudes (GEA): environmental concern, the extent to which an individual views him or herself as someone who is concerned with environmental issues (Morten et al., 2018).

Justifications: finding acceptable reasons to behave in a way that has negative consequences for the environment.

Perceived Behavioural Control (PBC): the extent to which people consider the performance of a behaviour to be easy or difficult to perform (Trafimow et al., 2002, p.101)

Personal Norm (PN): a feeling of moral obligation to act pro-socially activated when people are aware of the negative consequences of not acting and feel responsible for these consequences (Schwartz, 1977; Schwartz and Howard, 1981).

Pro-environmental behaviours (PEB): actions performed by people in daily life that are comparatively better for the environment, like reducing energy consumption (Sparkman et al., 2021).

Self-efficacy: the degree to which a person believes that they can contribute to perceived socially desired goals (such as environmental preservation) through their own behaviours (Dütschke et al., 2022).

Social Norm descriptive (SN): the individual's perception of whether significant others perform a certain behaviour.

Social Norm prescriptive: the individual's perception of whether significant others would expect him or her to perform a certain behaviour (adapted from Ajzen (1991); Morten et al. (2018)).

Value of Self-Direction: those that emphasise "independent thought and action" (Schwartz, 1994, p. 22), and maintains that they are opposed to values of conformity with dominant social norms (Schwartz, 1994, p. 25).

Value of Self-Transcendence: include both altruistic (concern for other people, including those beyond one's close family, friendship or community circles) and biospheric (concern for the environment) values.

Voluntary behavioural change: altering behaviour while not being forced to do so by externally imposed measures.

1. Introduction

1.1. Problem identification & goal specification

As concluded by the European Commission (EC, 2022a, p.1); “Aviation is one of the fastest-growing sources of greenhouse gas emissions.” The CO_2-emission of flying can be substantial, considering that a return flight from Lisbon to New York generates roughly the same amount of CO_2-emissions as a whole year of heating a home of an average European citizen (Sullivan, 2020). According to Lee et al. (2021), the negative contribution of the aviation sector to global warming is at least twice the effect of CO_2 alone; other emissions like nitrogen oxides (NO_x) and water vapor contribute as well. The aviation industry is therefore one of the most polluting industries in need of decarbonisation (Gössling et al., 2009).

Despite these worrisome facts about the impact of aviation on global warming, the number of flights have been growing each year since 1990 by at least 5 percent (IATA, 2021). The COVID-19 pandemic caused a significant reduction in flights; the number of flights performed by the global airline industry dropped from 40.3 million flights to 16.9 million flights (see figure 1; Statista, 2022). Nevertheless, the International Air Transport Association (2022) expects a total recovery of the air passenger numbers in 2024 relative to the pre-COVID numbers in 2019, after which the number will be rising again. This prediction will result in an even larger ecological footprint of the aviation industry.

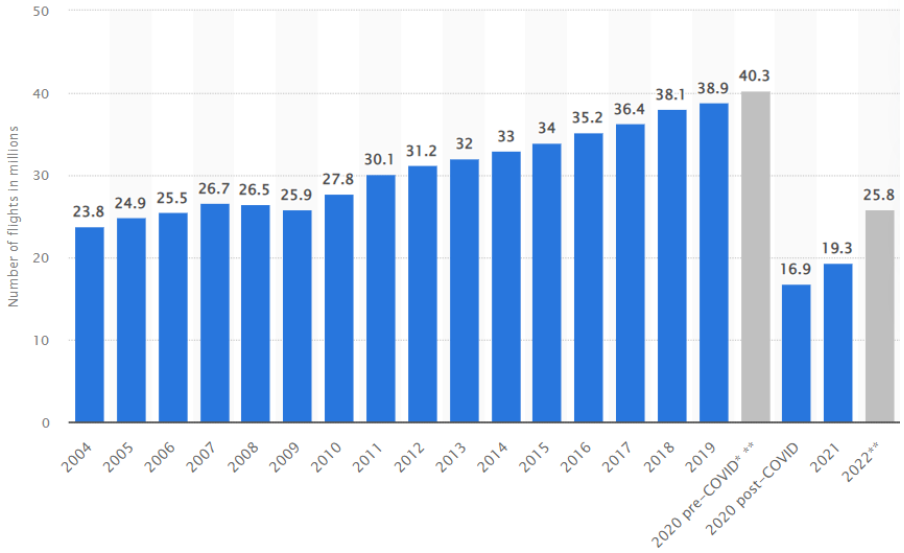


Figure 1; Number of flights performed by the global airline industry from 2004 to 2022 (Statista, 2022)

To prevent the further growth of greenhouse gas emissions, the number of flights need to be reduced and/or the aviation industry must become more sustainable. This is acknowledged by the world’s major aviation industry associations who adopted a 2050 net-zero carbon emission goal (ATAG, 2021), as well as by government agencies like the European Union who has adopted this same ambition and moreover has introduced concrete measures to reduce the aviation industry’s GHG emissions (EC, 2022a). According to Daley (2010), a reduction of the negative environmental effects of air travel can be achieved through five sorts of changes: technological, market-based, operational, regulatory and behavioural change. The European strategy for low-emission aviation is primarily focussed on regulatory and market-based changes, with the development of EU Emissions Trading System and the proposal of an increased obligation for the use of renewable fuels (EC, 2022a, 2022b). Zooming in at

the program of the Dutch government, the measures described in the 'Luchtvaartnota 2020-2050' and new coalition agreement of December 2021 focus primarily on technological and regulatory measures (Duurzame Luchtvaarttafel, 2021; Ministerie van I&W, 2020). According to several scientists, however, this narrow focus will not solve the climate problem in time (Peeters & Melkert, 2021; Werij et al., 2022). Other short-term changes need to be made to come even near to the goal of being climate-neutral in 2050.

A promising measure to mitigate the climate change impacts of aviation on a short term is stimulating voluntary behavioural change, i.e. altering behaviour in order to reduce the impact of aviation on climate change (Baumeister, 2020; Davison et al., 2014; Gössling et al., 2007). The word voluntary hereby refers to the self-willingness of people, not forced to do so by externally imposed measures. Voluntary behavioural change starts with making people aware of the choice they make and the effects these choices have. In the Netherlands, more than twenty organisations involved in aviation collaborated to develop ambitions, objectives and concrete actions to make aviation greener (Duurzame Luchtvaarttafel, 2022). One of the actions formulated is raising the awareness to encourage travellers to travel in a more conscious and more climate-friendly manner (Duurzame Luchtvaarttafel, 2021). Informing people about the relative environmental impact of flying compared with other activities contributing to climate change could, for example, give them the necessary insight to reconsider their choice to fly and change their flight frequency. Research, however, questions this way of inducing voluntary behavioural change (see section 1.2).

The aim of this study is to get insight into the effect of information about the negative contribution of air travel to climate change on the intention to fly among Dutch residents. This insight will help policy makers in finding out if providing information could be an effective strategy to actually induce voluntary behavioural change, in our case to get people out of the plane and encourage them to make more climate-friendly travel choices.

1.2. Knowledge gap identification

Voluntary behavioural change is hard to achieve. To find out what people who have changed their flying behaviour for the sake of the climate has motivated to stop travelling by air, Wormbs & Söderberg (2021) conducted an open answers survey which has been filled in by 673 Swedish residents. They asked the respondents how they did overcome the inertia of inaction regarding climate change and found different motives. The number one reason written down by the respondents is new knowledge. Reading about the size and proportions of the emissions when flying and the acuteness of the climate crisis brings insight and allows for comparison. This is concluded by Jacobson et al. (2020, p.1) as well, who state that "internalised knowledge about climate change and the impact of air travel is crucial for instigating behavioural change". Raising the level of knowledge could therefore be an effective measure to alter air travel behaviour in order to reduce the impact on climate change.

The type of information communicated to the public is important to evoke change. According to Reis & Higham (2016), well-communicated, centrally organised and easily understandable information about the impact of air travel on climate change is a pre-requisite for people to effectively reduce their travel emissions. Wormbs & Söderberg (2021) conclude that information that appeals to experiences and emotions as well as invokes moral action has helped people to drastically reduce their flying for climate reasons. Scientific and factual information is often hard to interpret and will therefore be less effective in activating behavioural change.

1.2.1 The current level of knowledge of the impact of air travel on climate change

Raising the level of knowledge is only effective when people acknowledge climate change but have currently little to no awareness of the impacts of air travel on climate change (Srivastava, 2016). Looking at the public perception on climate change in general, a survey set out by the UK government in 2020 showed that 83 percent of the almost 7000 respondents reported that climate change is a concern (BEIS, 2021). According to the Perceptions 2020 survey conducted by the Central Bureau of Statistics (2021) in the Netherlands, 94 percent of the Dutch population aged 18 and over confirm climate change. Three-quarters of the Dutch people are also concerned about the impact of climate change on future generations. It can therefore be concluded that the vast majority of people in western Europe countries is aware and even worried about climate change.

A wide range of research investigates the awareness and attitudes towards air travel related to climate change, either as goal of their study or as part to evaluate the possible effectiveness of different policy measures (Gössling et al., 2009; J. Higham & Cohen, 2011; Kroesen, 2013; Reis & Higham, 2016). Most of the studies show that there is awareness of the impact of peoples' air travel on climate change (Gössling et al., 2009; J. Higham & Cohen, 2011; Kroesen, 2013). Results of the study of Reis & Higham (2016) show, however, an evident low level of awareness.

The differences can be explained easily by the fact that the results on the study of Reis & Higham (2016) are based on interviews with 20 Australians, while the other studies are conducted with more respondents in different countries (Sweden, Norway, The Netherlands). This makes it more plausible that people in western countries generally are aware of the impact of air travel on climate change. A difference that could contradict this conclusion and shows that people are not really aware of the negative impact of air travel on climate change is the detail in which people were able to answer questions about their awareness. While in the study of Kroesen (2013, table 3 p. 277), for example, the respondents needed to indicate on a scale to what extent they agreed with the following statement: "I know what the contribution of my air travel behaviour is on the total carbon emission associated with my consumption", the study of Reis & Higham (2016) conducted semi-structured, open-ended interviews where people could give more detailed answers on their awareness of the impact of air travel on climate change. That this difference in questioning matters is acknowledged by Gössling et al. (2009), who states that even when there is a common understanding about the harmfulness of flying, it is still unclear how air travellers see aviation's contribution to climate change in contrast to other human activities contributing to global warming.

Furthermore, it must be mentioned that the studies indicating there is awareness of the negative impact of air travel on climate change are conducted at least 5 years ago. No more recent studies have been found questioning the awareness. The latest studies found on this topic carefully selected their respondents by choosing environmental experts as target group assuming they know the environmental effects of air travel (Bamdad, 2019) or did not question the perception on climate change in relation to air travel, only in general (BEIS, 2021; CBS, 2021a). While people's viewpoints change over time, it is hard to say if and to what extent people are nowadays aware of the negative contribution of air travel to climate change.

1.2.2. Information alone may not be sufficient to induce change in air travel behaviour

There are multiple studies indicating that informing the travelling public is not sufficient to induce behavioural change in relation to air travel (Becken, 2007; Higham et al., 2016; Jackson, 2005; Moser & Dilling, 2011). Jackson (2005) found that providing more information could even lead to a rise in the level of helplessness and lack of individual control. Although these studies only look at scientific and factual information to inform the public of which the effectiveness is doubted, they indicate multiple barriers which need to be solved first to achieve voluntary behavioural change regarding the use of air

travel by the public. These barriers explain why people continue flying while they are aware of the damage this causes to the environment.

There is a great wealth of evidence suggesting that even though people identify air travel as a cause of climate change and are familiar with the negative externalities of flying, there is little willingness to cut back their air travel to mitigate climate change (Alcock et al., 2017; Bamdad, 2019; Barr et al., 2010; Baumeister, 2020; Cohen & Higham, 2011; Hanna & Adams, 2017; Hares et al., 2010; Hibbert et al., 2013; Juvan & Dolnicar, 2014; Kroesen, 2013; Lassen, 2010). This is called the attitude-behaviour or value-action gap. Lowering a persons' air travel could feel like a restriction of personal freedom and/or like a decrease in the quality of life (Baumeister, 2020). According to Higham et al. (2014) and Young et al. (2015) this is characterised by the "flyers dilemma": a growing tension exists between the desirable consumption pattern of frequent air travel and the responsibility towards the environment.

An overall reason to explain the attitude-behaviour gap is the number of factors determining behaviour. Hence, attitude is not the only predictor of behaviour. There are multiple studies showing a wide range of factors explaining people's flying behaviour (Davison et al., 2014; Hansmann & Binder, 2021; Morten et al., 2018; Pandey & Joshi, 2021). Morten et al. (2018) for example, applies the Theory of Planned Behaviour (TPB) to the reduction of holiday air travel. They conclude that a substantial amount of the variance in the intention to reduce flying is explained by the core TPB predictors: attitudes, subjective norms and perceived behavioural control. Attitude is thus not the only factor explaining behaviour, making it possible for a gap to exist.

A second explanation found in literature relates to the role of justifications. To solve the unease felt by individuals when acting against their pro-environmental values, people will change their attitude rather than their behaviour (Hansmann & Binder, 2021; Jacobson et al., 2020; Juvan & Dolnicar, 2014). They try to find a form of justification for their flying behaviour instead of actually reduce flying. This so called cognitive dissonance can become stronger when individuals have weak reasons to explain their actions (Howarth et al., 2009). These justifications vary widely. Kroesen (2013) found for example justifications based on guilt, denial and indulgence, to which Hibbert et al. (2013) added justifications like the willingness of paying higher taxes as a "penance" and the compensation by sustainable practices at home.

A further gap is identified between pro-enviromental behaviour at home/work and on holiday (Alcock et al., 2017; Bamdad, 2019; Barr et al., 2010; Cohen et al., 2013; Miller et al., 2010). Alcock et al. (2017) explored if the pro-environmental consistency hypothesis, i.e. people with more pro-environmental attitudes will show more pro-environmental behaviour, extends to the non-work-related flying behaviour. They found evidence that there is a positive relationship between individuals' pro-environmental attitude and pro-environmental household behaviour, but this did not extend to the non-work-related flying behaviour. This is in line with the findings of Bamdad (2019), who concluded that there is no spillover from environmental experts' pro-environmental attitude-behaviour in work setting to the tourism context.

The identified barriers show the complexity of evoking voluntary behavioural change. This stresses the need for a better understanding of the underlying mechanisms when providing information to get people out of the plane. While there are various studies examining the socio-psychological factors that might influence individuals' intention to reduce flying or to use a more sustainable transport modes for long-distance leisure travel (Dütschke et al., 2022; Hansmann & Binder, 2021; Morten et al., 2018; Oswald & Ernst, 2020; Pandey & Joshi, 2021), their conclusions are based on correlational testing between these socio-psychological variables and the intention to fly or the actual flying behaviour. It

is not known via which causal pathway of socio-psychological variables the information about the relative impact of flying operates to the intention to fly.

1.2.3. Conclusion on the identified knowledge gaps

Various scientific gaps are identified which make it unclear if raising the current awareness by providing information could actually lead to a voluntary reduction in people's flying. Since it is not possible to fill all gaps identified, the aim of this study is to fill the following three gaps:

1. To what extent are people currently aware of the negative impact of their own decision to fly? How do they see aviation's contribution to climate change in contrast to other human activities contributing to global warming?
2. Via which causal pathway of socio-psychological variables does information about the relative impact of flying operate to the intention to fly? Which constructs are affected when informing people about the relative environmental impact of flying compared with other activities contributing to climate change?
3. Does the awareness about the impact of air travel on climate change reflect in people's choice to fly and could information raising this awareness help to steer this choice?

Knowing the existing awareness of Dutch residents is key to know whether this awareness can be raised at all. If this awareness can be raised, it is fundamental to know if the awareness reflects in people's choice to fly and which socio-psychological factors play a determining role for this awareness to reflect in the choice to fly. If part of the Dutch residents will not change their flying even when their awareness is raised, it is interesting to know what reasons they use to justify their behaviour. With this knowledge, the Dutch Ministry of Infrastructure and Water Management will be well informed about the effectiveness of raising the awareness of the Dutch residents as strategy to get people out of the plane.

1.3. Main research question & sub questions

This main goal of this study is to find out if providing information as a policy measure to raise awareness of the impact of flying on climate change could help to motivate people to reduce their air travel. From a policy perspective, we want to gain insight into the effect of receiving information about the relative impact of flying on climate change on the intention to fly. From a scientific perspective, we also want to know whether the information operates via the causal pathway that is assumed by the theories described in paragraph 1.2.2, so via attitudes and justifications, or whether it additionally operates via other constructs. This causal pathway will be made more explicit when diving further into the literature. The main research question is, therefore, defined as follows:

What is the effect of receiving information about the relative impact of air travel on climate change compared to other travel- and household activities on the attitudes towards flying and the intention to fly of Dutch leisure travellers?

While ideally people's flying behaviour is represented by their actual choice to fly, this study will only look at people's intention to fly due to constraints in time and resources. It must therefore be noted that in the desired case of finding a reduction in the intention to fly among people who received the information, only statements about the intended flying behaviour can be made.

Indirect effects of receiving information about the impact of flying on climate change, on the intention to fly via attitudes and justifications are included in this study. These indirect effects will provide more insight into the psychological path of factors influencing the intention to fly as well as into the

constructs that are affected when informing people about the relative environmental impact of flying compared with other activities contributing to climate change.

To support answering the main research questions, the following additional sub questions are proposed:

1. *How could the relations between information, awareness, attitudes and behaviour be conceptualized based on the existing scientific theories and knowledge?*
   Result: A theory expressed in a conceptual model containing the most important socio-psychological determinants of the choice to fly and its relations.

2. *What is the current level of awareness of Dutch citizens regarding the impact of air travel on climate change?*
   Result: The system-, action- and effectiveness-related awareness of the impact of flying on climate change of the Dutch citizens.

3. *What is the effect of receiving information regarding the negative contribution of air travel to climate change on people's intention to fly for leisure purposes?*
   Result: The possible presence and strength of the effect of receiving information about the impact of flying on climate change, on the intention to fly among Dutch residents.

4. *What are the reasons Dutch citizens use to justify their intended flying behaviour for leisure purposes?*
   Result: Overview of types of justifications most commonly used by Dutch citizens.

1.4. Methodology

In order to answer the formulated research questions, Structural Equations Modelling will be adopted as main research method, supported by various other analysis methods. The first sub question will be answered by performing a thorough systematic literature review. The academic search engines *Scopus*, *Google Scholar* and *Library TU Delft* are used to study the currently existing literature on the relations between information, awareness, attitudes and behaviour and other socio-psychological and socio-demographic factors affecting these relations in the context of pro-environmental behaviour and air travel reduction. Searches include terms like 'Behavioural models', 'Pro-environmental behaviour', 'Reducing Air travel/Flying', 'Holiday/Long-haul travel' and 'Determinants/Predictors'. Since a lot of studies are conducted in this area, recent European and empirical studies are preferred. The studies found serve as a basis to develop a theory among the way information could motivate and get people to act in a desirable way, i.e. to reduce their air travel for leisure purposes. This behavioural theory is captured in a conceptual causal model.

Since it could be the case that raising awareness will not be effective due to an already high awareness among Dutch people, the current level of awareness regarding the impact of aviation on climate change must be established (sub question 2). An online-survey will be conducted in which the respondents need to indicate to what extent they agree or disagree with several statements about the perception regarding their awareness of the impact of flying on climate change. This shows respondents stated current awareness regarding the contribution of air travel to climate change. Furthermore, they need to answer various multiple-choice questions as well as complete a ranking task, which together test their actual current awareness. The survey will be set out to the Dutch Mobility Panel (MPN) which includes respondents aged 12 years and older from about 2.000 complete households (Ministerie van I&W, 2016). The MPN is a suitable panel since the panel includes only

residents from the Netherlands who vary in terms of age, education, residential area, and more, making them a representative sample for the target group: the Dutch population (see section 1.5). After thoroughly cleaning the data obtained from the survey, the data will be analysed in IBM® SPSS® Statistics™ 26 using descriptive statistics. The results will show if there is already a high current awareness or not among the Dutch citizens and if a difference exists between their stated and actual awareness.

The third sub question will be answered by estimating and assessing the established conceptual causal model in a Structural equation Model. Structural Equation Modelling (SEM), also referred to as causal modelling, can be defined as "a collection of statistical techniques that allow a set of relationships between one or more independent variables and one or more dependent variables, both either continuous or discrete, to be examined" (Ullman & Bentler, 2012, p.1). These variables can be either observable variables or latent variables. Latent variables, i.e. factors, are complex concepts that are multi-faceted and cannot be directly observed, like perceptions and attitudes (Molin, 2019a). SEM is suitable for answering questions that involve multiple regression analysis of latent variables and can estimate indirect effects between different factors. Since this study looks into the socio-psychological factors underlying air travel behaviour and the relations between these factors, indirect effects between latent variables can be present. Another advantage of SEM is the possibility of decomposing complex, multi-faceted concepts in different variables which enhances the reliability and validity of the measurements (Kroesen, 2006). This will be applied by performing factor analysis to include the socio-psychological factors in the SEM.

The data necessary to estimate the Structural equation Model will be collected by setting out an online-survey to members of the Dutch Mobility Panel. The survey will include statements related to the various socio-psychological factors to which the respondents need to specify their level of agreement based on a 5-point Likert Scale. The data obtained will be first generally analysed using IBM® SPSS® Statistics™ 26, after which the software package IBM® SPSS® AMOS™ 26 is used to estimate the Structural equation Model. This will show if the conceptualised direct and indirect effects of receiving information about the impact of flying on climate change, on the intention to fly, are present among Dutch travellers, together with the strength of these relations.

The justifications used by Dutch citizens to explain their acting against their own pro-environmental values are questioned at the end of the online-survey, as these type of justifications provide interesting insights for policy-making (sub question 4). Different categories of justifications will be established by looking into the existing scientific literature. The respondents showing cognitive dissonance need to indicate in the survey which statements fit their reasons to fly while being environmentally concerned. They do so by ticking the box of all applicable statements. The resulting data will be analysed in IBM® SPSS® Statistics™ 26 using descriptive statistics. The importance of each category will be compared, which gives insight in the most commonly used types of justifications by Dutch citizens.

Based on the results found in this study as well as insights gained from previous studies regarding the decision making process on the choice to fly for leisure purposes, practical implications for policy makers will be drawn up.

1.5. Research scope

This research will be conducted in the Netherlands. One of the possible short term actions to make aviation greener is raising the level of awareness to encourage travellers to travel in a more conscious and more climate-friendly manner. A collaboration of experts in aviation has recommended this action to the Dutch government as potential short term measure to reduce the industry's GHG emissions

(Duurzame Luchtvaarttafel, 2021). This emphasises the relevance of this study for the Dutch ministry of Infrastructure and Water Management.

Since three quarters of all air travel by Dutch people is for private purposes (Zijlstra & Rienstra, 2021) and being in control of your choice is a prerequisite to induce voluntary behavioural change, this study will only take into account flights for leisure purposes. The motives to fly included in this research are holiday travel as well as visiting friends or family. Flights for business related purposes are excluded from this study, since these flights are subject to a complex process involving multiple parties sharing the control of the choice to fly.

The total Dutch population aged 18 years and older is the target group of this study. These people are all adults allowed to fly on their own and can therefore make their own decisions regarding their flying.

This study focusses only on negative impact of flying on climate change via CO_2-emissions. Although air travel is associated with multiple other emissions like nitrogen oxides (NO_x) and water vapor contribute which enhance the negative effect of air travel (Sullivan, 2020), the climate impact of these emissions are hard to measure and express, and bring along a lot of extra complexity. This makes it only harder for people to get an understanding of the negative impact of air travel on climate change, what goes beyond the purpose of raising awareness.

As we strive for voluntarily behavioural change, only socio-psychological factors are included in this research. Factors representing characteristics outside the person, like attributes defining the overall service of flying, are excluded.

1.6. Outline of the report

This study contains a total of six chapters, all building towards the sixth and last chapter in which the main research question will be answered.

The first chapter identifies the problems resulting in and related to the possibility of getting people out of the plane by providing information about the consequences of air travel and thereby raising awareness. The research questions are introduced, followed by a short description of the methods used to answer the questions.

In the second chapter, a literature review is presented with the aim to answer the first research question as well as to find out what type and form of information could be effective in reducing people's air travel. This results in a final causal conceptual model, which will be used as input for the design of the survey and the estimation of the structural equation models.

The third chapter provides a more in-depth overview of the methods used to gather, clean and analyse the data. The operationalisation of the various factors included in the causal conceptual model are presented. Additionally, the results of the first analysis constructing the various factors and variables are shown preparing the data to be implemented in the structural equation models.

The results answering the second, third and fourth sub question are presented in chapter four. The findings are presented and first conclusions are drawn.

The fifth chapter reflects on the presented results in chapter four, looking at the meaning of the results in the air travel context as well as in the broader context. The uncertainties and limitations of the study are acknowledge, ending the chapter with the final recommendations and opportunities for future research.

This all leads to the sixth chapter, the conclusion, which provides the answer on the main research question and presents the key takeaways of this study.

2. Theoretical framework

A lot of research has already been conducted in the field environmental behaviour, more specifically on stimulating pro-environmental behaviour in various low-effort and high-effort cases, among others reducing people's air travel. This existing research helps to map the most important socio-psychological predictors of the flying behaviour of leisure travellers and its relations between them, resulting in a conceptual causal model used as input for the Structural equation Model.

2.1. Theoretical models to study pro-environmental behaviour

In order to know how information can shape and change behaviour, it is important to have a basic understanding why people behave in the way they behave, i.e. how behaviour is formed. Different theories are applied in the environmental social psychology to study pro-environmental behaviours. These theories provide insights into what motivates and prevents people to engage in pro-environmental behaviours, which serves as foundation for informational interventions. Only the most discussed theories related to studying pro-environmental behaviours are outlined in this section.

2.1.1. Theory of Planned Behaviour (TPB)

One of the most prevalent and widely cited behavioural theory is the 'theory of planned behaviour'. This theory is developed by Ajzen (1991) and shows that the *intention* to carry out a certain behaviour is directly related to the *behaviour* actually shown. This intention is influenced by three groups of factors: *attitude towards the behaviour* (i.e. favourable or unfavourable evaluation of the behaviour), *subjective norms* (i.e. perceived social pressure to perform or not to perform the behaviour) and *perceived behavioural control* (i.e. perception of the extent to which the behaviour is within the persons' control) (see figure 2) (Luzzi & Spencer, 2008). So, a person will have strong intentions to act in a certain way, if they evaluate this act positively, if they expect important others to agree with the act and if they believe they are in control to perform the act.

Each type of behaviour is associated with a different relative importance of attitude, subjective norms and perceived behavioural control. Looking at different types of pro-environmental behaviour, Abrahamse (2019) states that car use or energy conservation behaviours are more strongly correlated with perceived behavioural control, while recycling and buying organic foods are more strongly correlated with attitudes and social norms.

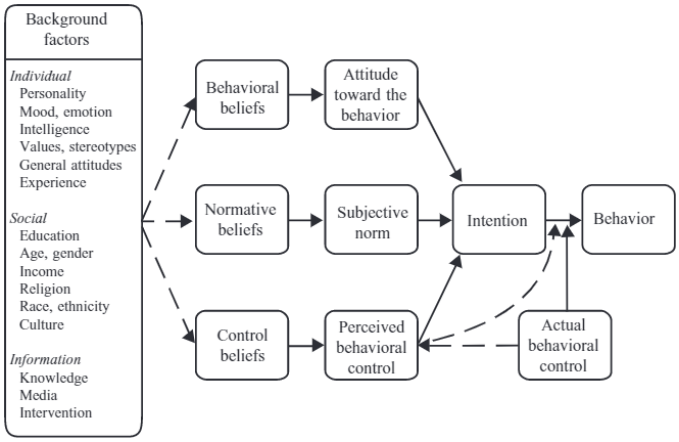


Figure 2; Theory of Planned Behaviour (Ajzen & Fishbein, 2005)

Beliefs are the determinants of all three groups of factors. Beliefs can be defined as "the assumptions or convictions that are held true about the entity" (Lyons et al., 2008, p.159). Beliefs are formed by becoming aware of objects, relationships, and events by means of the senses (APA, n.d.). By forming

judgements about the importance of the beliefs, so evaluating the beliefs, attitudes towards the behaviour as well as the subjective norm and perceived behavioural control are created.

According to the theory of planned behaviour, individuals make logical, reasoned decisions by evaluating information that is available to them (Ryan & Carr, 2010). Information, in all its forms, works through on beliefs, via attitudes, social norms and perceived behavioural control towards people's behavioural intention and their actual behaviour. To see how external influences like information and experiences shape behaviour, Lyons et al. (2008) made a simple conceptualisation based on the theory of planned behaviour (see figure 3). Although this is a simplified conceptual model, it clarifies the role of information in the behaviour forming process according to the principles of the theory of planned behaviour.

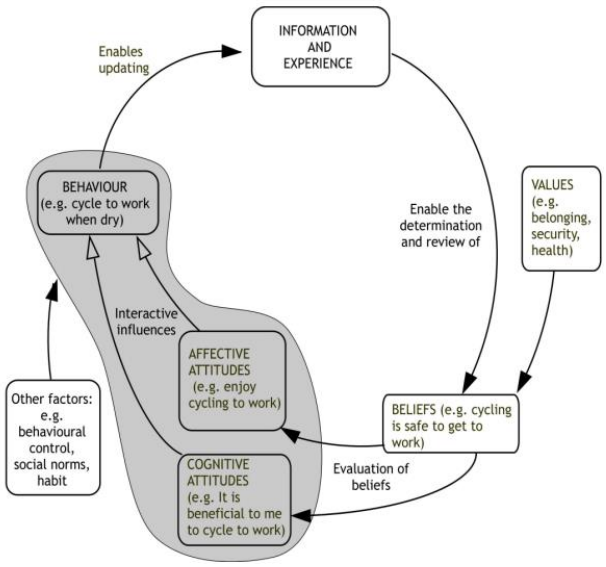


Figure 3; A simple conceptualisation of the relations between Values, Beliefs, Attitudes and Behaviour (Lyons et al., 2008, p.158)

2.1.2. Norm-Activation Theory (NAT)

Pro-environmental behaviour could be originated from an inner concern for the environment. While the theory of planned behaviour assumes people to be rational creatures making choices based on weighing costs and benefits, this rationality does often not hold true when making environmental behavioural choices (Abrahamse, 2019a). Environmental and altruistic motivations could make people give up some personal benefits for the greater good, the environment.

This is embedded in the Norm-Activation theory of Schwartz (1977) which centralises the idea of "altruistic behaviour being causally influenced by feelings of moral obligation to act on one's personally held norms". Individuals develop self-expectations regarding their pro-environmental behaviour called personal norms (Octav-Ionut, 2015). Since people feel the moral obligation to act upon these norms, personal norms directly influence behaviour. A conceptual model of the Norm-Activation theory of Schwartz is presented in figure 4.

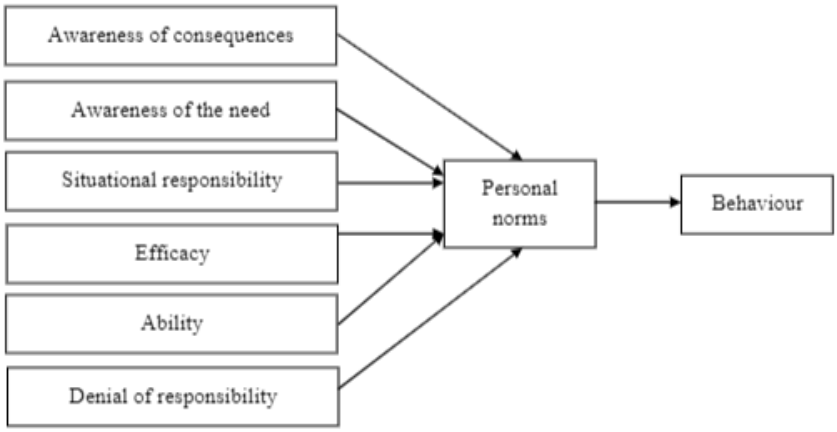


Figure 4; Norm Activation Theory (Schwartz, 1977)

Personal norms are determined by two types of factors: being aware that performing (or not performing) the particular behaviour has certain consequences, and feeling responsible for performing the specific behaviour. De Groot & Steg (2009) have examined the relationship between the variables included in the model and provided strong evidence for the NAM to be a moderation model. This suggests that an individual must be aware of the consequences of their behaviour to feel responsible for it and this responsibility, in turn, activates personal norms inducing behaviour (see figure 5).

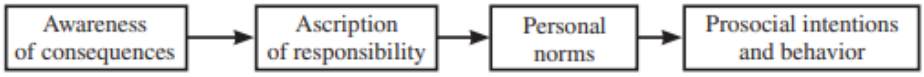


Figure 5; Norm Activation Model of prosocial behaviour as moderator model adapted from De Groot & Steg (2009)

2.1.3. Value-Belief-Norms (VBN) Theory

Stern and colleagues generalizes the norm activation theory by incorporating egoistic and biospheric value orientations next to the altruistic values toward other human beings (Stern, 2000; Stern et al., 1993, 1999). They believe that environmentally significant individual behaviour is also guided by norms based on self-interest, i.e. egoistic value orientation, and altruism towards nonhuman species, i.e. biospheric value orientation. All three types of personal norms are activated in the same way. These thoughts resulted in a more complex theory explaining the formation of pro-environmental behaviour: the value-belief-norms (VBN) theory.

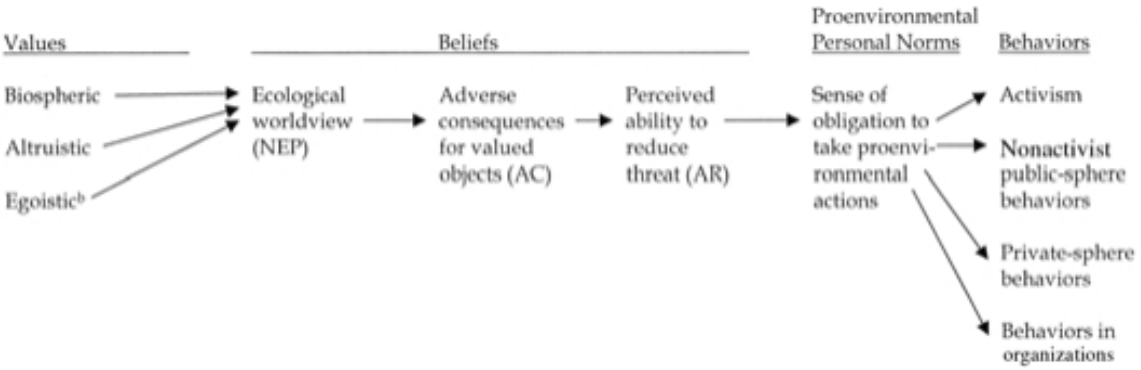


Figure 6; Value-belief-norms theory (Stern, 2000)

The conceptual framework is shown in figure 6. The three different types of value orientations are at the core of behavioural choices. They affect the individuals' level of environmental concern, which is measured by the New Ecological Paradigm (NEP). The NEP consists of 15 statements to which people are asked to indicate their level of agreement (Abrahamse, 2019a). The NEP is a more general measure

of environmental concern and influences, in turn, people's more behaviour-specific beliefs regarding the awareness of the environmental consequences of their actions, the belief that the environment conditions form a threat to things a person values (i.e. AC in figure 6). The responsibility to act (i.e. AR in figure 7) becomes stronger when the awareness of the negative environmental consequences is higher. The factors AC and AR can also be found in the norm activation model; these factors activate personal norms. People with stronger feelings regarding the responsibility to act will have a stronger feeling of moral obligation to act in a pro-environmental way; their pro-environmental personal norms become stronger.

This model is adapted in recent studies examining a broad range of pro-environmental behaviours, for example tourists' pro-sustainable behaviours (Landon et al., 2018), consumers' behaviour towards environmentally friendly drone food delivery services (Hwang et al., 2020) and people's behavioural intentions to use solar energy (Awais et al., 2022).

2.1.4. Conclusion

The different theoretical models discussed point out the importance of values, beliefs, attitudes, norms, control and behavioural intention to explain pro-environmental behaviour. These factors are already identified as important determinants in explaining recycling behaviour, energy conservation behaviour and travel behaviour. Since these factors are of a general nature, they need to be made case specific before being used, in our case, in the context of pro-environmental behavioural decisions regarding air travel. In this way, it can be determined which of these general theories has the most potential to explain people's air travel behaviour. This theory will then serve as a basis to conceptualise via which socio-psychological pathways air travel behaviour is formed.

2.2. Application of theoretical models to study behavioural decisions regarding flying

The discussed theoretical models to study pro-environmental behaviour serve as a basis for studying behavioural decisions regarding air travel. Multiple studies are conducted aiming at gaining a better understanding of the predictors of the intention to fly. Different theoretical models are used as a starting point to find the most important motivators influencing the choice to fly for leisure purposes. Table 11 in appendix B shows 25 determinants or factors found in literature to predict either the intention to reduce flying or the actual flying behaviour of western Europe residents.

Six studies are found trying to map out the socio-psychological determinants of the intention to reduce flying or the actual flight kilometres using statistical analysis. Most of these studies are published in the last five years, only the study of Davison et al. was already published in 2014. This study, however, is one of the first studies conducted that tries to get a thorough understanding of the psychological path of factors influencing the intention to fly and finally the actual flying behaviour by using statistical analysis, which is also one of the goals of this study. The study of Davison et al. (2014) is referred to in all other studies and can be seen as a basis to build on future research. The six studies are all conducted in western European countries including large samples. This makes them very representative for our study.

The three other incorporated studies are explorative of nature and based on interviews. These studies contribute in a way that they dive deeper in some of the important determinants and give a clear view on the way these factors serve as determinants.

2.2.1.'Intention to fly' as dependent variable to study air travel behaviour

All reviewed studies have the same goal; they all want to know what kind of socio-psychological factors are associated with the choice to fly for leisure purposes with the goal to find out how people could be steered in the direction to reduce their air travel. Nevertheless, the dependent variable differs in

most of the reviewed studies (see table 11 appendix B). This study looks at the *intention to fly* as dependent variable. Although the higher-end goal of this study is to change people's air travel behaviour and get people out of the plane, the actual flying behaviour is hard to measure when using a stated preference technique asking for hypothetical choices instead of looking at real choices. To get closer to people's real behaviour, a choice experiment could be conducted. Because of limitations of available time and resources, the idea of including a choice experiment has been rejected. According to the theory of planned behaviour (see paragraph 2.1.1.), the intention to perform a certain type of behaviour is the closest predictor of the actual behaviour, which is therefore incorporated as dependent variable in this study.

2.2.2. The 25 identified determinants and their relation to the intention to fly

As seen in the TPB, attitudes determine the intention to behave in a certain way. Two types of attitudes are incorporated in the studies found: general environmental attitudes and the attitudes towards flying. The *general environmental attitudes*, also called pro-environmental attitude or pro-environmental self-identity, is someone's general concern towards the environment. Although the naming is different among studies, the statements used to measure this factor are aligned. The idea behind is stated by Morten et al. (2018, p.299) as follows: "people's more general views of themselves as 'green' or 'concerned with environmental issues' might further contribute to the prediction of intentions to engage in pro-environmental behaviours." Hansmann & Binder (2021) have proven that a higher concern towards the general environment causes a greater intention to reduce flight travel ($\beta=0.24$, $p<0.001$). Other studies, however, show no significant relationship between the general environmental attitudes of people and their intention to reduce flying or their actual flight kilometres. This could be related to the difference in dependent variable (Alcock et al., 2017), suggesting that there is a significant relation between the general environmental attitudes and the intention to reduce flying but this does not spill over to the actual behaviour of these people. Other reasons explaining this difference in significance are circumstances like the sample size, sample composition, research method or countries the survey was held (Bamdad, 2019; Morten et al., 2018). It is therefore not clear if the general environmental attitudes of people determine the intention to reduce flying and the actual flying behaviour.

A lower-order attitude compared to the general environmental attitudes incorporated in studies as predicting variable is the *attitudes towards flying*. It more specifically looks at the feeling regarding reducing the number of flights as being good or bad, harmful or beneficial, worthless or valuable, and so forth (Morten et al., 2018). This factor has proven to be a significant determinant for the intention to reduce air travel as well as the actual flying behaviour expressed in flight kilometres (Morten et al., 2018; Oswald & Ernst, 2020), meaning that a more positive attitudes towards reducing the number of flights causes a reduction in the intention to fly and the actual flying behaviour.

There are multiple reasons why people believe they have or haven't control over their flying behaviour. Travelling is often a social activity involving more than one person (CBS, 2017). It is hence possible to think that someone else is making the decision for you when travelling with other people, so you are not in control of the decision, as well as to believe that there is no other doable option to travel which meets your travel requirements, so you perceive changing behaviour as difficult. This is all incorporated in the factor *perceived behavioural control*, which can be seen as a two-dimensional construct containing the perceived control and the perceived difficulty (Trafimow et al., 2002). Multiple studies included this factor and have shown that a person who has a feeling (s)he is in control of the choice to fly or not for their leisure trip is more willing to reduce their flying (Davison et al., 2014; Dütschke et al., 2022; Oswald & Ernst, 2020). In the study of Dütschke et al. (2022), perceived behavioural control,

defined by the perception of available and feasible alternatives, is even the most important predictor of the intention to use another mode than flying for the next long-distance leisure travel.

A factor related to the perceived behavioural control included by Dütschke et al. (2022, p. 117) is a person's *self-efficacy*, i.e. "the degree to which a person believes that they can contribute to desired goals (such as environmental preservation) through their own behaviours". The difference here is that it not only looks at if a person thinks (s)he could contribute to the goal of reducing air travel, but also encourage others to do the same. Although this factor has been found significant for everyday consumption (Hanss et al., 2016), Dütschke et al. (2022) found that self-efficacy is not significant in the air travel context.

The social or subjective norm is in most studies incorporated as one predictor of the intention to fly (see table 11), referred to as: 'we fly because others expect us to do so'. Hansmann & Binder (2021), however, incorporate the social norm as two determinants, differentiating between the prescriptive and descriptive social norm. Where the *prescriptive social norm* is described in the same way as the overall social/subjective norm incorporated in other studies, *the descriptive social norm* refers to people's perception of the actual behaviour of others. Since in the study of Hansmann & Binder (2021) only the prescriptive norm appears to be a significant predictor of the intention to fly, people's thoughts about what others expect and think they must do is affecting people's intention to fly. This perceived expectation is difficult to align with the actual expectations and thoughts of the people around you, which makes it hard to change by other parties.

Another type of norm included in several studies in line with the norm-activation theory and the value-belief-norm theory is an individual's *personal norm*. The personal norm in this case refers to a feeling of moral obligation to reduce flying and is activated when people are aware of the negative impact of flying for climate change and feel responsible for these negative externalities. The studies of Davison et al. (2014) and Oswald & Ernst (2020) combine both personal norms and subjective norms as one factor predicting the intention to reduce flying or the actual flying behaviour in flight kilometres. It is therefore hard to say if the personal norm itself is a significant predictor. The difference in operationalisation of the personal norm varies a lot between studies. Where Hansmann & Binder (2021, p.5 table 1) use the statement "One should take advantage of current low airfares" to measure personal norm, Dütschke et al. (2022, p.119) use multiple statements like "Because of my personal values I feel obliged to travel without the use of an airplane in my leisure time" to measure the personal norm. This causes a difference in significance of this factor among the various studies.

According to the norm-activation and value-belief-norm theory, personal norms are amongst others determined by the *awareness of consequences* and the *awareness of need*. The study of Dütschke et al. (2022) has included the awareness of consequences as well as the awareness of need as separate predictors for the intention to use another way of travelling than flying for the next long-haul leisure trip. These are both proven to be not statistically significant. Using interviews, Büchs (2017) confirms that the awareness of consequences is not systematically related to the decision to reduce flying. On the other hand, Davison et al. (2014) also incorporated the awareness of consequences and worldview as predictor of the intention to reduce flying and found this to be a significant determinant. This awareness, however, is operated in a similar way as the general environmental attitudes of other studies and could therefore not be seen as independent variable.

Büchs (2017) focussed in her study on the role values play in voluntary reducing holiday flights. Two types of values are examined in this research: the *value of self-direction*, i.e. the values that emphasise "independent thought and action" (Schwartz, 1994, p. 22) opposed to values of conformity with

dominant social norms (Schwartz, 1994, p. 25), and the *value of self-transcendence*, i.e. the values that include both altruistic (concern for other people, including those beyond one's close family, friendship or community circles) and biospheric (concern for the environment) values. According to the earlier mentioned VBN theory, values affect beliefs which in turn influence norms and behaviour. Büchs (2017) conducted 52 semi-structured interviews and came to the conclusion that both values only activate reduction in holiday flights when they coincide with other specific personal perceptions and norms.

The labels that one ascribes to oneself, in other words finding yourself the sort of person who would engage in the pro-environmental behaviour, is a motivator for reducing someone's intention to fly. Morten et al. (2018, p. 302) specified this as *behaviour-specific self-identity* and proved that "perceiving oneself as the type of person who would reduce the number of flights taken was associated with more positive intentions to engage in this behaviour".

To solve the existing cognitive dissonance regarding air travel for leisure purposes (see paragraph 1.2.2), people try to find a form of *justification* for their flying behaviour. They feel an unease when acting against their pro-environmental values, which is easier to solve by changing their attitude than their behaviour (Hansmann & Binder, 2021; Jacobson et al., 2020; Juvan & Dolnicar, 2014). Where Hansmann & Binder (2021) show these justifications to be a significant predictor of the intention to reduce people's air travel, Arnadottir et al. (2021) dived deeper into the factor justifications and identified six themes of justifications to continue air travel. This indicates that people use a lot of different types of explanations to justify their behaviour, like shifting the responsibility to act and not having the knowledge or being aware of the harm they cause. These justifications need to be tackled to change not only people's intention to reduce their flying, but also their actual behaviour.

Although *habits* are hard to change, the studies of Dütschke et al (2022) and Hansmann & Binder (2021) confirmed that this factor determines behavioural intention regarding air travel. This indicates that people are not re-evaluating their use of transport mode regularly, which makes it hard to induce voluntary behavioural change.

An unexpected result regarding the *non-moral aspects* defined as the perceived fun, freedom, and comfort of using an airplane for travelling came up in the study of Dütschke et al. (2022, p.122): "people with a stronger desire for distant places or who associate flying with having fun showed stronger intentions to use different modes instead of air travel". Since this contradicts expectations, more research into this predictor is necessary. However, this determinant will not be further included in this study, as it corresponds largely with the attitudes towards flying.

Oswald & Ernst (2020) included two external barriers for flying into their estimated SEM model as control variables: the *fear of flying* and *financial barriers*. Only the financial barriers are a significant determinant for the flight kilometres included as dependent variable. The study, however, does not show how these variables are operationalised and how they need to be interpreted.

The final predictors listed in table 11 are socio-demographic factors. These factors do not affect the intention to reduce flying or the actual flying behaviour; they are all proven to be non-significant (Dütschke et al., 2022; Hansmann & Binder, 2021; Morten et al., 2018). The only factors found as significant determinant for the intention to use a different mode than the airplane on the next leisure travel are the factor *urban area* and *high formal education*. These factors are included by Dütschke et al. (2022) as dummy variables indicating if respectively someone lives in an urban area or not and if someone has a high formal education or not. People with a higher formal education living in urban areas are positively associated with the use of an unsustainable transport mode.

2.2.3. Limitations while comparing determinants used in different studies

While comparing the different studies, there are several limitations found regarding the factors included. The same predictors included in multiple studies are interpreted differently per study. While some studies, for example, take the general environmental attitudes as the attitudes towards the flying behaviour, other studies look more specifically at the attitudes towards flying as predictor of the intention to fly. This is the same case for the social norm; most of the studies consider prescriptive social norms, i.e. what others expect us to do, as determinant while other studies incorporate descriptive norms as well, i.e. what others do.

Next to the interpretation, the operationalisation of determinants varies as well between studies; the way in which determinants are measured as well at the number of items included in the survey to measure the same construct is different in all studies. Incorporating short scales with sometimes only a single item to measure the determinant limits the explanatory power of these determinants. This is therefore one of the reasons studies are showing a difference in significance of the same predictors.

2.2.4. Conclusion

So, 25 determinants are identified looking at studies that try to map out the socio-psychological determinants of the intention to reduce flying or the actual flight kilometres. Only nine of these determinants are proven to be significant predictors of either the intention to reduce flying or the actual flying kilometres.

Looking back at the different general theories to study pro-environmental behaviours discussed in section 2.1., mainly the factors and variables described by the theory of planned behaviour are proven to be significant in the air travel context. It is thus likely that this theory is fundamental to explain air travel behaviour. This study therefore applies the theory of planned behaviour as basis to study pro-environmental behavioural decisions regarding air travel. Other variables and factors could potentially add to this theory, depending on the possibility to be influenced by information or not discussed in the next paragraph.

2.3. Determinants potentially influenced by informational interventions

Since this study looks at the way information could influence the social-psychological constructs determining air travel behaviour, only predictors that could potentially be changed by receiving information are interesting for this research. It therefore needs to be determined which scientifically proven predictors could be affected directly or indirectly by informational interventions.

2.3.1. Influence of information on the identified determinants

Table 1 provides an overview of all variables identified as predictor of the intention to reduce flying or the actual flying behaviour. It shows if these factors are often found significant in the reviewed studies, as well as if the significantly-proven factors could be changed by providing some type of information, whereas the type of information is not specified yet. The latter is determined by reviewing the existing literature, logical thinking, as well as by consulting with air travel experts.

The *general environmental attitude* relates to your own personal environmental concern (Hansmann & Binder, 2021; Morten et al., 2018). According to the principles of the Theory of Planned Behaviour, attitudes towards a certain behaviour could possibly be changed by receiving new information as well as by experience (Lyons et al., 2008). This will not always be the case, since new information must compete with a person's existing knowledge and beliefs about this same topic. The same applies to the *attitudes towards flying*; reading about the impact of flying on climate change together with feeling responsible to do something about it could possibly change people's evaluation towards flying.

Table 1; Overview of the determinants possibly explaining the (intended) flying behaviour and their possibility to be affected by information

Predictors of the intention to reduce flying and/or the actual flying behaviour	***Often found significant in earlier studies? (yes/no)***	***Could be affected by information? (yes/no)***
General environmental attitudes	yes	yes
Attitudes towards flying	yes	yes
Perceived behavioural control	yes	yes
Social Norm prescriptive	yes	yes
Social Norm descriptive	no	-
Personal norm	no	-
Awareness of Consequences	no	-
Awareness of need	no	-
Value of Self-Direction	-	no
Value of Self-Transcendence	-	no
Behaviour-specific self-identity	yes	no
Self-efficacy	no	-
Justifications	yes	yes
Habit	yes	no
Fear of flying	no	-
Financial barriers	yes	no
Subjective knowledge	no	-
Socio-demographic factors	yes	no

The perception of the extent to which a certain behaviour is within a persons' control, i.e. the *perceived behavioural control*, could be affected by information. Not feeling in control of the decision to fly or not to fly for leisure purposes could either be caused by others making the travel decisions for you, or by perceiving other alternatives as more difficult than to fly. The perception of other people making the decision for you is hard to change, providing new information will affect this perception. The perceived difficulty for changing your flying behaviour, however, could be tackled by providing information about the alternatives of flying. Many people are not aware of the possibilities current train networks provide to go on holiday to countries like England, France or Germany, as well as destinations further away, like the Balkan region (Van Doorn, 2020). Providing information about these possibilities, as well as more details about where to book and how to book could give people the insight that flying is not the only option to travel to their destination (RoyalHaskoningDHV, 2018).

Although providing information could be an effective measure to change *social norms*, Rhodes et al. (2020) show in their review on changing norms that a change is hard to achieve and is associated with a limited effect size. Still, some studies show a positive result when using social marketing to motivate environmental conservation (Goldstein et al., 2008; Hansmann & Steimer, 2015; Wee et al., 2021). These studies, however, are focussed on changing low-effort behaviours, like reducing littering, stimulating recycling or promoting towel reuse in hotels. Changing the social norm of high-effort behaviours like flying requires more high engagement techniques; providing information will then not be enough (Osbaldiston & Schott, 2012).

Since values are seen as higher-end desirable goals that serve as guiding principles in a life of a person (van der Weide et al., 2010), reading a piece of text including new information will not change a

person's values. The *value of self-direction* and the *value of self-transcendence* will therefore not be further included in this research.

Finding yourself the person who would engage in environmentally-friendly behaviour helps to actually behave environmentally-friendly. It is unknown if addressing this *behaviour-specific self-identity* in campaigns or policies can bring about behavioural change resulting in pro-environmental actions (van der Werff et al., 2013). Since this behaviour-specific self-identity is strongly related to people's values, it is found unlikely that providing information will change a person's behaviour-specific self-identity.

A factor that could be affected by receiving new information is the way in which people justify their behaviour (Árnadóttir et al., 2021; McDonald et al., 2015). This effect can be both positive and negative: addressing for example the impact of flying on climate change could on the one hand result desirably in decreasing the number of justifications held and realisation of the necessity to reduce flying and on the other hand create an undesirable backfire effect which leads to further entrenchment in previously-held views and possibly an increase in the intention to fly (Gorman & Gorman, 2018). This backfire effect must be closely monitored during this research.

As the term *habit* already implies, a habit is hard to give up and change. According to the Habit Discontinuity Hypothesis of (Verplanken & Wood, 2006), habits are only likely to change when a person's context changes in a way that this is disrupting a person's habit. When this is the case, a window of opportunity is present (Lanzini & Khan, 2017). As it is unlikely that this window of opportunity is present when reading new information about the impact of flying on climate change, habit will not be included in this research.

The predictor *financial barriers* will not be included further in this research, as the interpretation and operation of this predictor is unknown and the explaining variance is low. The last two predictors proven significantly in earlier research are summarised in table 1 as the *socio-demographic factors*. These factors are exogenous factors and will not be affected by information.

2.3.2. Conclusion

So, the general environmental attitudes, the attitudes towards flying, the perceived behavioural control, the social norm and justifications could be affected by the provision of information. All these socio-psychological factors are included in the conceptual causal diagram as determinants of the intention to fly. The actual type of information provided will, however, determine which of these factors will be actually related to the informational intervention.

2.4. Informational intervention

The type of information presented to the public plays an important role in the effectiveness of providing information as measure to induce voluntary behavioural change (see paragraph 1.2). Therefore, a well-founded choice must be made about the type of information provided.

2.4.1. Type of informational intervention

Climate change is currently an important issue in the Netherlands; almost 6 in 10 Dutch people are concerned about the consequences of climate change for the Netherlands (Ipsos, 2021). Despite these concerns, there is a tremendous amount of flying in the Netherlands, with as main motive to fly for holiday purposes (Zijlstra & Huibregtse, 2018). That raises the next questions: How is it possible that people are worried about the consequences of climate change but keep contributing to this problem themselves by continuing to fly for leisure purposes? Are people actually aware of the fact that flying has an enormous impact on climate change? And wouldn't people make different choices regarding flying once they knew the impact of their own flying behaviour on climate change?

Awareness campaigns are often based on the notion that people will behave in a way that mitigates the problem when they know what the problem is, so a change in knowledge leads to a change in behaviour (Gorman & Gorman, 2018). This suggests that the action of raising the awareness to encourage travellers to travel in a more conscious and more climate-friendly manner prepared by the Duurzame Luchtvaarttafel (2021) could be an effective strategy. Since it is unclear if the Dutch citizens are aware of the fact that flying has an enormous negative impact on climate change (see section 1.2.1.), creating more awareness among Dutch citizens by *giving information about the problem of flying related to climate change* could cause for a change in their intended and actual flying behaviour.

2.4.2. Design of informational intervention

Research, however, shows that providing purely factual and scientific information is not enough to induce voluntary behavioural change (see paragraph 1.2.). To make people voluntarily behave in a desirable way, information needs to be easily understandable, must appeal to people's experiences and emotions and should invoke moral action (Reis & Higham, 2016; Wormbs & Söderberg, 2021). This does not rule out the possibility of combining both ways. To inform people about the problem of flying related to climate change, we need factual and scientific information to provide insight into the impact of their flying on climate change. The way you present this information to the public could, however, be designed in a way that it is easily understandable and appeals more to emotions or experiences too.

One way to make people aware of the impact of their behaviour in a way that is easily understandable is to bring their behaviour into perspective. Bringing your own behaviour into perspective is difficult as shown by research of Gössling et al. (2009). They discovered that even though people have a rather common understanding about the harmfulness of flying, it is unclear how air travellers see aviation's contribution to climate change in contrast to other human activities contributing to global warming. But there is evidence to suggest that some people are willing to stop or drastically reduce flying, when they do get insight into the relative weight of flying compared to other emission sources. This is found by Wormbs & Soderberg (2021) in a series of interviews aimed at finding the motives to stop or drastically reduce flying. So, *showing people the relative impact of flying on climate change by comparing this to other activities contributing to global warming* may help to induce the voluntary behavioural change needed to get people out of the plane. This research aims to empirically test this hypothesis.

Besides providing information in an easily understandable way, the information needs to appeal to experiences and emotions. The way in which the relative impact of flying on climate change is framed can help in appealing more to people's own experiences and emotions. According to Abrahamse (2019b) and Hansmann & Binder (2021), the effectiveness of the message used to induce pro-environmental behaviour depends on the presentation and framing strategy involved. Avineri & Owen D. Waygood (2013) examined the effect of valence framing of amounts of CO_2-emissions on the perceived differences between alternative modes. Their findings imply negative framing, in terms of environmental losses, as being more effective than positive framing, in terms of environmental gains, to influence travel-related choices. Scannell & Gifford (2013) studied the role of local versus global message framing for people's engagement with climate change. Their study showed a higher level of engagement with climate change when providing people with locally framed messages compared to global messages or no message at all. This is similar to personalised vs general messaging (Abrahamse, 2019b). When presenting personal messages, people can connect themselves better to the message; they feel more related. This suggests that *negatively framed local or personal messages* will be most effective to induce pro-environmental behaviour. These characteristics will be taken into account when designing the informational intervention in more detail (see paragraph 3.2.1.).

2.4.3. Relation informational intervention and socio-psychological factors

As the type of informational intervention is known, the presence and direction of the relations between the informational intervention and the various socio-psychological factors which could be affected by information shown in table 1 can be assessed.

Table 2; Overview of the determinants explaining the (intended) flying behaviour and their possibility to be affected by the information in general and by the proposed informational intervention

Factors predicting the intention to fly and/or the actual flying behaviour*	***Could be affected by information? (yes/no)***	***Could be affected by the chosen informational intervention? (yes/no)***
General environmental attitudes	yes	no
Attitudes towards flying	yes	yes
Perceived behavioural control	yes	no
Social Norm prescriptive	yes	no
Justifications	yes	yes

*In this table, only determinants that could be affected by information are included.

Looking at the five socio-psychological determinants, receiving information about the relative impact of flying to other activities contributing to global warming only affects the attitudes towards flying and the justifications used to explain a person's flying behaviour (see table 2). Making people aware of the impact of flying on climate change by putting it into perspective gets people to think about their flying behaviour in relation to their ecological footprint. This results in a re-evaluation of the overall appraisal of flying as either more positive, more negative or similar as the former evaluation. Since the negative impact of flying on climate change is emphasised, a more negative appraisal of flying is expected.

As described in paragraph 2.3, the influence of providing information on justifications must be monitored closely. Receiving information about the impact of flying compared to other activities contributing to global warming could either make people adapt their flying frequency, or could enhance the attitude-behaviour gap resulting in finding more ways to justify your flying behaviour. Since this latter backfire effect will prevent the desired reduction in flying from happening and the size of this effect is unknown, the relation from justifications to the intention to fly needs to be included in this study.

No relationships between receiving information about the relative impact of flying to other activities contributing to global warming and the general environmental attitudes, the social norm or the perceived behavioural control are assumed. A person's environmental concern, so the extent to which an individual views him or herself as someone who is concerned with environmental issues, is not something that changes in a day. Receiving a short piece of text about the relative impact of flying will not significantly change a person's environmental concern; this relation is therefore not included in the conceptual causal diagram. Furthermore, no social marketing or information related to the alternatives of flying will be provided in this study. The effect of the informational intervention on the social norm or the perceived behavioural control are therefore excluded.

2.5. Final conceptual causal model

The scientific theories described in the former sections as well as the hypotheses build upon these theories lead to the final conceptual causal model as presented in figure 7.

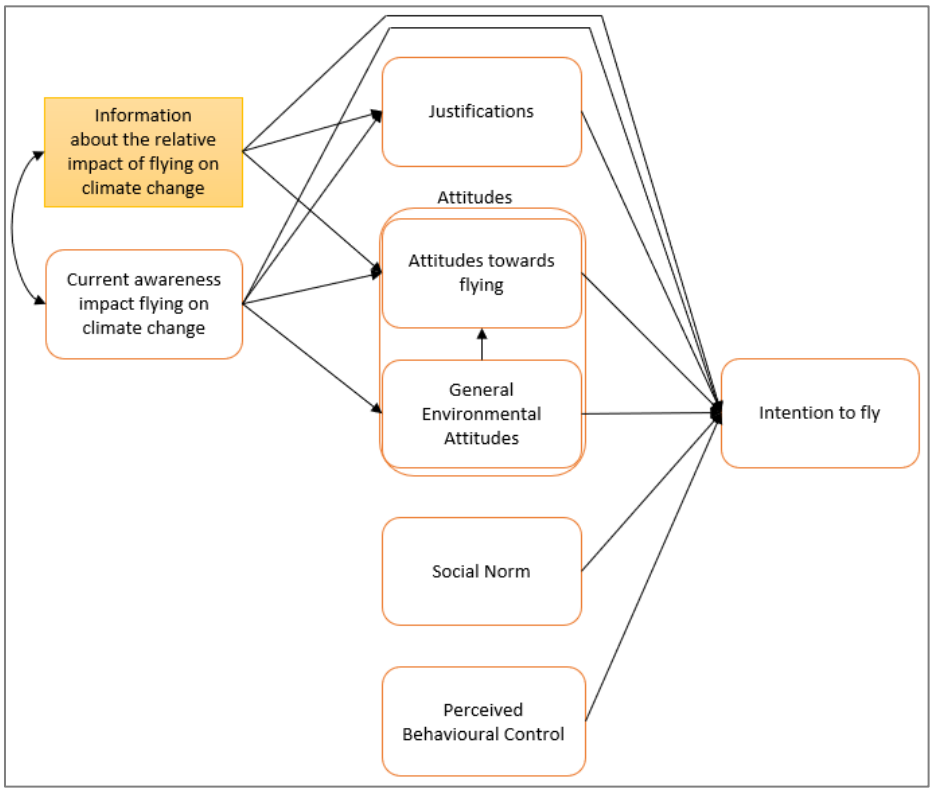


Figure 7; Final conceptual causal model

The model shows five socio-psychological determinants of the intention to fly, of which two determinants are endogenous factors affected by the informational intervention and the other three determinants are exogenous factors on which there is assumed to be zero effect from the informational intervention. These three exogenous determinants are, nevertheless, included in the model to control for the effects of justifications and attitudes towards flying on the intention to fly. Since former studies show that these three predictors explain the highest proportion of variance of the intention to reduce flying, next to the attitudes towards flying and the justifications, these three socio-psychological factors are included to prevent for overestimation of the effects of the attitudes towards flying and the justifications on the intention to fly.

Raising the level of awareness by showing people the relative impact of flying on climate change will only be effective when there is currently little to no awareness of this relative impact of air travel on climate change (see section 1.2.1.). It is therefore essential to measure the current awareness of the impact of flying on climate change and to include this current awareness. This factor could, like the informational intervention itself, affect the attitudes and justifications.

We expect that the information received by the respondents on the relative impact of flying on climate change in contrast to other activities contributing to global warming, as well as the current awareness causes a negative effect on the intention to fly via justifications and a positive effect on the intention to fly via attitudes. To test if these expectations based on the theory are indeed correct, a direct effect from the informational intervention and the current awareness to the intention to fly is included in the conceptual causal model. If a direct effect is present next to the indirect effects via attitudes and justifications, it means that the informational intervention or the current awareness does not only

affect the attitudes towards flying and the justifications. Other relations are present that are not captured in this model. The direct effect therefore serves as a way to validate the assumed relationships based on theory.

Furthermore, an effect from the higher-end attitude, the general environmental attitudes, towards the lower-end attitude, the attitudes towards flying, is included. It is unclear if these two types of attitudes are independent of each other or that a relation between them is present. Additionally, it is unclear if they both affect the intention to fly or that only the lower-end attitude affects the intention to fly. Hence, both relationships are incorporated in the conceptual model for now. When implementing the model in AMOS, all options will be assessed resulting in one final model.

3. Methodology

This chapter presents the steps taken to gather and analyse the data which will result in answering the research question and completion of the knowledge gaps. Section 3.1 elaborates on the basic principles of Structural Equation Modelling (SEM) and its application in this research. In section 3.2, the data gathering will be discussed, including the design of the survey used to gather the data, the survey pre-testing, sample selection and survey implementation. The way the gathered data is prepared for use is discussed in section 3.3. The last section, section 3.4, addresses the steps taken to construct the factors and variables and making them ready to use for the SEM. The chapter ends with a discussion of the model assumptions and model building of the SEMs.

3.1. Structural Equation Modelling

With Structural Equation Modelling (SEM), it is possible to simultaneously assess the dependence relations between different factors in the structural model as well as the quality of the measurement in the measurement model. This is the case since SEM combines path analysis with confirmatory factor analysis, which results in the possibility to estimate the causal relations between 'pure' factors that are corrected for measurement errors (Kroesen, 2006). The correction for the measurement errors, in turn, increases the strength of the relationships between the factors, which is reflected in higher correlations between the factors.

The factors, also called latent variables, constructs or unobserved continuous variables, are complex. They have many facets and need to be constructed with multiple indicators or items. Using multiple items to measure the latent variables increases their reliability, i.e. the extent to which a measurement is free of random errors, and their validity, i.e. the extent to which a measurement is free of systematic errors (Molin, 2019a). The validity can only be ensured when there is an underlying structure present in the set of selected items (Hair et al., 2006). This means that all aspects related to the latent variable must be covered by the indicators to prevent the occurrence of a systematic error.

SEM allows for testing theories that explain observed correlations. It is rather confirmatory than exploratory; building a structural equation model requires an in advance constructed conceptual causal model with unidirectional arrows of one variable to another based on a devised theory (Golob, 2003).

A SEM is estimated using covariance analysis. The model parameters are determined such that the model implied variances and covariances of the variables are as close as possible to the observed variances and covariances of these variables in the sample (Golob, 2003). In other words, the parameters are estimated in a way that the difference between the model implied variance-covariance matrix and the population variance-covariance matrix is mathematically minimised (Kroesen, 2006). It is hereby assumed that the variables follow a multivariate normal distribution, which needs to be checked (see paragraph 3.4.6.).

To assess the goodness-of-fit to see how well the theory fits the data, the chi-square test as statistical test is used (Golob, 2003). The chi-square test measures the difference between the two variance-covariance matrices. A non-significant result is desired, since this implies that there is no significant difference between the observed covariance-variance matrix and the reproduced covariance-variance matrix by the model. So, the model fits the data well. This, however, does not imply that the assumed causal structure of the model is correct (Molin, 2019b). A similar model with the same variables but different relationships between them may fit evenly well. Hence, a good theory is crucial to correctly determine the causal directions of the modelled paths.

There are some problems associated with using the chi-square test only to assess the goodness-of-fit of the model. The chi-square value depends on the sample size; how larger the sample size used, how higher the chi-square value becomes. It may therefore be very difficult for larger samples to find a model that cannot be rejected. When this is the case, other model fit indicators as the Comparative Fit Index (CFI) or the Root Mean Square Error of Approximation (RMSEA) can be consulted which correct for model complexity and sample size (Hair et al., 2006; Shi et al., 2019).

3.1.1. Suitability & application of SEM in this study

This research uses Structural Equation Modelling to validate the theory and model outlined in chapter 2. The objective thereby is to find out which constructs are affected when informing people about the relative environmental impact of flying compared with other activities contributing to climate change and if this eventually works through to people's intention to fly. The final theoretical model shown in chapter 2 is assumed to accurately reflect reality.

Two important observations can be made from this theoretical model in support of the use of SEM as suitable modelling technique. First of all, many latent variables are present which cannot be measured directly and need to be constructed using multiple items to reflect these variables. This will improve both the reliability and validity of the measurements. Secondly, an indirect relationship is present between the information about the relative impact of air travel on climate change and the intention to fly. Since a multiple regression model only estimates direct relationships between variables, SEM is used to be able to incorporate this indirect relation. So, both important characteristics of the model (the presence of latent variables and indirect relations) can be encompassed using SEM as modelling technique. The software program IBM® SPSS® AMOS™ 26 is used to estimate the structural equation model.

To measure the different socio-psychological factors included in the theoretical framework, factor analysis is performed. This is performed a priori using IBM® SPSS® Statistics™ 26, since the model would become too large and complex, having too many free parameters, when including both structural and measurement model in AMOS. Summated scales of the latent variables will be constructed of which the measurement errors are specified based on the Cronbach's alpha. These measurement error terms will be included in AMOS as fixed measurement error terms, which results in retaining the benefits of having a structural and measurement model in one. Section 3.2.1 *Operationalisation of the socio-psychological variables* will dive further into the identification of the different factors, while paragraph 3.4.3. *Factor analysis* will describe the more detailed procedure and choices made performing the factor analysis in SPSS.

3.2. Data gathering

The first steps taken after the conceptualisation phase is to design a survey that could help answer the last three sub questions aiming at assessing the current awareness of the Dutch population, getting insight into the effect of providing information on people's attitudes, justifications and intention to fly and examining the reasons used to justify people's air travel while being environmentally concerned. This paragraph presents the process of designing and conducting the survey including the operationalisation of the different parts of the survey as well as the sample selection and implementation of the survey.

3.2.1. Survey design

The survey consists of three parts. The first part introduces the topic, tests the current awareness of the Dutch citizens and assesses the more general determinants of the intention to fly as the general environmental attitudes and the social norm. The second part presents the experimental condition,

Questionnaire design

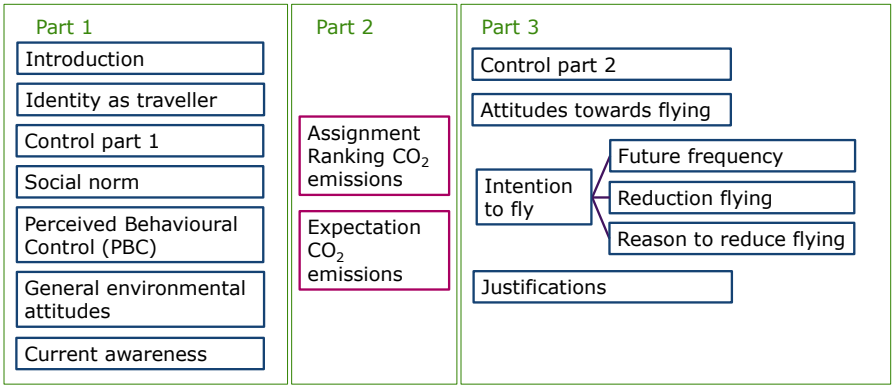


Figure 8; Outline survey – examined topics and their sequence

i.e. the informational intervention. The third part includes questions assessing the socio-psychological factors which could be influenced by the experimental condition. The final outline of the survey is summarised in figure 8. Since this survey is not used for this study only, several concepts measured will not be outlined in this study. The final survey (in Dutch) is presented in Appendix C.

Not all respondents received the same amount of questions when completing the survey. Since this study looks into the effect of providing information, a control group is needed. Hence, the respondents are randomly divided into two groups of which just one group receives the informational intervention (part 2). Due to practical restrictions, one third of all respondents received part 2. The other two third of the respondents just received the first and third part of the questionnaire. Since the respondents are assigned randomly to one of the two groups, both groups are comparable; no systematic differences exist (Tjaden et al., 2018). As a result, the potential differences found in attitudes, justifications and intention to fly can thus be attributed to the experimental condition: the informational intervention.

Besides the informational intervention, some respondents received questions related to the justifications afterwards and others did not receive these questions. Justifying your behaviour is only necessary when a person has pro-environmental values but is acting against those values. This so called cognitive dissonance is present in the case of air travel for leisure purposes when a person indicates that he or she is concerned about climate and its consequences, but still intends to fly for leisure purposes. These two criteria are used to determine if a person did or did not receive the questions related to the justifications.

Testing the current awareness of the impact of flying on climate change

The current awareness is a complex construct with many facets. To capture this complex construct, multiple questions need to be included covering the different facets forming the current awareness of the Dutch citizens. Besides, according to Boussemaere (2021), a remarking paradox exists related to global warming and climate change. In a study among Belgium residents, they found out that only a very small part of the people can actually explain what climate change entails while these people all indicate that they are aware of climate change and are sufficiently informed. To prevent from wrongful conclusions in this study, the respondents are both asked to state their awareness and to complete several exercises that question the different facets of the 'actual' awareness of the respondents.

To test the stated awareness of the impact of flying on climate change, the respondents each received 3 items on which they must indicate if they agree with it or not on a 5-point Likert scale from totally

disagree to totally agree: “Climate change affects life on earth”, “CO_2-emissions from human activities such as flying contribute to climate change” and “When I fly, I contribute to climate change”. Especially the last item is important to measure the awareness of the impact of flying on climate change.

Testing the actual awareness is complex. After consultation with various experts in the field of behavioural & social sciences and aviation, two different exercises are created aimed at mapping people’s actual awareness of the impact of flying on climate change. These exercises are based on the notion that there are three types/facets of knowledge forms that must work together in promoting conservation behaviour: system, action-related and effectiveness knowledge (Frick et al., 2004). Applying this typology of knowledge to a designed competence model for environmental education, Roczen et al. (2014) showed that only the latter two more applied forms of knowledge have a direct effect on the environmental behaviour of individuals and are an important precondition for environmental action-taking by individuals. All three types of knowledge have been incorporated in the exercises, but the emphasis is mainly on the action-related and effectiveness knowledge.

The first exercise contains four questions in total: two system-related questions, which test the understanding of the impact of flying on climate change, and two action-related questions, which test the understanding of knowing how to reduce the environmental impact related to flying. Together with different experts, 12 questions were initially drafted either system- or action-related. After collaboratively selecting the most promising 6 questions, these questions were tested among several individuals with different education levels to test the understandability and difficulty of these questions. From these 6 questions, 4 multiple-choice questions are incorporated in the final survey. These questions are shown in Appendix C coded as B1 to B4 (Q116 to Q119).

In the second exercise, the respondents need to rank different household and travel activities based on their CO_2-emissions. This exercise is incorporated in the experimental condition and assesses the effectiveness-related knowledge of the respondents, i.e. knowing what the impact is on the environment when reducing your flight frequency. This exercise will be further discussed in the next paragraph, which will dive further into the design of the experimental condition.

Operationalisation of the informational intervention

The aim of the informational intervention is raising people’s awareness about the impact of flying on climate change. It is assumed that this awareness can be created by showing people, and more specifically by getting people to think about, the impact of flying on climate change in contrast to other activities contributing to global warming.

Design of the informational intervention

The total design of the informational intervention can be found in Appendix C Part 2 of the questionnaire coded as “Q21/Ranking” & “Q22/VerwachtingUitstootVliegen”. In short, the informational intervention is operationalised as follows: about one-third of all respondents are asked to make a task which entails ranking different household and travel related activities based on the CO_2-emissions these activities cause. This assignment forces the respondents to think about the CO_2-emissions caused by flying compared to other activities. After finishing the assignment, the respondents receive a screen showing their answers together with the correct ranking. The correct ranking is shown in two ways: textually and visually. They are asked to compare their ranking to the correct ranking. Finally, the participants need to indicate if the emissions related to flying are less, similar or more than previously thought.

Zooming into the ranking task, a total of seven household or travel related activities are included in the task and need to be ranked from most emitting activity (1) to least emitting activity (7) based on their CO_2-emissions only:

1. Making a roundtrip by train to Berlin together with a friend.
2. Flying back and forth to Berlin together with a friend.
3. Sending 1000 e-mails (without attachments).
4. Supplying a household of 2 with electricity for a year.
5. Taking a bath (of 120 litres) twice a week for a year.
6. Flying back and forth to Bali (Indonesia) together with a friend.
7. Driving a petrol-driven car from Rotterdam to Gouda (about 10,000 km in total) five working days a week for a year.

Since all respondents can relate to either household or travel activities, these type of activities are chosen to include in the assignment. Different grey and scientific literature is used to come up with a total of twelve different activities. These activities together with the calculations to determine the CO_2-emissions per activity and the literature used for these calculations can be found in Appendix D. To make the ranking task doable for all respondents, the seven activities which differ most in terms of emissions are chosen to incorporate in the assignment.

Reasoning behind the design of the informational intervention

The aim of the informational intervention is to raise people's awareness about the impact of flying on climate change. It is assumed that this awareness can be created by showing people the impact of flying on climate change in contrast to other activities contributing to global warming (see paragraph 2.4.2). However, to instigate behavioural change, the knowledge acquired needs to be internalised (Jacobson et al., 2020; see section 1.2). Although this is not possible to achieve when conducting a survey only, the way you present the information can help in getting closer to the internalisation of knowledge. Showing just a piece of text will not help to reach the goal of internalising knowledge. By giving an assignment which needs to be completed before one can proceed with the survey, the respondents are stimulated to really think about the impact of flying on climate change in contrast to other activities contributing to global warming, which helps the internalisation process. Moreover, after completing the ranking task, a second screen is shown which allows the respondents to compare both the given answer and the correct answer to the task. This increases the engagement even further. The last screen reminds the respondents one time more about the impact of flying in comparison to other activities by putting emphasis on the large amount of CO_2-emissions associated with flying. They need to indicate if the emissions of flying are larger, equal or less than thought in advance of completing the ranking task, which makes them think one more time about the environmental losses related to flying. This altogether helps to get closer to the internalisation of the information provided and tries to create more awareness of the relative impact of flying on climate change.

To improve the effectiveness of making people aware of the impact of flying on climate change even further and thereby induce pro-environmental behaviour, the information provided needs to be easily understandable and preferably appeal to emotions or experiences (Reis & Higham, 2016; Wormbs & Söderberg, 2021; see paragraph 2.4.2). The somewhat factual information presented to the respondents is made more easy to understand and more appealing to own experiences by comparing flying with other household and travel activities that people are familiar with, can relate to and often come into contact with. A second way to enlarge the effectiveness of the message used to induce pro-environmental behaviour is using the right framing of the message (paragraph 2.4.2). Confronting the respondents with the environmental losses when flying as well as referring to the respondents

personally by presenting the activities in a way that the respondent is involved in it, increases the level of engagement of the respondents as suggested by Abrahamse (2019b) and Avineri & Owen D. Waygood (2013).

Besides enlarging the effectiveness of the informational intervention, another advantage of designing the informational intervention in a way that the respondents need to complete a task is the possibility to test the pre-knowledge of the respondents. Comparing the ranking answered by the respondents with the correct ranking gives an indication of how 'new' the presented information is for the respondents. This information is important, since the informational intervention could only affect people's intention to fly when this informational intervention is 'new' to people, so the information is not known in advance. The possibility to compare the answered and correct ranking creates opportunities for the implementation of the informational intervention as variable in the structural equation models, which will be further discussed in section 3.4.5.

Operationalisation of the socio-psychological factors

A total of 5 socio-psychological factors are included in the survey. These factors are derived from the conceptual causal model shown in paragraph 2.5. The different factors are identified based on existing scales, the researcher's own judgement and consultation with experts. The items and scales of the general predictors of the intention to fly will be described first, after which the factors potentially influenced by the experimental condition follow. To increase the reliability and validity of the socio-psychological factors, a minimum of four items per factor are incorporated in the questionnaire.

General environmental attitudes

Participants' general environmental attitudes are examined by the four items "I am very concerned about global warming", "I see no need for sustainability", "Climate change is a serious problem" and "Environmental problems are greatly exaggerated". All four items were scored using the same five-point Likert scale (from strongly disagree to strongly agree). These items are similar to the items used by Witte et al. (2022) to measure the respondents' environmental concern.

Social norm

The subjectively perceived norms of important others in the respondents' social network are assessed through 4 items inspired by the items used in the studies of Dütschke et al. (2022) & Hansmann & Binder (2021): "In my circle of friends it is common to go on holiday by plane", "On social media, it seems like everyone is travelling by plane", "For a weekend getaway, people around me get on a plane" and "Going on holiday by plane has become very normal". The response scale for all four items is a five-point Likert scale ranging from strongly disagree to strongly agree.

Perceived behavioural control

Participants' perceived behavioural control could refer to two different latent constructs: their perceived control and the perceived difficulty (see paragraph 2.2.2 & 2.3.1.). According to a meta-analysis performed by Trafimow et al. (2002), the perceived difficulty is a better predictor of most behavioural intentions and behaviours than the perceived control. The perceived behavioural control therefore refers in this study to "the extent to which people consider the performance of a behaviour to be easy or difficult to perform" (Trafimow et al., 2002, p.101). The respondents are asked to react on the following four items: "For me, reducing the number of flights I make from now on is ...", "Not getting on a plane anymore is for me...", "If I wanted to, I could easily reduce the distance of my air trips by visiting destinations closer to home" and "Going on holiday without flying is for me...". On the first, second and fourth item, the participants need to indicate the level of difficulty on a five-point

Likert scale from very difficult to very easy. To response scale for the third item is a five-point Likert scale ranging from strongly disagree to strongly agree.

Attitudes towards flying

The operationalisation of the factor 'attitudes towards flying' is based on the way a theory of planned behaviour questionnaire needs to be constructed according to Ajzen (2006). A five-points Likert scale is used to find out what people think about flying. The attitude is examined by showing four times the same item "I think of flying as..." and one time an almost similar item "Personally, I think of flying as...", but with different response scales: (1) very unpleasant to very pleasant, (2) very exhausting to very refreshing, (3) very difficult to very simple, (4) very unaffordable to very affordable and (5) very unacceptable to very acceptable.

Justifications

There are many reasons why people still fly despite the fact that they are concerned about the environment. Based on previous studies, these justifications are divided into six different categories:

1. Having the right to fly (Q1)
   Drastically reduce flying or even stop flying could feel like a restriction of personal freedom and decrease the quality of life (Baumeister, 2020).
2. No suitable alternative is present (Q2)
   People do not know how they could change their behaviour. When travelling to the other side of the world, the only option is to go by plane. (Árnadóttir et al., 2021; Hansmann & Binder, 2021; Juvan et al., 2016)
3. Compensate for flying emissions (Q3)
   People compensate their flying emissions by participation to compensation schemes or by sustainable practices at home (Árnadóttir et al., 2021; Hibbert et al., 2013; Kroesen, 2013)
4. Others are more environmentally unfriendly (Q4)
   People find their personal travel footprint not that big compared to others (Árnadóttir et al., 2021).
5. Shifting responsibility to solve the problem to others (Q5)
   Other parties, such as the government, industry and other countries, have to solve climate change (Juvan et al., 2016; Kroesen, 2013)
6. Having no impact (Q6)
   Adjusting one's own behaviour does not contribute to solving the problem (Juvan et al., 2016).

The respondents are asked to respond to 6 questions (one question per category) containing 4 to 5 items each. They are asked to select all applicable statements, so all statements they agree with, by checking the box of these items. Each question starts with either the statement 'Despite the climate impact, I want to fly because ...'or 'Although it is not good for the climate I want to fly, because ...', followed by several possible reasons that can be selected by the respondents. All exact reasons questioned per justification category are included in Appendix C. The more reasons, i.e. the total number of justifications, the respondents select, the higher the respondent will ultimately score on the justification scale incorporated in the SEM.

The question related to the category 'Shifting responsibility to solve the problem to others' is formulated in a different way than the other questions. For this category, it is not only interesting to know if people shift the responsibility to tackle climate damage to other, but also to whom they shift this responsibility. Hence, the question is phrased as 'The responsibility for tackling the climate damage

of flying lies primarily with ...' followed by 5 different parties to select: *myself*, *frequent-flyers*, *governments*, *airports (like Schiphol)*, and *airlines (like KLM)*.

To know what reasons are most commonly used to justify the cognitive dissonance present, all 6 defined categories of justifications will be compared to each other which will provide an answer on the last sub question formulated for this research. To make this possible, the category 'Shifting responsibility to solve the problem to others' must be recoded since this category is measured in a different way than all other categories. Therefore, a differentiation is made in the respondents indicating they are primarily (co-)responsible for tackling climate damage and the respondents who do not see themselves as (co-)responsible for tackling climate change, of which the latter group shifts the responsibility to solve the problem to others.

Operationalisation of the dependent variable

The *intention to fly* is measured by a single item: "How often do you expect to travel by plane for private purposes in the coming 2 years?". The respondents received six different multiple-choice answers on which they could indicate their expected flight frequency: Not, 1 time, 2 times, 3 times, 4 to 5 times, and 6 times and more. The format of this question is similar to the question drafted by the Netherlands Institute for Transport Policy Analysis (KiM) measuring the flight frequency of previous years, so the resulting data could be compared and used in future longitudinal studies related to this topic.

3.2.2. Survey pre-testing, implementation & sample selection

Before the launch of the survey, pre-testing took place in order to test the comprehensibility and technical functionality of the online survey. In total, three rounds of testing took place. In between these pre-testing rounds, consultation with survey design experts took place for further advise on changes made.

During the first round, seven people tested a printed Word version of the survey. When making the survey, I stayed close to them so I could monitor them and help them when they got stuck. Since the survey was printed, the testers could write their notes on the survey and give feedback in real life or on the survey. The first round led to changes to the structure of the survey, as well as the phrasing of several questions and the removal of types.

14 people tested the survey online during the second pre-testing round. The survey was programmed in a test environment so people received a link to the survey and could click through it. Each tester received a different task to focus on, like the duration to complete the survey, the comprehensibility of the survey as well as the technical functioning of the survey. The feedback was written in Word documents, which were collected afterwards and formed the basis for further improvements. Improvements were mainly necessary in the phrasing of questions and the duration of the survey.

In the final pre-testing round, a final check was performed by two survey design experts. This did not lead to many changes; a few phrases were adapted and the last typos found were removed. After this round of pre-testing, the survey was ready to launch.

The designed survey is launched online during the summer holidays from July 18 to August 7, three weeks in total. Members of the Dutch Mobility Panel (MPN) are contacted on the 18th of July to fill in the questionnaire and received a reminder after 2 weeks. After filling in the survey, the respondents may choose a small present in the form of a gift voucher, airmiles or a donation to a charity organisation.

A total of 2384 MPN members were invited by email to participate in the survey. The prospective participants were asked whether they like to participate in the MPN Holiday Questionnaire, no information about the exact content was given. This number is based on a response rate of 85 percent, aiming for about 2025 respondents to actually fill in the survey. The participants are selected based on the following conditions:

- *Representative to the Dutch population*
  The target group for this study is the Dutch population (see section 1.5.). Participants thus need to be representative for the Dutch population on sex, age, level of education and residential area. This is already covered by selection of respondents for the MPN panel.
- *Only members aged between 18 and 80 are selected.*
  An adult is supposed to be able to make their own decisions regarding travel modes for leisure purposes. Former research in the Netherlands shows that people of the age higher than 80 barely fly (Zijlstra & Huibregtse, 2018); these people are therefore excluded from the sample. Since the group of people aged between 18 and 30 fly frequently and often belong to the non-response group, this group is oversampled.
- *Participants preferably come from different households.*
  People are social animals, they travel mostly in groups often with the people they live together. To reach a public as diverse as possible, it is thus preferred to have participants from different households.
- *Participants have been a member of the MPN for at least 4 years*.
  To be able to use the resulting data for future longitudinal studies related to this topic, the participants need to be a member of the MPN since 2019.

3.3. Data cleaning

To improve the quality of the collected data, incorrect and incomplete data need to be removed from the dataset. An overview of all steps taken to clean the data can be found in Appendix E. In general, the following main steps are taken to clean the data:

1. Checking the completeness of the data.
2. Horizontal Cleaning; including early termination of participation, speeding, straightlining etc.
3. Vertical Cleaning; including removing outliers and recoding.
4. Data Imputation.
5. Weights for representative sampling.
6. Data Enrichment; including linking other databases and recoding/computing variables.

Table 3; Number and percentages of respondents being removed from the final data set

	Exp 1	**Exp 2**	**Total (Abs.)**	**Total (%)**
Invited	*1582*	*802*	*2348*	*100*
No response	199	121	320	13.4%
Not willing to participate	13	5	18	0.8%
Dropped out	9	7	16	0.7%
Removed after cleaning	28	26	54	2.3%
Remaining (Abs.)	*1333*	*643*	*1976*	*82.9%*
Remaining (%)	*67.5*	*32.5*	*100*	

Table 3 shows the number and percentages of respondents being removed from the data set divided based on the reason for not being present in the final data set. Of the 2384 respondents asked to participate in the questionnaire, a total of 2030 respondents filled in the survey completely. The total

response ratio is 85.2%, which is in line with what was expected. After cleaning the data, a total of 1976 respondents are left in the final data with a desired distribution of one third presented with the experimental condition and two third presented without the experimental condition.

3.4. Data analysis

Before being able to find out what the current awareness of the Dutch citizens about the impact of flying on climate change is, the representativity of the sample needs to be checked. This will be tested first in this paragraph. To also be able to explore via which causal pathway of socio-psychological variables the information about the relative impact of flying operates to the intention to fly, the different socio-psychological factors need to be constructed a priori. This is done using Rasch analysis and factor analysis, which will be explained in section 3.4.2 & 3.4.3. To make sure the justifications categories established are independent of each other, their correlations are checked (3.4.4.). Section 3.4.5. describes the two ways in which informational intervention will be implemented in the SEMs. The last two paragraphs will discuss the model assumptions and model building of the structural equation models.

3.4.1. Representativity of the sample

Since the higher aim of this study is to motivate Dutch citizens to reduce their air travel, the participants need to represent the Dutch population aged 18 years and older. Table 4 provides a detailed overview of the sample characteristics and compares them to characteristics of the Dutch population retrieved from Statistics Netherlands. In order to test if the sample is representative, chi-square tests have been applied.

The representativity of the variables sex, age, education level and urbanity of the residential area have been tested. Dütschke et al. (2022) found education level and urban area as significant determinants for the intention to use a different mode than the airplane on the next leisure travel. Besides, this study is all about taking in and thinking about the presented information. For these reasons, it is important to test if these characteristics are distributed well among the sample. Although income could play an important role in the number of flights taken per person, a strong correlation exists between income and education level. Testing the education level is therefore supposed to be sufficient in order to draw conclusions on the representativity of the sample.

Significant differences between the sample and population data have been found on age and highest level of education attained (see the chi-square test results shown in the last two columns of table 4). The results show a little overrepresentation of respondents aged 65-80 who attained a low to average education level. These differences, however, are relatively small (see table 4). It can thus be concluded that the sample represents the Dutch population reasonably well in relation to sex, age, education level and urbanity of the residential area. Moreover, since this study looks into the relations between the different socio-psychological variables, the little differences found will not cause for problems as long as there is enough variation in the independent variables in the sample. As there is sufficient variation present, it is assumed that the relations between factors will be estimated without bias against the population.

3.4.2. Rasch modelling to measure the current awareness

To measure the respondent's current awareness of the impact of flying on climate change in an adequate and reliable way, a Rasch model is used. A Rasch model "allows researchers to use a respondent's raw test or scale scores and express the respondent's performance on a linear scale that accounts for the unequal difficulties across all test items" (Boone, 2016, p.3). It is built on the assumption that the relationship between the difficulty of an item and the ability of a person is the

Table 4; Comparison between sample and population characteristics

	Study sample		**Population**		
Sex *(CBS, 2022b)*	**Abs.**	**%**	**%**	**Chi-square test**	
Male	1018	51.5	49.7	Chi-square	1.822
Female	958	48.5	50.3	p-value	0.18
Total	*1976*	*100.0*	*100.0*		
Age (year) *(CBS, 2022b)*	**Abs.**	**%**	**%**	**Chi-square test**	
18-20	25	1.3	3.2	Chi-square	74.123
20-40	619	31.3	33.7	p-value	<0.001
40-65	806	40.8	42.8		
65-80	509	25.8	19.5		
80	17	0.9	0.8		
Total	*1976*	*100.0*	*100.0*		
Highest level of education attained *(CBS, 2022a)*	**Abs.**	**%**	**%**	**Chi-square test**	
Primary education	99	5.0	7.4	Chi-square	159.582
Lower pre-vocational education (LBO/VBO/VMBO-KBL/BBL)	293	14.8	9.3	p-value	<0.001
Pre-Vocational education (VMBO-T/GL) & Lower secondary education (HAVO/VWO)	270	13.7	9.3		
Vocational education (MBO)	452	22.9	26.2		
Secondary education (HAVO/VWO)	241	12.2	11.1		
HBO-/WO-bachelor degree	401	20.3	22.6		
HBO-/WO-master degree & Doctoral	220	11.1	14.1		
Total	*1976*	*100.0*	*100.0*		
Urbanity residential area* *(CBS, 2021b)*	**Abs.**	**%**	**%**	**Chi-square test**	
Non-urbanised	142	7.2	7.3	Chi-square	0.166
Low urbanised	413	20.9	21.7	p-value	0.997
Moderately urbanised	278	14.1	14.9		
Highly urbanised	623	31.5	30.3		
Very highly urbanised	520	26.3	25.7		
Total	*1976*	*100.0*	*100.0*		

*Definition according to CBS (2021a). The numbers include people under 18. This is not concerning since the numbers related to urbanity do not differ substantially between the two groups.

most effective and parsimonious predictor of a character trait (Columbia University Mailman School of Public Health, 2022). A person has a higher probability of correctly answering an easier question, while more difficult questions are associated with a lower probability of correctly answering. This is the underlying principal of Rash analysis.

This analysis is applied to the four multiple-choice questions presented measuring the understanding of the impact of flying on climate change and the understanding of knowing how to reduce the environmental impact related to flying. Since for the third question multiple answers have to be selected by the respondents, each item is included separately in the analysis. As shown in the item information curve in appendix F, not all questions are included; the decoy option 'choosing for a more luxurious stay' as possible way to reduce the climate impact of your holiday trip does not add any information to the created scale representing the current awareness and is therefore removed.

The resulting 'current awareness' scale shows a normal distribution among the respondents (see appendix F). This scale will be used as measurement of the respondent's current awareness about the impact of flying on climate change in the structural equation model.

3.4.3. Factor analysis to construct the socio-psychological factors

Confirmative factor analysis is used to check the uni-dimensionality of the individual factors. Since the different factors are identified carefully and thoroughly in consultation with experts, it is assumed that the selected items represent each factor individually. To check if this is indeed the case, the correlation matrix of the summated scales is analysed (see table 10). The matrix shows that almost all factors correlate with each other. Most correlation coefficients, however, are so small that the individuality of these factors can be confirmed. The highest correlation exists between the *perceived behavioural control* and the *attitudes towards flying*. Since this correlation is quite high, an exploratively analysis is performed to check for possible cross-loadings present in this set of factors. This analysis showed a significant cross-loading of the item "Personally, I think of flying as ... very unacceptable (1) to very acceptable (5)" on both factors. For this reason, this item is removed from further analysis, which resulted in a correlation between the *perceived behavioural control* and the *attitudes towards flying* low enough to confirm the individuality of both factors (r=-0.322). The different items are subsequently analysed in separate factor analyses. Possible other cross-loading has been disregarded in this study.

To extract the factor loadings of the different constructs, principal axis factoring is chosen. This is a suitable extraction method since we are only interested in the common variance of the items measuring the underlying latent construct (Molin, 2019b). Several 'rule-of-thumbs' are used to create valid and reliable factors: (1) Communalities > 0.25, (2) Initial Eigenvalue of factor > 1, (3) Factor loadings > 0.50, (4) Cronbach's alpha of summated scale > 0.70. Items and factors that do not satisfy these so called pre-conditions are re-designed or excluded.

Table 5 shows the underlying factors, i.e. psychological constructs, with items used to construct the factor, the item factor loadings and descriptive. All items and factors shown in table 5 meet the required pre-conditions. It can be observed that not all items included in the survey are used to construct the underlying factors; the excluded items did not meet the requirements set.

It has to be noted that the *Social Norm* is based on a single item. A choice has been made between the four items representing the *Social Norm* included in the survey, since the common variance of the items was not large enough to derive an underlying factor. Looking back at the studies analysed during the literature analysis, Hansmann & Binder (2021) showed in their study that only the prescriptive social norm appears to be a significant predictor of the intention to fly. The prescriptive social norm

Table 5; Psychological Constructs with item components and descriptive

Psychological constructs (Cronbach's alpha)	Items	Factor loadings	Descriptive	
			Mean***	Standard Deviation
General Environmental Attitudes (α=0.878)	Climate change is a serious problem.*	0.881	4.12	0.95
	I am very concerned about global warming.*	0.848	3.80	1.05
	Environmental problems are greatly exaggerated.*	0.824	3.73	1.15
	I see no need for sustainability.*	0.670	4.12	0.95
Social Norm (N/A)	Going on holiday by plane has become very normal.*	N/A	3.81	0.85
Perceived Behavioural Control (α=0.885)	Not getting on a plane anymore is for me... very difficult (1) to very easy (5)	0.913	3.70	1.24
	For me, reducing the number of flights I make from now on is ... very difficult (1) to very easy (5)	0.872	3.99	1.10
	Going on holiday without flying is for me... very difficult (1) to very easy (5)	0.747	4.06	1.03
	If I wanted to, I could easily reduce the distance of my air trips by visiting destinations closer to home.*	0.720	3.91	1.12
Attitudes towards Flying (α=0.713)	I think of flying as ... very unpleasant (1) to very pleasant (5)	0.787	3.24	0.92
	I think of flying as ... very difficult (1) to very simple (5)	0.674	3.23	0.89
	I think of flying as ... very exhausting (1) to very refreshing (5)	0.575	2.63	0.70
Intention to fly (N/A)	How often do you expect to travel by plane for private purposes in the coming 2 years?**	N/A	2.02	1.16

* Measured on a 5-point Likert scale where, 1 = strongly disagree, 2 = disagree, 3 = neither disagree nor agree, 4 = agree, and 5 = strongly agree.
** Measured as follow: 1 = Not, 2 = 1 time, 3 = 2 times, 4 = 3 times, 5= 4 to 5 times, and 6 = 6 times and more.
*** Box '6 = I don't know' merged with '3 = neither X, nor Y' where X and Y differ per scale.

encompasses people's thoughts about what others expect and think they must do. Since this is hard to measure, and this feeling especially rises when people in your circle of friends and family fly, the statement "In my circle of friends it is common to go on holiday by plane" is chosen to best represent the social norm included in this study.

When the factor satisfies the reliability requirements set (Cronbach's alpha > 0.70), the factors are constructed through summated scales of the different items. This method has the advantage that only items with high factor loadings are included (Molin, 2019b). Furthermore, constructing summated scales is a simple process since no weights are used. The summated scales together with the corresponding fixed measurement error term (based on the Cronbach's alpha) will be included in the structural equation model in AMOS.

3.4.4. Analysis of correlations justifications categories

As shown in the operationalisation section, the 'justifications' questions are categorized into 6 types of justifications, each category containing 3 to 4 items, for which the respondents need to select all statements they agree with by checking the box of these items. To enable the comparison of the different categories, it needs to be checked if the categories really represent different types of justifications or that these categories are highly correlated. Hence, the correlation matrix of the

Table 6; Correlation matrix of the 6 variables representing the justifications categories

	Having the right to fly	No suitable alternative is present	Compensate for flying emissions	Shifting responsibility to reduce emissions to others	Shifting responsibility to solve the problem to others	Having no impact
Having the right to fly	1	0.326	0.067	0.148	0.040	0.256
sig.		*<0.001*	*0.040*	*<0.001*	*0.223*	*<0.001*
No suitable alternative is present	0.326	1	0.065	0.086	0.072	0.116
sig.	*<0.001*		*0.047*	*0.008*	*0.028*	*<0.001*
Compensate for flying emissions	0.067	0.065	1	0.064	0.117	0.017
sig.	*0.040*	*0.047*		*0.049*	*<0.001*	*0.611*
Shifting responsibility to reduce emissions to others	0.148	0.086	0.064	1	0.025	0.332
sig.	*<0.001*	*0.008*	*0.049*		*0.450*	*<0.001*
Shifting responsibility to solve the problem to others	0.040	0.072	0.117	0.025	1	-0.050
sig.	*0.223*	*0.028*	*<0.001*	*0.450*		*0.127*
Having no impact	0.256	0.116	0.017	0.332	-0.050	1
sig.	*<0.001*	*<0.001*	*0.611*	*<0.001*	*0.127*	

variables representing the number of selected reasons per category by the respondents is checked (N=934). Table 6 shows that almost all variables correlate with each other, what is to be expected. Though, the correlations are that small (0.332 as largest correlation) that the individuality of the different categories can be confirmed.

3.4.5. Implementation of informational intervention

To find out if information has an effect on people's choice to fly, the respondents are randomly divided into two groups (1/3rd & 2/3rd of respondents) of which just one group (1/3rd of respondents) received the informational intervention when completing the survey. A dummy variable will be incorporated in the SEM to represent this variation in having or having not received the informational intervention. In this way, it can be studied if, in what direction and via which causal pathway raising awareness by informing people about the relative environmental impact of flying compared with other activities contributing to climate change will operate to the intention to fly.

To be able to measure the effect of receiving information about the relative impact of flying on climate change more purely, without noise of the already existing knowledge of the respondents, a second sub-model will be built in which the informational intervention is incorporated in a different way. Asking the respondents to rank the different household and travel related activities based on the CO_2-emissions these activities cause, gives information about the proportion of awareness created for each respondent individually when making this ranking task (as introduced in section 3.2.1.). In other words, the difference in correct ranking and answered ranking by the respondents when completing the ranking task shows the extent to which the information about the relative impact of flying compared to other household and travel related activities is 'new' to them. As mentioned before, the informational intervention will only affect people's intention to fly when this informational intervention is 'new' to people. By making a distinction in how 'new' the information is for the respondent, or, the other way around, in how much is already known by the respondent in advance, the effect of the informational intervention is measured more purely.

The *deviation in ranking between the ranking position selected by the respondents and the correct ranking position of both flying activities* represents this proportion of 'new' awareness, compared to the already existing awareness, about the relative impact of flying on climate change created by making the ranking task. The two flying activities incorporated in the ranking task are 'Flying back and forth to Berlin together with a friend' and 'Flying back and forth to Bali (Indonesia) together with a friend'. The deviation in ranking position for both flying activities is calculated by subtracting the *correct ranking position of the flying activity* from the *ranking position selected by the respondents for this flying activity*.

Since 'Flying back and forth to Bali' should be ranked at the first position, the scale ranges from 0, which indicates no deviation, to 6, indicating the highest deviation possible. A deviation of 0 here implies no created awareness by the informational intervention and of 6 lots of awareness created by the informational intervention. 'Flying back and forth to Berlin' is positioned correctly at the fourth ranking position. The scale therefore ranges from -3 to 3, respectively indicating an overestimation and underestimation of the CO_2-emissions caused by flying back and forth to Berlin. A deviation level of 0 implies that no extra awareness is created by the informational intervention, while the most awareness is created with deviation levels of -3 and 3.

To include the *deviation of the respondent's ranking from the correct ranking of both flying activities* as variables representing the newly created awareness, a separate structural equation model is built. Since one third of the respondents received the ranking task, this sub-model will be based on the data of these respondents only. This model therefore serves as validation model to see if there is a larger effect present when measuring the effect of receiving information about the relative impact of flying on climate change more purely.

3.4.6. Model assumptions

According to Hair et al. (2006), the most fundamental assumption when performing a multivariate analysis is normality. The Maximum Likelihood (ML) estimator used as procedure to estimate the structural equation model assumes this multivariate normality among the variables as well. When the SEM is fitted to non-normal data, both inflated model test statistics and under-estimated standard errors will occur, which needs to be prevented (CenterStat, 2019).

The multivariate normality of the variables implies that the individual variables as well as their combinations are normally distributed in a univariate sense. It needs to be noted that not all variables need to be normally distributed; the normality assumption only applies to the residuals which is only relevant for the dependent variables included in the SEM (CenterStat, 2019). Since the multivariate normality is hard to test, it is chosen to only asses the normality of the individual variables. The individual normality of the variables will help gain, but not guarantee, multivariate normality (Hair et al., 2016). Appendix F shows the results of the assessed normality of the variables included as dependent variables in the SEM model. There are no severe deviations from the normal distribution present. The intention to fly, however, shows some skewness to the right which deviates from the normal distribution, but the distribution is not found sufficiently non-normal to introduce problems in estimation. All variables are therefore assumed normal and included in the SEM.

3.4.7. Model building

In line with section 3.4.5., two models are built using IBM® SPSS® AMOS™ 26; one main model in which the informational intervention is represented by a dummy variable (N=1976) and one sub-model representing the informational intervention by the deviation of the respondent's ranking from the correct ranking of both flying activities (N=643).

For the first model, the conceptual causal model of chapter 2 is implemented as structural (path) model in AMOS. Since the exact paths between the general environmental attitudes, the attitudes towards flying and the intention to fly are unclear, a simple initial model is built and assessed. Appendix G shows the steps taken and final results of this assessment. Only an indirect path from the general environmental attitudes towards the intention to fly, via the attitudes towards flying, is included in the final (path) model.

The measurement model, which consists of the summated scales of the latent variables together with their fixed error terms, is added thereafter. Since both the social norm and the intention to fly are measured by a single item, the fixed error terms of these items are equal to 0. To complete the structural equation model, the measurement errors of the endogenous variables are incorporated as final element. Since these are possibly correlated, the measurement errors of the variables directly explaining the intention to fly are correlated. The resulting model can be found in Appendix G.

Only some minor changes are made to build the second model in AMOS. The variable 'Information about the relative impact of flying on climate change' is now replaced by two variables representing the added awareness created by the information provided. This is expressed as the deviation of the respondent's ranking from the correct ranking of both flying activities (see section 3.4.5). The correlation between the two 'deviation' variables is small enough to be incorporated into the same model. Since the ranking task is made by one third of all respondents, only the data of these respondents is included in the model (N=643).

4. Results

This chapter shows the results of the performed descriptive analysis and the estimated structural equation models. In the first paragraph, the findings related to the current awareness among Dutch citizens about the impact of flying on climate change are presented. This is followed by a description of the intention to fly for leisure purposes, presenting the expected flight frequency among Dutch citizens. The third paragraph dives into the estimated structural equation models, showing if and via which socio-psychological path the informational intervention as well as the current awareness about the impact of flying on climate change operates to the intention to fly. Finally, the different reasons used to justify people's flying while being environmentally concerned are presented. The importance of the various justifications are compared, which provides guidance for policy makers for the introduction of more targeted measures to reduce flying among Dutch citizens.

4.1. Current awareness of Dutch citizens about the impact of flying on climate change

After forming the conceptual causal model, the next step in this research is to find out more about the current awareness among Dutch citizens about the impact of flying on climate change (see section 1.3 sub question 2). The respondents are asked to at first state to what extent they are aware of the contribution of flying to climate change, after which they needed to answer four multiple-choice questions to test both their actual understanding of the impact of flying on climate change as well of their knowing how to reduce the environmental impact related to flying .

While 82.1 percent of the respondents indicate they are (totally) aware of the fact that the CO_2-emissions of human activities like flying contribute to climate change, only 70.4 percent point out that they themselves contribute to climate change when they fly (see figure 9A & 9B). Although this difference is remarkable, no more than 3.2 and 9.2 percent of the respondents totally disagree or disagree with the statements respectively; the remaining respondents do not agree nor disagree. We can therefore conclude that the main part of the Dutch citizens indicate that they are aware of the impact of flying on climate change.

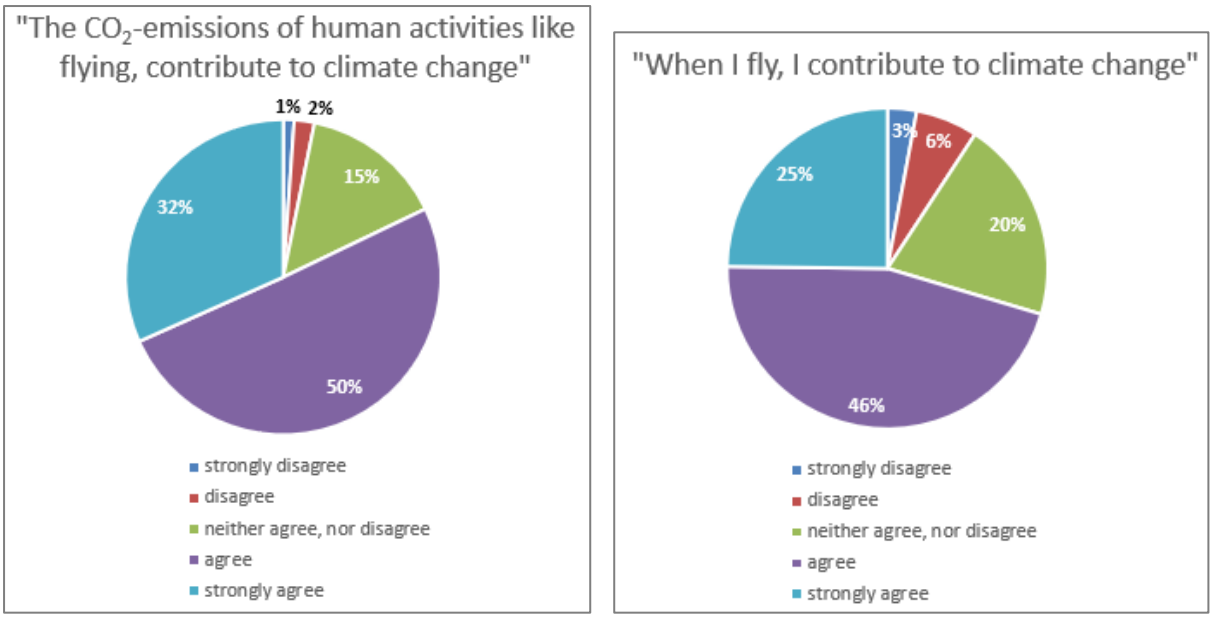
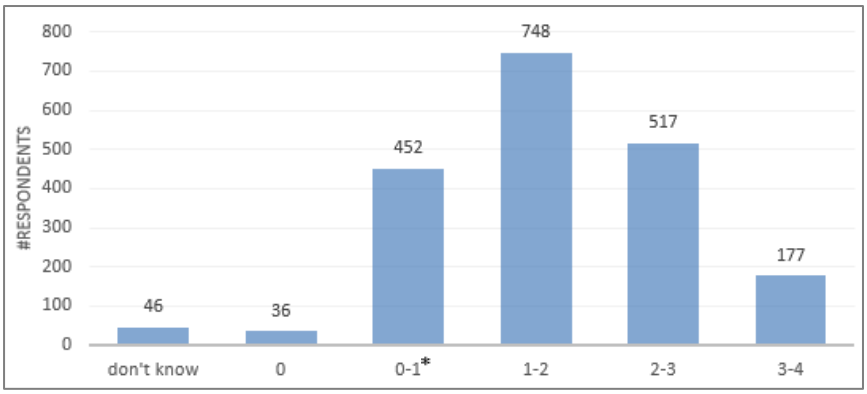


Figure 9A & 9B; Percentage of respondents that indicate they are (not) aware of the/their impact of flying on climate change



*range 0-1 includes all numbers from 0 up to and including

Figure 10; Total number correctly answered awareness questions impact flying on climate change;

Two different exercises were created to question the different facets of respondents' actual awareness about the impact of flying on climate change. Looking at the four multiple-choice questions answered (exercise 1), of the 1930 respondents who tried to answer the questions, only 36 percent correctly answered more than half of the questions (see figure 10). Most of the respondents (more than 40%) properly answered 1 to 2 questions. This suggests that the main part of the Dutch citizens finds it hard to explain the way in which air travel contributes to climate change.

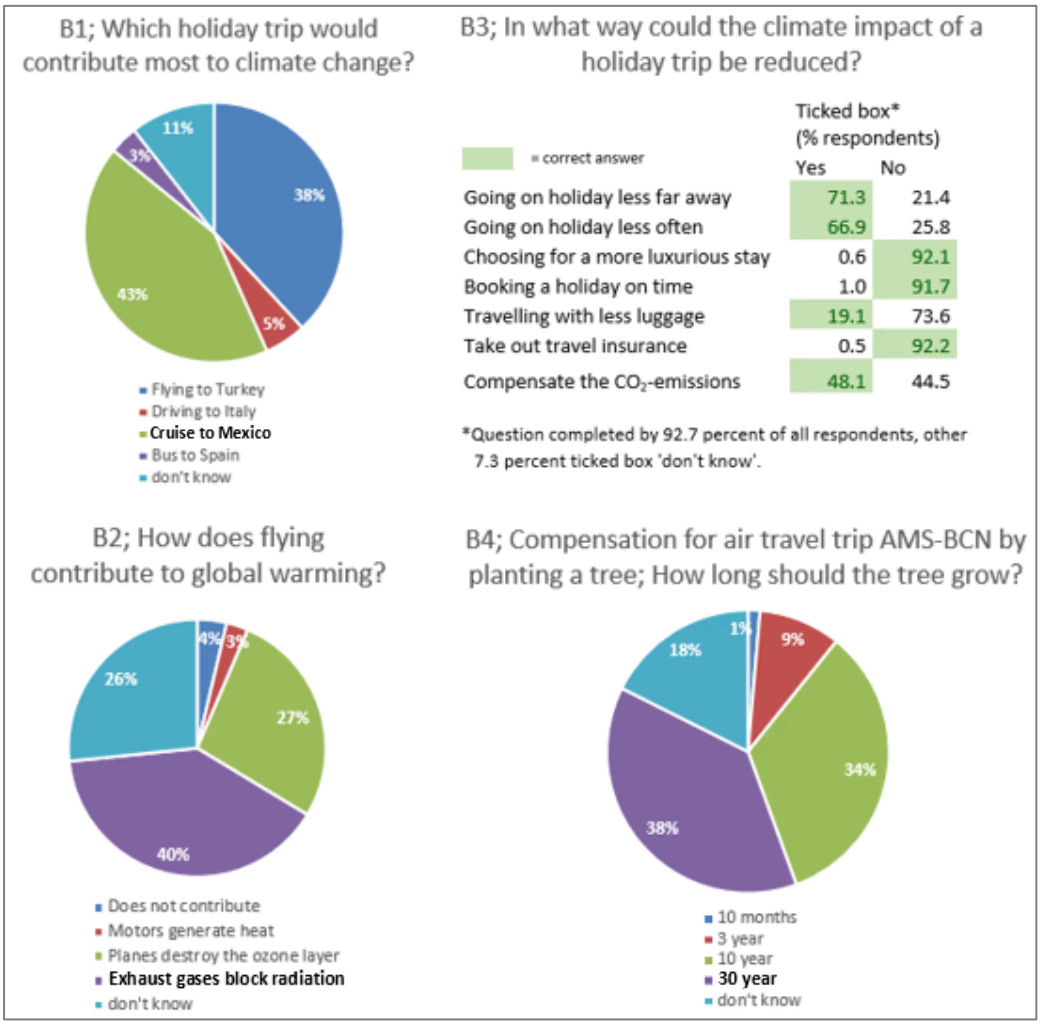


Figure 11; Respondents' answers to questions testing the system- and action related awareness related to air travel and climate change

Looking in more detail to the four multiple-choice questions (see figure 11; correct answers are bold or in green), all questions are answered correctly by around 40 percent of the respondents. The following points stood out:

- A large part of the respondents denoted 'Flying to Turkey' as the most emitting holiday trip instead of the 'Cruise to Mexico'.
- Answering how flying contributes to climate change has proven to be difficult; almost 27 percent of the people ticked the 'I don't know' box.
- Most respondents do know how to reduce the impact of their holiday on climate change; reducing luggage as a way to reduce the footprint of your holiday is unknown.

The former multiple-choice questions are system and action related questions (see section 3.2.1.). The ranking assignment made by one third of the respondents gives more insight into the awareness about the effectiveness of a reduction in flight frequency, i.e. knowing what the impact is on the environment when reducing your flight frequency or distance of your flights (exercise 2).

Table 7; Frequency table of respondents rankings of ranking task assignment

↓ rank (kg CO_2)	Flight Bali	Driving	Electricity	Flight Ber	Bathing	Train Ber	E-mails
1 (3300)	455	124	11	35	4	5	9
2 (1800)	112	155	34	275	43	13	10
3 (815)	26	228	84	177	84	32	12
4 (450)	20	79	184	72	168	103	17
5 (146)	9	41	186	51	192	135	29
6 (70)	11	13	125	25	137	255	78
7 (4)	10	3	19	8	15	100	488

The frequency table (table 7) shows at what rank the 643 respondents have arranged the different activities, so the answered ranking positions. The correct ranking positions are shown in the most left column. The green cells represent the number of respondents who ranked the named activity at the correct ranking position. The table shows, for example, that 255 respondents correctly ranked the activity *Making a roundtrip by train to Berlin together with a friend* at rank 6, while 135 respondents overestimated and 100 respondents underestimated this activity by one rank.

Several interesting insights can be derived from this table. *Flying back and forth to Bali*, the highest activity in ranking, and *sending 1000 e-mails*, the lowest activity in ranking, are both generally well assessed. More than 70 percent of the respondents correctly ranked these activities. The activities in between were more difficult to rank. *Supplying the electricity for a two-persons household for a year* is often estimated as a lower emitting activity than it actually is, while *flying back and forth to Berlin* is most of the times estimated as a more emitting activity than it really is. The remaining three activities were ranked about right, but the exact ranking position is in general not completed well.

Looking at the data, it is striking that 58 respondents (9%) ranked flying back and forth to Berlin higher than flying back and forth to Bali. This could on the one hand indicate that not all respondents know the location of both cities and think Berlin is located further away from the Netherlands than Bali or Indonesia or on the other hand do not know that long haul flights are more polluting than short haul flights.

Focussing on the flying activities in comparison with the other household and travel related activities, a large part of the respondents correctly assess the relative impact of flying on climate change when comparing the CO_2-emissions of the different activities. This is shown in figures 12A and 12B, which presents the deviation in ranking between the ranking position selected by the respondents and the

correct ranking position of both flying activities. A positive deviation means that the respondent underestimated the relative impact of the flying activity by X positions in ranking and a negative deviation means an overestimation of the impact of the flying activity by X raking positions. As can be seen in figure 12A, flying back and forth to Bali is mainly estimated correctly. Looking at the deviation of the activity flying back and forth to Berlin, many respondents even overestimate the impact of flying on climate change. This suggests that the respondents are aware of the large impact air travel has on climate change relative to other activities and in some cases even overestimate this relative impact.

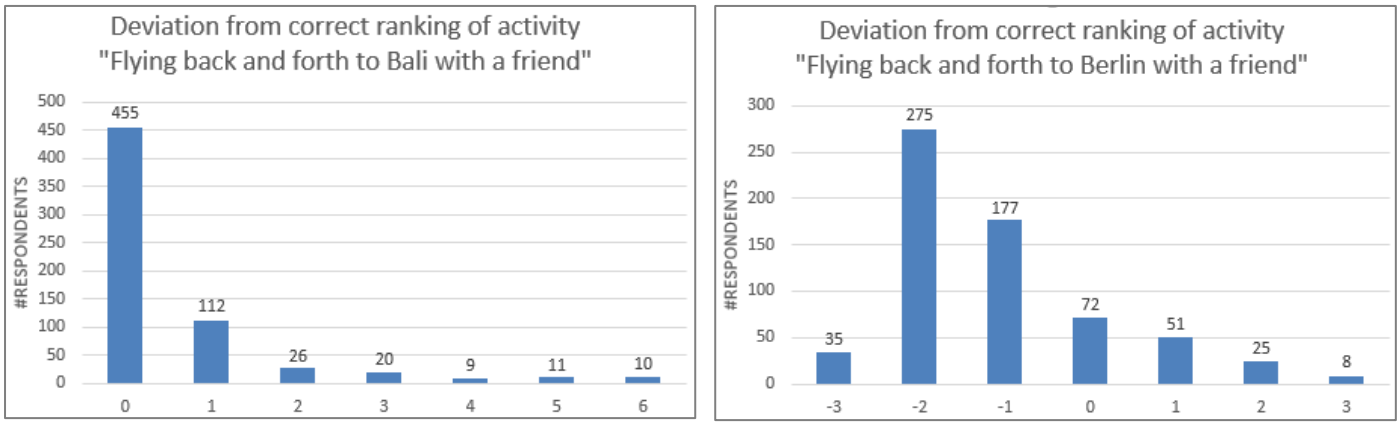


Figure 12A & 12B; Deviation in ranking between the ranking position selected by the respondents and the correct ranking position of both flying activities

So, although people in general have difficulties with indicating how flying actually contributes to climate change, the data shows that the respondents are aware that flying contributes to climate change. They can correctly indicate how to reduce their footprint as well as estimate what the impact is of flying on climate change relative to other household and travel activities.

4.2. Intention to fly among Dutch citizens

Since this survey has the higher societal aim to get people out of the plane, the intention to fly is an important factor to look at in more detail. When asking people about their experience with flying during the completion of the survey, 31.1 percent of the respondents (615 respondents) point out that they do not fly at all. Only 87 percent of these respondents, however, also indicate at the end of the questionnaire that they do not intend to fly for leisure purposes in the coming two years. This means that 13 percent did not fly in the recent past but expects to fly in the near future.

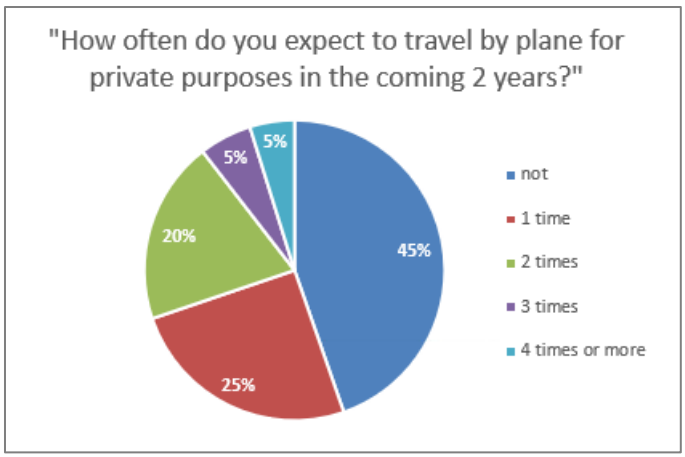


Figure 13; Intention to fly for leisure purposes in the coming two years among Dutch citizens

In total, 55.3 percent of all respondents answered that they intend to fly for leisure purposes in the coming two years (see figure 13). A total of 883 respondents (44.7%) do not expect to fly for leisure

purposes in the coming two years. This implies a growth of more than 40 percent of people who do not intend to fly compared to the earlier mentioned 615 respondents indicating they do not fly at all. There are, though, still a lot of Dutch citizens who will fly in the coming years.

4.3. Effects of the socio-psychological variables on the intention to fly

This paragraph shows the results of the structural equation models, which differ in operationalisation of the informational intervention, created in AMOS. These models will give more insight into the effect of providing information and enhancing awareness about the (relative) environmental impact of flying on climate change, on the intention to fly and into the causal pathway of socio-psychological variables via which information operates to the intention to fly. First, the model fit of the two models is presented, after which the path coefficients will be discussed.

4.3.1. Model fit

Although only one model does fit according to the Chi-square test, i.e. an insignificant result is found, other model fit measures suggest that both models fit the data well. Table 8 shows the model fit statistics for both models. The p-value belonging to the chi-square test statistics of the first model suggest that the observed and estimated covariance matrices differ significantly from each other. The chi-square test, however, depends on the size of the sample, which makes it hard for larger samples (N>500) to find a model that cannot be rejected (see section 3.1.). Hence, the comparative fit index (CFI) and the root mean square error of approximation (RMSEA) are examined as well. These goodness-of-fit measures score, respectively, higher and lower than the recommended values suggested by Shi et al. (2019). Based on these measures, it can therefore be concluded that both models fit the data well.

Table 8; Model fit results

		Model 1 (N=1976)	**Model 2 (N=643)**	**Recommended values**
Fit measures	X^2	32.532	18.105	
	p-value	0.00	0.11	>0.05
	df	9	12	
	CFI	0.990	0.993	>0.95
	RMSEA	0.036	0.028	<0.06
Parameters	R^2 of intention to fly	0.606	0.613	
	β-parameters (#sign.)	7(3)	10(3)	
	Γ-parameters (#sign.)	5(4)	5(2)	

Besides looking at the goodness-of-fit statistics, the extent to which the model is able to explain observed variance in the intention to fly also says something about the quality of the model. 60.6 percent of the variance in the dependent variable intention to fly is explained by the first model. This means that the model does not include all determinants of the intention to fly, there is still quite some unexplained variance in the intention to fly left.

Looking lastly at the path coefficients between exogenous and endogenous factors (β-parameters) and the path coefficients between endogenous factors and other endogenous factors (Γ-parameters), many paths are insignificant. This means that these paths are equal to 0. Especially the paths between the exogenous variables, so the experimental condition and the current awareness, and the endogenous variables, the direct predictors of the intention to fly, are found insignificant. This suggests that the experimental condition did not enrich the initial model of the intention to fly and its predictors. This will be explained further in the next section.

Overall, it can be concluded that the models fit the data well.

4.3.2. SEM results

Figure 14 and 15 show the path diagrams of both estimated SEMs. The path coefficients presented are the standardized path estimates estimated by the model, which allows for comparison and assessment of the relative importance of the paths. Only significant paths are included in the path diagram; all paths found insignificant by the model hold the value 0. All indirect path coefficients can be found in appendix H.

SEM 1; Effect of Information and Awareness about the impact of flying on climate change on the intention to fly.

The provided information about the relative impact of flying on climate change does not have any significant relation towards the intention to fly; all outcoming direct and indirect paths are insignificant. The current awareness of the impact of flying on climate change, on the other hand, does have a significant positive relation with the factors general environmental attitudes, justifications and the intention to fly, which means that a higher awareness about the impact of flying on climate change leads to a more positive general environmental attitude, a higher amount of justifications given to explain the cognitive dissonance present and a little higher intention to fly. Especially the path towards the general environmental attitudes is quite strong; a path coefficient of 0.42 is found. A significant direct relation between the current awareness and the intention to fly is found, which implies that the current awareness does not only affect the general environmental attitudes and justifications; other indirect relations not captured in this model are present. Though, it is questionable if it is worth specifying this non-captured path, since the strength of this relation is very low (β =0.04).

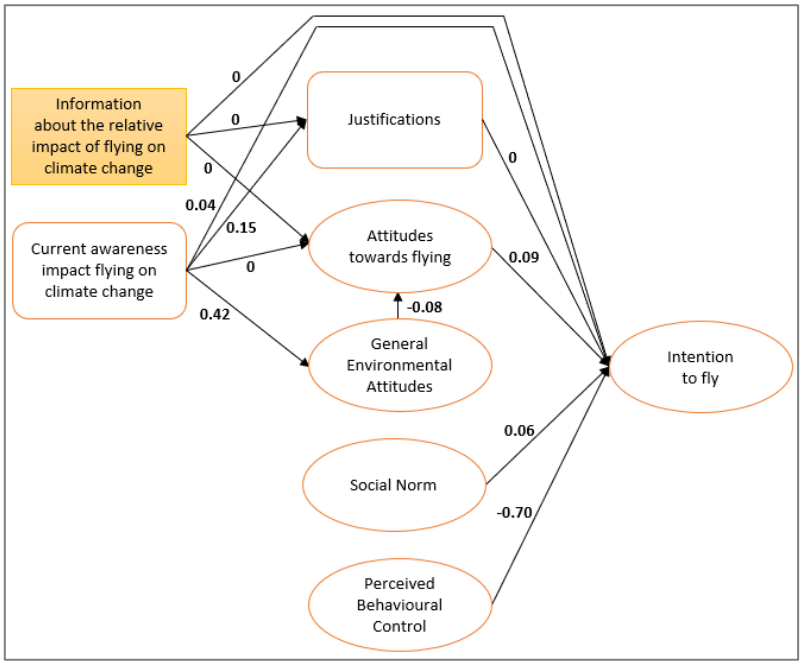


Figure 14; SEM 1 path diagram with standardized regression weights

No direct significant relation between the current awareness of the impact of flying on climate change and the attitudes towards flying is found. This indicates that being aware of the impact of flying on climate change does not change your feeling regarding flying directly, which is against expectation. The current awareness only relates to the higher order general environmental attitudes, i.e. the respondent's environmental concern. Being more concerned with environmental issues, in turn, results in an only slightly lower, i.e. little more negative, attitude towards flying.

In order to assess the effects of each factor on the main variable the intention to fly, the total effects need to be evaluated. These standardized total effects are presented in table 9.

Table 9; Standardized total effects and importance of all exogenous and endogenous variables on the intention to fly

Variable (Factor Label)	Effect
Information about the relative impact of flying on climate change	0
Current Awareness impact flying on climate change	0.04
Justifications	0
Attitudes towards flying (LATF)	0.09
General Environmental Attitudes (LGEA)	-0.01
Social Norm (LSN)	0.06
Perceived Behavioural Control (LPBC)	-0.70

While most of the signs of the path coefficients are as expected, the direction of the path between the current awareness of the impact of flying on climate change and the intention to fly does not meet expectations. Being more aware of the impact of flying on climate change results in a higher intention to fly. This positive effect can be fully assigned to the direct path included in the model; both indirect paths via the general environmental attitudes and/or via the attitudes towards flying is respectively negligibly small (Γ=-0.001) or not even present (not significant; see appendix H). This outcome suggests that being aware of the problem does not make you behave in a way to help dealing with this problem, but the other way around. As stated before, the current awareness of the impact of flying on climate change has, however, only very little effect on the intention to fly, which makes it questionable if this result is worth mentioning.

The distribution in strength/sizes of the path coefficients shown in table 9 is quite unexpected. The perceived behavioural control is the strongest predictor of the intention to fly. Citizens who consider reducing the frequency of flying for leisure purposes as easy or could easily reduce the distance of their flights are more likely to reduce their flights in the coming two years. This perceived difficulty to perform a certain behaviour, in our case reducing your flying for leisure purposes, is of such importance that the other factors only have minor effects as predictors of the intention to fly. The second strongest predictor of the intention to fly captured in the model is the attitudes towards flying. Residents who experience flying as more pleasant, refreshing and simple have a higher intention to fly in the coming two years. The strength of this relationship is only an eighth of the strength of the strongest predictor. This shows the relative importance of the perceived behavioural control to the other predictors captured in the model.

The strong effect of the perceived behavioural control (PBC) towards the intention to fly can partly be explained by the correlations of this factor with the other determinants of the intention to fly. Table 10 presents the correlation matrix of the factors potentially determining the intention to fly. It shows that the PBC has quite substantive significant relationships with all other determinants of the intention to fly, especially the attitudes towards flying. This makes it possible for this factor to force the other factors out, resulting in a high path coefficient for the PBC to the intention to fly and low path coefficients for the other determinants to the intention to fly (see table 9). Section 5.3. will further elaborate on the findings related to the strength of the effects.

Table 10; Correlation matrix of the correlations between the incorporated determinants of the intention to fly

	Perceived Behavioural Control (PBC)	Social Norm (SN)	General Environmental Attitudes (GEA)	Attitudes towards Flying (ATF)	Justifications
Perceived Behavioural Control (PBC)	1	-0.161	0.108	-0.322	-0.266
sig.		*<0.001*	*<0.001*	*<0.001*	*<0.001*
N		*1976*	*1976*	*1976*	*934*
Social Norm (SN)	-0.161	1	0.025	0.038	0.131
sig.	*<0.001*		*0.259*	*0.094*	*<0.001*
N	*1976*		*1976*	*1976*	*934*
General Environmental Attitudes (GEA)	0.108	0.025	1	-0.109	-0.004
sig.	*<0.001*	*0.259*		*<0.001*	*0.897*
N	*1976*	*1976*		*1976*	*934*
Attitudes towards Flying (ATF)	-0.322	0.038	-0.109	1	0.142
sig.	*<0.001*	*0.094*	*<0.001*		*<0.001*
N	*1976*	*1976*	*1976*		*934*
Justifications	-0.266	0.131	-0.004	0.142	1
sig.	*<0.001*	*<0.001*	*0.897*	*<0.001*	
N	*934*	*934*	*934*	*934*	

After estimating the first SEM, it can be concluded that the awareness about the impact of flying on climate change does affect people's environmental concern and people's need to justify their flying behaviour, but does not work through to the intention to fly. Since the attitudes towards flying and justifications have a significant lower importance in predicting the intention to fly than the perceived behavioural control has, it is only possible to find a small effect of the awareness about the impact of flying on climate change on the intention to fly. Informing the public about the relative impact of flying on climate change does not cause for any reduction in the intention to fly as was hypothesized. This effect, however, must be studied in more detail considering the notion that providing information is only effective when the information given is 'new' to people, which is not taken into account here. Model 2 will dive deeper in this phenomenon.

SEM 2; Effect of information about the relative impact of flying on climate change on the intention to fly, corrected for the already existing awareness about the relative impact of flying on climate change.

Since the information provided about the relative impact of flying on climate change will only possibly affect the intended behaviour of people who did not have this knowledge in advance, this second model uses a different measure to represent the increase in awareness that is achieved by providing information. The increase in awareness, i.e. the proportion of 'new' awareness, is now represented by the deviation in ranking between the ranking position of both flying activities selected by the respondents when making the ranking task and the correct ranking position of these flying activities (see section 3.4.5 for the underlying reasoning). Both flying activities, i.e. flying back and forth with a friend to Bali (Indonesia) and to Berlin, are separately included in the model (see figure 15); the rest of the model has remained similar to the first model. It needs to be noted that only one third of the respondents were provided with the informational intervention, meaning that only the data of these respondents is included in AMOS (i.e. N=643).

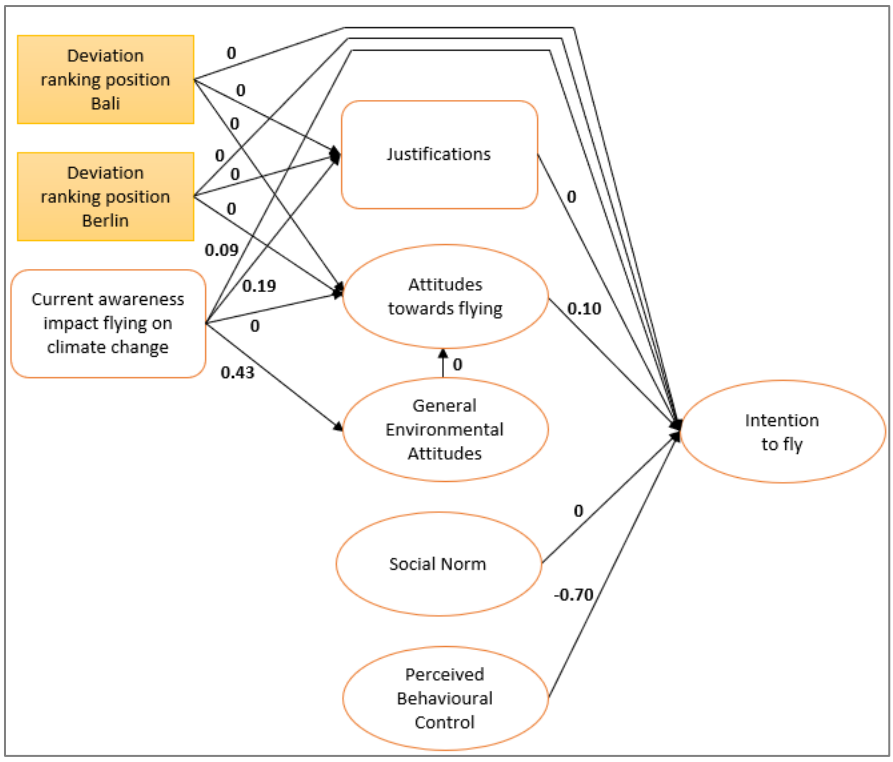


Figure 15; SEM 2 path diagram with standardized regression weights

Even when people are not familiar with the relative impact of flying on climate change and this information is thus new to them, no direct or indirect effect is found from the informational intervention to the intention to fly (see figure 15). All outgoing paths of the variables deviation ranking position Bali and deviation ranking position Berlin are insignificant, i.e. equal to zero. The current awareness of the impact of flying on climate change does have a small effect on the intention to fly; only the direct path is found significant. This indicates that either the current awareness about the impact of flying is already of a certain height that being aware of the relative impact does not contribute to this overall awareness, or that the ranking task is not effective in raising awareness. This will be discussed further in chapter 5 Discussion.

4.4. Reasons used to justify intended flying behaviour

The respondents who are acting against their pro-environmental values by worrying about global warming but still intend to fly for leisure purposes in the next coming two years (*N=934*) received several extra questions about their reasons behind this cognitive dissonance. This paragraph presents the results from the conducted survey related to these so called justifications questions and describes the most commonly used reasons of the respondents to justify their intended flying behaviour.

Figure 16 shows the number of respondents that selected one of the reasons per category to justify their intended flying behaviour. This represents the importance of each category in explaining the identified cognitive dissonance regarding pro-environmental values and flying intention. As can be concluded from figure 16, the group of reasons 'no suitable alternative present' is most important, followed by the category 'having the right to fly'. 'Others are more environmentally unfriendly' is mentioned the least as reason to fly against pro-environmental values.

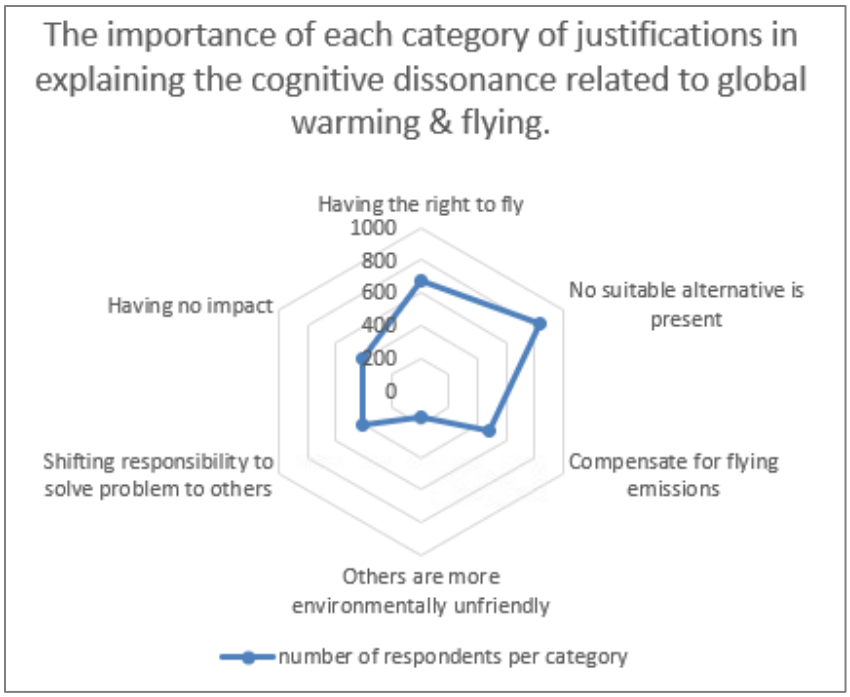


Figure 16; The importance of each category of justifications in explaining the cognitive dissonance related to climate change & flying (N=943)

89 percent of the respondents point out that there is no suitable alternative present to get where one wants to go for leisure purposes (see table 11), while almost 73 percent of the respondents indicate they want to enjoy life and discover the world. Diving deeper into the different reasons selected per category (see appendix I for full analysis), the respondents state particularly that they will not get where they want to go if they do not use the plane as travel mode; 64 percent of the total answers given in this category refers to this statement. Reasons related to the time and price of the alternative transport modes are selected much less; only 37 percent of the answers given. This suggests that either the destination of the desired trips is too far away to reach by another transport mode or people are not aware of the alternatives present.

Table 11; The number of respondents that did or did not select a justification per category, whereby N = 934

N=934	**Number of respondents that selected reason**	
	Abs.	**%**
1. Having the right to fly	678	72.6
Reason not applicable	*256*	*27.4*
2. No suitable alternative is present	832	**89.1**
Reason not applicable	*102*	*10.9*
3. Compensate for flying emissions	485	51.9
Reason not applicable	*449*	*48.1*
4. Others are more environmentally unfriendly	158	16.9
Reason not applicable	*776*	*83.1*
5. Shifting responsibility to solve the problem to others*	407	43.6
Reason not applicable	*527*	*56.4*
6. Having no impact	404	43.3
Reason not applicable	*530*	*56.7*

*Indicating number of respondents who do not see themselves (co-)responsible for tackling climate damage.

As it is not only interesting for the category 'Shifting responsibility to solve the problem to others' to know if people shift the responsibility to tackle climate damage to others but also to whom they shift this responsibility, this is analysed as well. Almost 44 percent of the respondents do not consider themselves mainly responsible for tackling the climate damage; these respondents did select (multiple) other parties as primarily responsible. More than 70 percent of the respondents name the government as party who is primarily responsible for tackling climate change, followed by airlines (58.4%), frequent flyers (51.3%) and myself (50.9%).

So, 49 percent of the respondents do not consider themselves mainly responsible for tackling the climate problem and 73 percent of the respondents have the perception that they do not get to their destination as soon as they do not travel by plane. These results suggest that only a small part of the flying Dutch population could be influenced at all in reducing their air travel by providing information about the impact of flying on climate change.

5. Conclusion & Discussion

This research focuses on if information about the relative impact of flying on climate change could help in motivating people to reduce their air travel for leisure purposes. Now the results have been presented, conclusions can be drawn (paragraph 1). This study has added value to the existing scientific literature in various ways, which will be described in the second paragraph. Several interesting insights are gained from analysing the gathered data and looking at the results of the estimated SEMs, which will be discussed in the third paragraph followed by the resulting implications in paragraph 4. Although this study found various interesting results, limitations need to be acknowledged when interpreting the results (paragraph 5). The discussion ends with scientific and policy-related recommendations, outlining various opportunities for future research.

5.1. Conclusion

This study examined the role of information as a means to raise awareness about the impact of flying on climate change and, in turn, to make people voluntarily reduce their intended flying. The Ministry of Infrastructure and Water Management looks into the possibility of raising the awareness of Dutch citizens as policy measure to encourage travellers to travel in a more conscious and more climate-friendly manner. The scientific literature, however, shows contradictory results on the effectiveness of this measure. There is an ongoing academic discussion on to what extent making people aware about the consequences of their behaviour could stimulate a desirable change in that behaviour. This research tried to get a thorough understanding of the relation between information about the impact of flying on climate change and the intention to fly for leisure purposes, and, therefore, has examined via which causal pathway of socio-psychological factors information and awareness run to the intention to fly. This led to the following research question:

What is the effect of receiving information about the relative impact of air travel on climate change compared to other travel- and household activities on the attitudes towards flying and the intention to fly of Dutch leisure travellers?

This research question was answered using structural equation modelling for which data is gathered with a survey among Dutch citizens. The gathered data together with a pre-defined conceptual causal model based on academic literature served as input for the path model and measurement model, which together created the structural equation model.

The main conclusion that can be drawn from this research is that becoming aware about the relative impact of flying on climate change is not enough to change people's intended flying behaviour. A possible explanation for this finding could be that this study found an in general reasonably high awareness of the relative impact of flying on climate change compared to other household- and travel activities among Dutch citizens. In fact, many respondents even overestimated the relative impact of flying on climate change. However, even when this reasonably high awareness is taken in to account, no effect is found from information to the attitudes towards flying and intention to fly.

Although the given information does not lead to any change in people's attitudes, justifications or intended flying behaviour, an interesting finding is that the current awareness about the impact of flying on climate change does affect people's attitudes and justifications. These effects, however, do not result in a change in people's intended flying behaviour. This suggests that people will change their attitude rather than their behaviour to solve the unease felt when acting against their environmental concern. So, it is likely that an attitude-behaviour gap is present in the context of air travel behaviour.

The final important conclusion that can be drawn from this research relates to the reasons used to justify the intended flying behaviour. The most common reason given by Dutch citizens to keep flying

even when they are concerned about climate change is that there is no suitable alternative present to get where one wants to go for leisure purposes. This means that either the destination of the desired trips is too far away to reach by another transport mode or people are not aware of the alternatives present.

It needs to be noted that these findings hold true only for the type and framing of the information used in this study. If future research using different type and framing of information finds similar results, it can be concluded that awareness only serves as pre-condition for behavioural change. In that case, other complementary measures are necessary to actually reduce the flying frequency among Dutch citizens.

5.2. Added value of this research

This study has contributed to the existing scientific literature in multiple ways. This paragraph underlines the added value of this research.

Contradictory results are found in literature when evaluating the possibilities for providing information aiming at raising awareness as a means for inducing behavioural change. This study contributes to the ongoing academic discussion if making people aware about the consequences of their behaviour leads to a desirable change in behaviour, applied to the case of air travel behaviour and its negative impact on climate change.

This study is one of the first studies conducted that tries to get a thorough understanding of the psychological path of factors running from information and awareness to the intention to fly by using statistical analysis. It maps the way in which air travel behaviour is formed together with the way in which information aiming at raising awareness about the impact of flying on climate change links to this formation of behaviour. This study builds upon the study of Davison et al. (2014), which is, to the best knowledge of the author, one of the first studies that uses path analyses to find out what psychological paths underlie air travel behaviour. The study of Davison et al. (2014), however, examines a limited number of factors and paths which moreover differ from the paths studied in this research. Furthermore, no link is made to information and its role to steer behavioural choices in the study of Davison et al. (2014). By doing this, this study has further expanded the scientific knowledge on the psychological path of factors related to information, awareness and the intention to fly and contributed to the existing academic debate on this topic.

From a more practical perspective, this study firstly looks into the extent to which Dutch citizens are currently aware of the negative impact of their own decision to fly. No clear view on the current awareness is present, as studies only focus on the perception of citizens on climate change in general (Centraal Bureau voor de Statistiek, 2021; Ipsos, 2021) or on a single item (van der Schelde & Kanne, 2022). Besides, there is, as the author could find, no knowledge about the way in which Dutch citizens see aviation's contribution to climate change in contrast to other human activities contributing to global warming. This study provides insights on the presence of these types of awareness in the Netherlands.

Secondly, this research shows that the particular policy measure of providing information about the relative impact of flying on climate change probably would not help to motivate Dutch citizens to reduce their air travel. This helps the Dutch ministry of Infrastructure and Water Management to make a more thoughtful decision about the possible effectiveness of launching an awareness campaign to induce voluntary behavioural change in the case of reducing flying for leisure purposes.

Lastly, building upon the studies of Árnadóttir et al. (2021), Hansmann & Binder (2021), Kroesen (2013) & McDonald et al. (2015), an overview is provided on the reasons given by Dutch citizens to justify

their intended flying behaviour while showing a great environmental concern. This overview provides guidance for Dutch policy-making in making policies that better suit the goal to reduce the flying frequency of Dutch citizens.

5.3. Discussion on the findings

The various interesting insights gained from analysing the data and looking at the results are further discussed in this paragraph.

The conceptual causal model which aims at mapping the way in which air travel behaviour is formed, fits the data well. 60.6 percent of the variance of participants' intention to fly is explained by the model. According to the meta-analysis of Armitage & Conner (2001) who analysed 185 studies implementing the TPB in various contexts, a mean of 39 percent of the behavioural intention is explained by the TPB. 60.6 percent therefore represents a rather high level of explanative power. Since this model applies the TPB as main theory, supplemented by the factor justifications as direct predictor of the intention to fly, it can be stated that the theory of planned behaviour forms a good basis for behavioural research into the air travel behaviour context.

This study shows that the Dutch citizens are currently already aware of the relative impact of flying on climate change. Even though an understanding of the way in which flying actually contributes to climate change lacks, people show a high understanding of the way in which they could reduce their footprint concerning air travel as well as of the impact of flying on climate change relative to the impact of other household and travel activities. This could explain the absence of any effect found between the informational intervention and the intention to fly. Awareness can only be raised when information adds to the existing awareness and knowledge. As for most people the provided information is not 'new', the information will not have any effect on their attitudes and intended flying behaviour. However, when looking only at people to whom the information provided is 'new', no effect of the informational intervention on any other psychological construct is found. This could on the one hand indicate that the presented informational intervention is not effective in raising awareness, or, on the other hand, that the awareness does not reflect in people's attitudes towards flying or their intention to fly.

The perceived behavioural control (PBC) is the strongest and thus most important predictor of the intention to fly in this study. This is in line with the findings of Abrahamse (2019) and Dütschke et al. (2022), and opposed to the results of the studies of Davison et al. (2014) and Oswald & Ernst (2020), who all tried to map the socio-psychological determinants of decisions regarding air travel behaviour. It is, however, against all expectations and opposed to the results of all above mentioned studies that this factor accounts for almost 2/3rd of the explained variance of the intention to fly. This remarkable finding could partially be explained by the way in which this factor, as well as the other factors included in the model, are operationalized.

First of all, all non-flyers, 31 percent of the sample, have answered that they do not fly (at all), which means that they did not answer the questions related to the difficulty of reducing their flying. Since this group does not fly, the assumption is made that they find it very easy to reduce their flying and are assigned to this answer to determine their PBC. The main part of the group non-flyers does also not intend to fly in the coming two years, which causes for a strong relationship between 'very easy' to reduce flying and 'no' flying intention in the coming two years. This, in turn, is represented by a high explained variance of the intention to fly by the PBC.

Secondly, the scales of other determinants, like the social norm, are less reliable and could be less valid according to the conducted principal component analysis. As all factors are complex with many facets,

they need to be constructed with multiple items. Since the social norm, for example, is measured by only one item as result of internal inconsistency of the questioned asked in the survey, this enlarges the possibility of a systematic error to occur. This could have diminished the explanatory strength of these determinants compared to the findings of other studies.

Finally, as pointed out in chapter 4, the correlations of the PBC with the other determinants of the intention to fly incorporated in the model are quite substantive. This makes it possible for the PBC to force the other factors out, resulting in low explanatory power for the other determinants. This is especially the case for the attitudes towards flying, since this factor has the highest correlation with the perceived behavioural control. It therefore doesn't necessarily mean that other determinants like the attitudes towards flying are not relevant in predicting the intention to fly.

Despite the fact that the PBC explains more variance than found in other studies, this finding is in line with the given reasons of people to justify their intended flying behaviour. The reason 'there is no alternative present to come to the destination one wants to go' emerges from the data as most significant reason to justify the intended flying behaviour. This reason relates to the PBC, which is defined as the difficulty to reduce your flight frequency. With no perceived alternative transport mode present to come where one wants to be, it is very hard to reduce your air travel. For this reason, it is very likely that the PBC will still be the strongest predictor of the intention to fly even when a change in operationalisation of the different factors included in the model is made.

5.4. Implications

This study did not find any effect of informing and raising awareness on the intention to fly. Taking into account the wider context, this is an interesting result for several reasons.

These results build on the existing evidence that awareness does affect attitudes, but it does not relate to the actual flying behaviour. (Alcock et al., 2017; Bamdad, 2019; Barr et al., 2010; Baumeister, 2020; Cohen & Higham, 2011; Hanna & Adams, 2017; Hares et al., 2010; Hibbert et al., 2013; Juvan & Dolnicar, 2014; Kroesen, 2013; Lassen, 2010) An attitude-behaviour gap should exist in the case of flying, meaning that even though people identify air travel as a cause of climate change and are familiar with the negative externalities of flying, there is little willingness to cut back their air travel to mitigate climate change. This study confirms the existence of an attitude-behaviour gap in this context. The results show that the current awareness about the impact of flying on climate change does affect people's general environmental attitudes, i.e. environmental concern, and people's need to justify their flying behaviour, but these effects do not result in a reduced intention to fly. These three findings all point to the presence of an attitude-behaviour gap in the context of air travel, which argues against the frequently used notion of automatically obtaining a desirably change in behaviour when making people aware about the consequences of their behaviour.

Furthermore, it is important to note that this study is conducted among Dutch citizens and cultural differences could cause for results that are not applicable to other countries. The studies of Wormbs & Söderberg (2021) and Jacobson et al. (2020), both conducted in Sweden, show that knowledge about the impact of flying on climate change is one of the most important reasons to stop travelling by air. In Sweden, topics like climate change and sustainability are higher up on the social and political agenda than in the Netherlands. 'Flight shame' is an often used term in Sweden which has caused many Swedish residents to stop flying (Gössling et al., 2019). As the survey conducted in this study shows that Dutch citizens' environmental concern does not relate to their flying behaviour, unlike in Sweden, a culture needs to be created in which preventing climate damage from happening becomes not only a public goal, but a personal goal as well.

Finding no effect of informing and raising awareness on the intention to fly does not fit with studies looking at the effect of information on other pro-environmental behaviours. For pro-environmental behaviours like 'dropping litter in to a recycle bin' (Donmez-Turan & Kiliclar, 2021; Hansmann & Steimer, 2015), 'participating in an environmental event' (Donmez-Turan & Kiliclar, 2021), 'reusing towels in hotel rooms' (Goldstein et al., 2008), informing the participants did have an effect on the pro-environmental behaviour studied. So, in those situations, providing information could result in behavioural change. This difference may be explained by the fact that these studies look into pro-environmental behaviours which are low-effort behaviour. It is therefore easy to implement and can be seen as small life style changes. Reducing air travel is a more high-effort behaviour, for which information techniques to encourage pro-environmental behaviour are less well suited (Osbaldiston & Schott, 2012).

5.5. Limitations

Although this study found various interesting results, limitations need to be acknowledged when interpreting the results. Hence, the main limitations of this study are discussed in this paragraph, divided in limitations related to the overall methodology (paragraph 5.4.1.) and to the design of the informational intervention (paragraph 5.4.2.).

5.5.1. Methodological limitations

The use of socio-psychological theories in travel behaviour research have some limitations that need to be acknowledged. No support for the causal structure assumed in this theory can be established. Structural equation modelling allows for testing theories that explain observed correlations. Goodness-of-fit statistics are provided to see if the model, representing the developed theory, fits the data well. A good model fit, however, cannot be used to establish support for the assumed causal structure of the theory. A SEM is not able to tell which variable is influencing the other, only that both variables relate to each other. Other model structures, including the same variables but different directions of causation, may fit the model equally well, or even better. Since it is often impossible to test all model structures, a good pre-devised theory is crucial to eventually make recommendations based on the tested causal structure. By giving possible explanations for all included causal relations, which is substantiated by using a broad range of scientific studies, as well as by consulting experts to validate the created theory, a good theoretical underpinning is established for this study. Still, it is important to keep in mind the uncertainty of the causal structure that is presented.

As cross-sectional data is used, the included causality could also not be supported by statistical analysis. Using cross-sectional data, the temporal precedence requirement is not met, which means that the cause must come before its effect in time. This makes it possible that some variables are indeed related, but that this relationship is not necessarily a cause-effect relationship.

A second limitation of using cross-sectional data in this study is the possibility to measure the actual flying behaviour instead of the intention to fly. To see whether changes have occurred in someone's actual flying behaviour over time, longitudinal research is necessary. Although the intention to fly is a good estimate of the actual flying behaviour, it is still easy for respondents to deviate from their stated intention. This means that a gap could exist between the intention to fly and the actual flying behaviour, which could cause for wrongful estimation of the effects between the different socio-psychological factors and the actual flying behaviour. As a result, only statements related to the intention to fly could be made, not for the actual flying behaviour.

The questionnaire used to gather the data is set out to the MPN panel during the summer break in a period of strikes and long queues at Schiphol. The timing could have influenced the results obtained in this study. This study questions people intention to fly for leisure purposes, of which going on holiday

is the main motive for people to fly (Zijlstra & Huibregtse, 2018). It is hard for the respondents to state that they intend to fly less often in the coming two years when they plan to go on holiday by plane in the coming months, while it could be easier to state when they just went on holiday. On the other hand, the current strikes and long queues at Schiphol made flying less attractive. The timing of the launch of the survey could thus have affected the results.

Finally, there are some limitations regarding the operationalisation and measurement of the different socio-psychological factors. Next to the limited reliability and validity of some factors as stated in the previous section, it must be mentioned that it could not be checked if the items questioned per category of justifications really represent this category. Ideally, if a submitted scale is constructed, it should be checked via factor analysis whether the items of this scale indeed converge on one dimension. Since the items are binary, it is not possible to check this convergence. It could thus not be confirmed that the categories are rightfully constructed.

5.5.2. Informational intervention design limitations

Next to methodological limitations, the decisions made related to the design of the informational intervention cause for several limitations as well. This paragraph will shed light on these limitations and will show what these limitations mean for the results found in this research.

The combination of the type of information presented and the type of framing used in this study to raise awareness about the impact of flying on climate change does not help in reducing the expected flying frequency for leisure purposes of Dutch citizens. However, this does not mean that no informational intervention could help to get people out of the plane for leisure trips. With different design choices for the informational intervention, a better result may be found. The following three choices need to be researched first before it can be concluded that no informational intervention could lead to a reduction in air travel for leisure purposes.

The first point relates to the internalisation of knowledge. According to Jacobsen et al. (2020), the internalisation of knowledge is crucial to instigate behavioural change. The internalisation of knowledge is a long-term process, which is hard to capture in a survey. To get as close as possible to a situation where information is internalised, an assignment is incorporated, which gets people thinking about the topic, and the questions related to the attitudes, intention and justifications are located close after this ranking task, so the received information is still a vivid memory when completing these questions. It is, however, better to repeatedly present the information to people, preferably already from a young age. This could cause for a change in effectiveness of the informational intervention proposed in this study.

Using a different type of framing when presenting the same information could also help to make the informational intervention more effective in reducing the intention to fly. In this study, only a limited literature review is conducted on the different styles in which information can be framed. This has resulted in a rather confronting way of showing the personal environmental losses. More extensive research must be conducted to find out if this is indeed is the best way to present the information to the public or that another way could be more effective.

Presenting other information could furthermore have a different impact on the intention to fly. The ultimate goal for the Ministry of Infrastructure and Water Management in this case is to prevent further growth of greenhouse gas emissions while keeping the international accessibility high (based on the general goals of the Ministry of I&W (2022)). It is, though, not necessary to motivate people by the impact of air travel on climate change to obtain this goal. Other negative news about air travel like

noise produced by aircrafts and health related issues as the spread of infection diseases like COVID, or other positive news like promoting holiday destinations nearby, could also obtain the same goal.

Only if the various possible changes as described above do not result in the desirable change in air travel behaviour, it can then be concluded that an information campaign to induce voluntarily behavioural change is not enough to change people's air travel behaviour and get them out of the plane. This would support the thoughts of Wi & Chang (2019), who imply that awareness serves as a pre-condition for behavioural change, but is insufficient to actually induce action. It is important to make people aware of the consequences of their behaviour, so people do understand why policies are made to change their behaviour. This will create more support for the implementation of other, more invasive measures, which are necessary to create actual behavioural change.

5.6. Recommendations

The aim of this research was to gain insight into if and how information about the relative impact of flying on climate change could help in motivating people to reduce their air travel for leisure purposes. A rich data set emerged from gathering the data using a survey among 1976 Dutch residents. This data set should be further explored, as presented in the first part of this paragraph. This research has made multiple contributions towards the academic knowledge on this topic, but also has its limitations and uncertainties as discussed above. These serve as starting point for future research, which will be shown in the second half of this paragraph. Besides, the findings of this study lead to new research possibilities and more applied actions for the ministry of Infrastructure and Water Management to take and explore, which is discussed in the third half of this paragraph.

Future research should further explore the gathered data on the following points:

- Almost all explained variance of the intended flying behaviour can in this study be attributed to a single factor: the PBC. This makes the other determinants non-relevant in predicting the intention to fly. Further analysis must be performed to see if this is really the case, accounting for the limitations of the performed analysis in this study. The following steps are suggested:
    - The respondents indicating that they do not fly could be excluded from the data set. These people do not have to reduce their flying. Besides, the assumption made that they find it very easy to reduce their flying possibly strengthens the relation between the PBC and the intention to fly.
    - As the PBC correlates highly with the other determinants of the intention to fly, the composition of this factor could be re-evaluated.
- As the Dutch population is a complex group to target as a whole, the effect of information on the intention to fly of different sub-groups should be researched as well. This enables to design more tailor-suited policies and to focus on groups for whom these policies are needed and effective. The following sub-groups could be of interest:
    - The extent to which the awareness is raised is measured by the deviation in ranking between the ranking position selected by the respondents and the correct ranking position of both flying activities in absolute terms. It could be interesting for future research to make a distinction between groups with a positive and negative deviation, representing the people that underestimate and overestimate the impact of flying on climate change.
    - Looking at effects present for the flying population only, excluding non-flyers, or for the people with cognitive dissonance only could provide interesting insights.

To find out if information could affect people's flying behaviour, future scientific research should be conducted on the following points:

- Include different framing styles of the presented information. A second experimental condition could be added to the current experimental condition, in which different types of framings of the same information can be researched. This will result in finding the most effective way to frame the information about the impact of flying on climate change.
- The internalisation of knowledge can be better captured in future studies. Environmental training could, for example, help to exhibit voluntary pro-environmental behaviour (Donmez-Turan & Kiliclar, 2021). This can be achieved by having multiple training/focus group sessions before asking the respondents to complete the survey. By better capturing the internalisation of knowledge, a stronger result could be found between information and the intention to fly.
- People's actual flying behaviour should be studied instead of the intention to fly only. This requires knowledge of the same individual's flying behaviours over several years. In this way the actual change in flying frequency among individuals could be derived from the data. Such a study could help to improve the understanding of the possible gap between the intention to fly and the actual flying behaviour. Moreover, recommendations can then be made directly on changing the actual flying behaviour instead of making assumptions about the relation between the intended and actual flying behaviour.
- New paths of socio-psychological factors should be researched to see if there is a different, not captured, indirect path that explains the relation between the information provided to raise awareness and the intention to fly and, desirably, the actual flying behaviour. This requires new creative insights into the factors that could additionally explain air travel behaviour, which could improve the understanding and lead to the development of more effective policies.

Next to academic research, more applied research or actions should be taken by the ministry of Infrastructure and Water Management to encourage travellers to travel in a more conscious and more climate-friendly manner and eventually achieve the 2050 net-zero carbon emissions goal. These possibilities are described in the following three points:

- Although the current awareness of the Dutch citizens on the impact of flying on climate change is already quite high, it is important to keep this awareness high since it likely serves as a pre-condition for behavioural change. This could be accomplished, for example, by obliging schools to include this topic in their curriculum and focus more on promoting the most effective emission-reduction strategies to close this climate mitigation gap (see also the study of Wynes & Nicholas (2017)).
- Furthermore, this study implies that the 'soft' measures like providing information will probably not work on itself to get people voluntarily out of the plane. Other complementary measures must be implemented to reduce the number of flights in the Netherlands. More research must be conducted to see what kind of measures are effective on and supported by the Dutch population.
- Research should be conducted to see what policy measures are suitable to undermine people's current reasons to fly, especially the perception of no alternative being present to come where one wants to go. Examples include:
    - Promoting other means of transport and improve the provided services;
    - Promoting holiday destinations nearby;
    - Measures focused on a changing people's lifestyle.

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Appendix A: Scientific paper

The scientific paper can be found on the next pages.

Flying in the face of climate change;
The role of information to induce voluntary behavioural change

Meijneke, S.

Abstract
The Ministry of Infrastructure and Water Management looks into the possibility of raising the awareness of Dutch citizens as policy measure to encourage travellers to travel in a more conscious and more climate-friendly manner. Scientific literature, however, shows contradictory results on the effectiveness of this measure. An ongoing academic discussion is present on the extent to which awareness about the consequences of behaviour results in a desirable change of that behaviour. This study applies structural equation modelling on Dutch Mobility Panel data to examine if and via which causal pathway of socio-psychological factors information and awareness about the relative impact of flying on climate change run to the intention to fly. We find that raising awareness of Dutch citizens about the relative impact of flying on climate change is not enough to change people's intended flying behaviour. The current awareness only changes people's attitudes and reasons used to justify their flying behaviour, not the intention to fly. Further research, however, is necessary to find out if raising awareness on other consequences or other alternatives result in the same findings. Only then it could be recommended to look into other measures to encourage travellers to travel in a more conscious and more climate-friendly manner.

Keywords: Air travel behaviour, Mitigating climate change, Informational intervention, Socio-psychological factors

1. Introduction

The 2050 net-zero carbon emission goal adopted by the world's major aviation industry associations and multiple government agencies, like the Dutch government, calls for radical action to limit the emissions caused by aviation (ATAG, 2021; EC, 2022). As the window of opportunity to meet this goal is rapidly closing, short-term measures are necessary to become climate-neutral in time (Peeters & Melkert, 2021; Werij et al., 2022).

A promising measure to mitigate the climate change impacts of aviation on a short term is stimulating voluntary behavioural change, i.e. altering behaviour in order to reduce the impact of aviation on climate change (Baumeister, 2020; Davison et al., 2014; Gössling et al., 2007). The Ministry of Infrastructure and Water Management, on the advice of the Duurzame Luchtvaarttafel (2021), looks into the possibility of raising the awareness of Dutch citizens as a policy measure to encourage travellers to travel in a more conscious and more climate-friendly manner. Informing the Dutch citizens about the consequences of their flying behaviour could give them the necessary insight to reconsider their choice to fly and reduce their flight frequency.

The scientific literature, however, shows contradictory results on the effectiveness of this measure. There is an ongoing academic discussion on whether or not making people aware about the consequences of their behaviour leads to a desirable change in that behaviour. While Wormbs & Söderberg (2021) & Jacobson et al. (2020) show in their studies that awareness and knowledge about the impact of air travel on climate change is a pre-requisite and number one reason for people to effectively reduce their travel emissions, other studies indicate that informing the travelling public is not sufficient to induce behavioural change in relation to air travel (Becken, 2007; Higham et al., 2016; Jackson, 2005; Moser & Dilling, 2011). An attitude-behaviour would exist as result of the many factors determining behaviour (Davison et al., 2014; Hansmann & Binder, 2021; Morten et al., 2018; Pandey & Joshi, 2021) as well as the ease to find reasons to justify flying instead of actually reduce flying (Árnadóttir et al., 2021; Hansmann & Binder, 2021; Kroesen, 2013). This makes evoking voluntary behavioural change complex.

This complexity stresses the need for a better understanding of the underlying mechanisms when providing information. While there are various studies examining the socio-psychological factors that might influence individuals' (intended) flying behaviour (Dütschke et al., 2022; Hansmann & Binder, 2021; Morten et al., 2018; Oswald & Ernst, 2020; Pandey & Joshi, 2021), their conclusions are based on correlational testing between these variables and the (intended) flying behaviour. It is not known via which causal pathway of socio-psychological variables the information about the relative impact of flying operates to the intention to fly.

The main goal of this study is to find out if providing information as a policy measure to raise awareness of the impact of flying on climate change could help to motivate Dutch citizens to reduce their air travel. This study is one of the first studies that aims to get a thorough understanding of the relation between information about the impact of flying on climate change and the intention to fly for leisure purposes. It will therefore examine if and via which causal pathway of socio-psychological factors information and awareness run to the intention to fly. This is done using structural equation modelling (SEM) for which data is gathered with a survey among Dutch citizens. The gathered data along with a pre-defined conceptual causal model based on academic literature presented in chapter 2 serve as input for the path model and measurement model, which together create the structural equation model.

2. Theoretical framework

2.1. Informational intervention

Awareness campaigns are often based on the notion that people will behave in a way that mitigates the problem when they know what the problem is, so a change in knowledge leads to a change in behaviour (Gorman & Gorman, 2018). This suggests that the action of raising the awareness to encourage travellers to travel in a more conscious and more climate-friendly manner could be an effective strategy. Since it is unclear if the Dutch citizens are aware of the fact that flying has a large negative impact on climate change, creating more awareness among Dutch citizens by giving information about the problem of flying related to climate change could cause for a change in their intended and actual flying behaviour.

Research shows that knowledge needs to be internalised to instigate behavioural change (Jacobson et al., 2020). The information provided needs to be easily understandable and must appeal to people's experiences and emotions (Reis & Higham, 2016; Wormbs & Söderberg, 2021); showing purely factual and scientific information is not enough to induce voluntary behavioural change.

To meet these requirements, *information about the relative impact of flying on climate change by comparing this to other activities contributing to climate change* will be provided as informational intervention in this study. Gössling et al. (2009) discovered that even though people have a rather common understanding about the harmfulness of flying, it is unclear how air travellers see aviation's contribution to climate change in contrast to other human activities contributing to climate change. Moreover, getting insight into the relative weight of flying compared to other emission sources is one of the main reasons Swedish people are willing to stop or drastically reduce flying (Wormbs & Soderberg, 2021). Comparing the impact of air travel on climate change with other activities could therefore be an effective way to create awareness about the consequences of flying and induce voluntary behavioural change. This relative impact of flying on climate change will, however, only be effective when the current awareness of the relative impact of air travel on climate change is limited. It is therefore essential to measure the *current awareness of the impact of flying on climate change* as well.

2.2. Socio-psychological constructs

In order to understand how information can shape and change behaviour, it is important to have a basic understanding of why people behave in the way they do, i.e. how behaviour is formed. Multiple studies are conducted aiming at gaining a better understanding of the determinants of the (intended) flying behaviour. While reviewing the scientific literature, nine studies are identified as particularly interesting, as these studies are conducted in western European countries, have large sample sizes and are almost all published in the last six years (2017-2022; see appendix A). Furthermore, these studies use mainly statistical analyses like path analysis and regression analysis to actually prove the significance of the relations between the various predictors and the (intended) air travel behaviour.

These nine studies identify 25 possible determinants of the (intended) flying behaviour, of which only nine of these determinants are proven to be significant socio-psychological or socio-demographic determinants. The nine determinants are shown in table 1. As this study examines the way information could potentially influence the socio-psychological constructs determining air travel behaviour, only determinants that could be changed by receiving the informational intervention and raising awareness are interesting for this research.

General environmental attitudes (GEA), *attitudes towards flying*, *social norms (SN)* and the *perceived behavioural control (PBC)* are frequently named and significantly proven determinants of air travel behaviour (Davison et al., 2014; Dütschke et al., 2022;

Table 1; Determinants of the intended flying behaviour and their possibility to be affected by information

Determinants of the (intended) flying behaviour	Could be affected by information? (yes/no)	Could be affected by the chosen informational intervention? (yes/no)
General environmental attitudes	**yes**	no
Attitudes towards flying	**yes**	**yes**
Perceived behavioural control	**yes**	no
Social norm	**yes**	no
Behaviour-specific self-identity	no	-
Justifications	**yes**	**yes**
Habit	no	-
Financial barriers	no	-
Socio-demographic factors	no	-

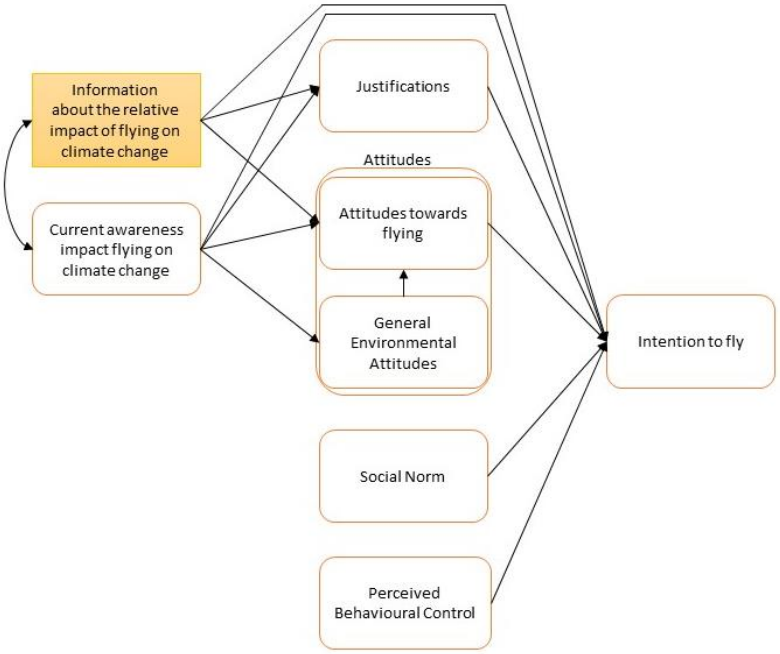

Figure 1; Final conceptual causal model

Hansmann & Binder, 2021; Morten et al., 2018; Oswald & Ernst, 2020) , which is in line with the Theory of Planned Behaviour (TPB) developed by Ajzen (1991). Receiving information about the relative impact of flying on climate change will only affect the *attitudes towards flying*, as no social marketing to affect the *SN* (Rhodes et al., 2020) or information related to the alternatives of flying to affect the *PBC* will be provided in this study. Furthermore, a person's environmental concern, the *GEA*, is a higher-order attitude, that is unlikely to change by receiving a short piece of text. A re-evaluation of the overall appraisal of flying as either more positive, more negative or similar to the former evaluation, i.e. the *attitudes towards flying*, will be encouraged by providing information about the impact of flying on climate change.

Next to the determinants in line with the TPB, Hansmann & Binder (2021) show *justifications* to be a crucial determinant of the intention to reduce people's flying, which is derived from studies using the Neutralization Theory (NT) introduced by Sykes & Matza (1957) as a lens to look at environmental behaviour. Addressing the impact of flying on climate change could on one hand result in the desirable reduction of the number of justifications held and the intended flying behaviour. On the other hand, it could also create an undesirable backfire effect which leads to further entrenchment in previously-held views and possibly an increase in the intention to fly (Árnadóttir et al., 2021; Gorman & Gorman, 2018; McDonald et al., 2015).

2.3. Path model

Reviewing the existing scientific literature leads to the final conceptual causal model or path model as presented in figure 1. Although the GEA, SN and PBC are not affected by the information about the relative impact of flying on climate change, these are still included in the model to control for the effects of justifications and attitudes towards flying on the intention to fly. Furthermore, to validate the expected path from information to the intended flying behaviour, a direct relation from the informational intervention and the current awareness to the intention to fly is included. If a direct effect is present next to the indirect effects via attitudes and justifications, other relations are present that are not captured in this model.

3. Methodology

Structural equation modelling (SEM) is performed in IBM® SPSS® AMOS™ 26 Graphics to find out if and via which causal pathway of socio-psychological factors information and awareness run to the intention to fly. This modelling technique allows for answering questions that involve multiple regression analysis of latent variables (Kroesen, 2006; Molin, 2019; Ullman & Bentler, 2012). In this research, these variables are complex socio-psychological constructs. Additionally, SEM allows for estimating indirect effects between these different latent variables (Molin, 2019). A conceptual causal model based on a devised theory is constructed in advance, as this modelling technique is not able to confirm the directions of causation between factors (Golob, 2003; Hair et al., 2006).

Based on the latent variables incorporated in the constructed path model, a survey is designed and conducted among members of the Dutch Mobility Panel (MPN). 2030 members completed the survey of which 1976 were left in the data set after cleaning the data. The respondents formed a good representation of the Dutch population. They gave scores to various statements representing the many facets of the latent variables. These scores are used as input to construct the latent variables by performing confirmatory factor analysis. The gathered data together with the pre-defined conceptual causal model and constructed factors served as input for the structural equation model.

3.1. Questionnaire design, implementation and sample selection

The designed survey consists of three parts: (1) introduction of the topic and questioning the current awareness of the Dutch citizens and the more general determinants of the intention to fly, (2) the informational intervention, (3) questioning the socio-psychological factors that could be influenced by the informational intervention. As this study looks into the effect of providing information, the respondents are randomly divided into two groups of which only one receives the informational intervention (part 2). Due to practical restrictions, one third of all respondents received part 2. The survey is launched online during the summer holidays from July 18 to August 7 2022. The survey is set out to the MPN which includes respondents aged 12 years and older from about 2.000 complete households (Ministerie van I&W, 2016). The MPN is a suitable panel since the panel includes only residents from the Netherlands who vary in terms of age, education, residential area, and more, making them a representative sample for the target group: the Dutch population. Members of the MPN are contacted on the 18th of July 2022 to fill in the questionnaire and received a reminder after 2 weeks. After filling in the survey, the respondents could choose a small present in the form of a gift voucher, airmiles or a donation to a charity organisation.

3.2 Measures

Operationalisation informational intervention

The respondents are asked to rank different household and travel related activities based on the CO_2-emissions these activities cause. Comparing flying with other household and travel activities that people are familiar with and can relate to, makes the somewhat factual information easier to understand and more appealing to own experiences (Reis & Higham, 2016; Wormbs & Söderberg, 2021). This assignment forces the respondents to think about the CO_2-emissions caused by flying compared to other activities, which helps the internalisation process necessary to instigate behavioural change (Jacobson et al., 2020).

After finishing the assignment, the respondents receive a screen showing their answers together with the correct ranking. The correct ranking is shown in two ways: textually and visually. They are asked to compare their ranking to the correct ranking. Finally, the participants need to indicate if the emissions related to flying are less, similar or more than previously thought. The whole informational intervention helps to get closer to the internalisation of the information provided and tries to create more awareness of the relative impact of flying on climate change.

Designing the informational intervention in a way that the respondents need to complete a task enables testing respondents' pre-knowledge about the subject. Comparing the ranking answered by the respondents with the correct ranking gives an indication of how 'new' the presented information is to the respondents. This is important to know, since the informational intervention could only affect people's intention to fly when the information provided is not known in advance. Therefore, two models will be estimated in AMOS varying in operationalisation of the informational intervention. The first model incorporates the informational intervention as dummy variable, representing the variation of having or having not received information about the relative impact of flying on climate change (N=1976). The second model looks at the extent to which the information is 'new', operationalised as the deviation in ranking between the ranking position selected by the respondents and the correct ranking position of both flying activities (N=643). This second model serves as validation model to see if there is a larger effect present when measuring the effect of receiving information about the relative impact of flying on climate change more purely.

Operationalisation current awareness

The current awareness is operationalised based on the notion that there are three forms of knowledge that must work together in promoting conservation behaviour: system, action-related and effectiveness knowledge (Frick et al., 2004; Roczen et al., 2014). Where the informational intervention questions the effectiveness related knowledge, two other types of questions are drafted questioning the system and

Table 2; Psychological constructs with item components and descriptive

Psychological constructs (Cronbach's alpha)	Items	Factor loadings	Descriptive	
			Mean***	Standard Deviation
General Environmental Attitudes (α=0.878)	Climate change is a serious problem.*	0.881	4.12	0.95
	I am very concerned about global warming.*	0.848	3.80	1.05
	Environmental problems are greatly exaggerated.*	0.824	3.73	1.15
	I see no need for sustainability.*	0.670	4.12	0.95
Social Norm (N/A)	Going on holiday by plane has become very normal.*	N/A	3.81	0.85
Perceived Behavioural Control (α=0.885)	Not getting on a plane anymore is for me... very difficult (1) to very easy (5)	0.913	3.70	1.24
	For me, reducing the number of flights I make from now on is ... very difficult (1) to very easy (5)	0.872	3.99	1.10
	Going on holiday without flying is for me... very difficult (1) to very easy (5)	0.747	4.06	1.03
	If I wanted to, I could easily reduce the distance of my air trips by visiting destinations closer to home.*	0.720	3.91	1.12
Attitudes towards Flying (α=0.713)	I think of flying as ... very unpleasant (1) to very pleasant (5)	0.787	3.24	0.92
	I think of flying as ... very difficult (1) to very simple (5)	0.674	3.23	0.89
	I think of flying as ... very exhausting (1) to very refreshing (5)	0.575	2.63	0.70
Intention to fly (N/A)	How often do you expect to travel by plane for private purposes in the coming 2 years?**	N/A	2.02	1.16

* Measured on a 5-point Likert scale where, 1 = strongly disagree, 2 = disagree, 3 = neither disagree nor agree, 4 = agree, and 5 = strongly agree.
** Measured as follow: 1 = Not, 2 = 1 time, 3 = 2 times, 4 = 3 times, 5= 4 to 5 times, and 6 = 6 times and more.
*** Box '6 = I don't know' merged with '3 = neither X, nor Y' where X and Y differ per scale.

action-related knowledge. Participants are first asked to indicate to what extent they agree or disagree, on a 5-point Likert scale, with three statements about the perception regarding their system-related awareness. Secondly, four multiple-choice questions are included in the survey testing both the understanding of the impact of flying on climate change and the knowing how to reduce the environmental impact related to flying.

Operationalisation justifications

There are many reasons why people still fly despite the fact that they are concerned about the environment. Based on existing literature, multiple statements have been drawn up representing the different reasons people could have to justify their flying (Árnadóttir et al., 2021; Baumeister, 2020; Hansmann & Binder, 2021; Hibbert et al., 2013; Juvan & Dolnicar, 2014; Kroesen, 2013). The respondents are asked to select all statements they agree with by checking the box of these statements. The more reasons the respondents select, the higher the respondent will score on the justification scale incorporated in the SEM.

Operationalisation other socio-psychological variables

The other five socio-psychological factors included in the theoretical framework are measured based on existing literature which is somewhat adjusted to fit the topic of this study. Table 2 shows the operationalisation of the factors. For most factors, participants were asked to indicate their level of agreement on a 5-point Likert scale with statements representing the socio-psychological construct. Respondents' perceived behavioural control is questioned differently, since this refers to the perceived difficulty of reducing their air travel for leisure purposes. The participants, therefore, needed to indicate the level of difficulty of three items on a 5-point Likert scale. Furthermore, the *Intention to fly* is measured by a single item in line with Zijlstra & Huibregtse (2018): "How often do you expect to travel by plane for private purposes in the coming 2 years?".

3.3. Data preparation

Factor analysis and Rasch modelling is performed a priori using respectively IBM® SPSS® Statistics™ 26 and RStudio, to prevent the model from becoming too large and complex, with too many free parameters, when it is included in IBM® SPSS® AMOS™ 26.

A Rasch model is used to measure the respondent's current awareness of the impact of flying on climate change in an adequate and reliable way. Rasch modelling "allows researchers to use a respondent's raw test or scale scores and express the respondent's performance on a linear scale that accounts for the unequal difficulties across all test items" (Boone, 2016, p.3). This analysis is applied to the four multiple-choice questions questioning the system and action-related understanding related to the environmental impact of flying. Not all questions are included in the final analysis; one question does not add any information to the created scale representing the current awareness

and is therefore removed. The resulting 'current awareness' scale shows a normal distribution among the respondents.

Factor analysis (i.e. principal component analysis) is performed to measure the other socio-psychological factors included in the path model. The results of the factor analysis are shown in table 2. Summated scales of the latent variables are constructed of which the measurement errors are specified based on the Cronbach's alpha. These measurement error terms will be included in the SEM as fixed measurement error terms, which results in retaining the benefits of having a structural and measurement model in one.

The most fundamental assumption when estimating a SEM is the multivariate normality among the dependent variables (Hair et al., 2006). No severe deviations from the normal distribution are found, complying with the assumed multivariate normality.

4. Results

4.1. Descriptive statistics of the dependent and explanatory variable

The participants' intended flying behaviour was quite pronounced. In total, 55.3 percent of the 1976 respondents intend to fly for leisure purposes in the coming two years, of which 30.2 percent intends to fly more than once. A total of 883 respondents (44.7%) do not expect to fly for leisure purposes in the coming two years.

Most respondents indicate that they are aware of the impact of flying on climate change: 82.1 percent of the 1976 respondents indicate they are (totally) aware of the fact that the CO_2-emissions of human activities like flying contribute to climate change and 70.4 percent point out that they themselves contribute to climate change when they fly. The main part of the Dutch citizens, though, finds it hard to explain the way in which air travel contributes to climate change. Looking at the four system and action related multiple-choice questions answered, only 36 percent of the respondents correctly answered more than half of the questions. Most of the respondents (more than 40%) answered just 1 or 2 questions correctly. The ranking task, on the other hand, shows that the respondents in general correctly estimate or even overestimate the impact of flying on climate change relative to other household and travel activities. More than 70 percent of the 643 respondents accurately ranked the activity 'flying back and forth to Bali' as most impactful while about three quarters overestimated the CO_2-emissions of the activity 'flying back and forth to Berlin'.

4.2. Effects of the socio-psychological variables on the intention to fly

Two models were estimated in AMOS varying in the operationalisation of the informational intervention (see paragraph 3.2.). Looking at the model fit statistics (see the chi-square and RMSEA statistics in table 3), it can be concluded that both models fit the data well. Moreover, 60.6 percent of the variance in the dependent variable 'intention to fly' is explained by the model.

Results SEM 1

The provided information about the relative impact of

Table 3; Standardized total, direct and indirect effects

Variable (Factor Label)*	General Environmental Attitudes (LGEA)			Justifications			Attitudes towards flying (LATF)			Intention to fly		
	Total	*Direct*	*Indirect*	*Total*	*Direct*	*Indirect*	*Total*	*Direct*	*Indirect*	*Total*	*Direct*	*Indirect*
Model 1 (N=1976) *X^2=32.532, p-value=0.00 / RMSEA=0.036*												
Information about the relative impact of flying on climate change	-	-	-	0	0	-	0	0	-	0	0	0
Current Awareness impact flying on climate change	0.415	0.415	-	0.147	0.147	-	0	0	0	0.043	0.043	0.001
Justifications	-	-	-	-	-	-	-	-	-	0	0	-
Attitudes towards flying (LATF)	-	-	-	-	-	-	-	-	-	0.087	0.087	-
General Environmental Attitudes (LGEA)	-	-	-	-	-	-	-0.080	-0.080	-	-0.007	-	-0.007
Social Norm (LSN)	-	-	-	-	-	-	-	-	-	0.059	0.059	-
Perceived Behavioural Control (LPBC)	-	-	-	-	-	-	-	-	-	-0.697	-0.697	-
Model 2 (N=643) *X^2=18.105, p-value=0.11 / RMSEA=0.028*												
Deviation ranking position Bali	-	-	-	0	0	-	0	0	-	0	0	0
Deviation ranking position Berlin	-	-	-	0	0	-	0	0	-	0	0	0
Current Awareness impact flying on climate change	0.434	0.434	-	0.191	0.191	-	0	0	0	0.086	0.087	-0.001
Justifications	-	-	-	-	-	-	-	-	-	0	0	-
Attitudes towards flying (LATF)	-	-	-	-	-	-	-	-	-	0.103	0.103	-
General Environmental Attitudes (LGEA)	-	-	-	-	-	-	0	0	-	-0.004	-	-0.004
Social Norm (LSN)	-	-	-	-	-	-	-	-	-	0	0	-
Perceived Behavioural Control (LPBC)	-	-	-	-	-	-	-	-	-	-0.700	-0.700	-

*direction of effects: from row variables to column variables; all insignificant relationships are 0.

flying on climate change does not have any significant relation towards the intention to fly; all outcoming direct and indirect paths are not significant (α=0.05). A higher current awareness of the impact of flying on climate change, on the other hand, leads to a more positive general environmental attitude (β=0.415), to a higher number of justifications given to explain the cognitive dissonance present (β=0.147), and to a slightly higher intention to fly (β=0.043). This last finding is surprising, since this outcome suggests that being aware of the problem does not make you behave in a way to help dealing with this problem, but the other way around. The strength of the relationship is, however, so small that it is questionable if this result needs to be noted. Furthermore, no direct significant relation between the current awareness of the impact of flying on climate change and the attitudes towards flying is found. This indicates that being aware of the impact of flying on climate change does not change your feeling regarding flying directly, which is against expectation.

The distribution in strength/sizes of the path coefficients is quite surprising as well. The perceived behavioural control is the strongest predictor of the intention to fly. This perceived difficulty to perform a certain behaviour, in this case reducing your flying for leisure purposes, is of such importance that the other factors only have minor effects as predictors of the intention to fly. This can partially be explained by the quite substantive significant relationships the PBC has with the other determinants of the intention to fly (see table 4). This makes it possible for the PBC to force the other factors out, resulting in a high path coefficient for the PBC to the intention to fly and low path coefficients for the other determinants to the intention to fly.

Table 4; Correlation matrix of the correlations between the incorporated determinants of the intention to fly

	Perceived Behavioural Control (PBC)	Social Norm (SN)	General Environmental Attitudes (GEA)	Attitudes towards Flying (ATF)	Justifications
Perceived Behavioural Control (PBC)	1	-0.161	0.108	-0.322	-0.266
sig.		*<0.001*	*<0.001*	*<0.001*	*<0.001*
N		*1976*	*1976*	*1976*	*934*
Social Norm (SN)	-0.161	1	0.025	0.038	0.131
sig.	*<0.001*		*0.259*	*0.094*	*<0.001*
N	*1976*		*1976*	*1976*	*934*
General Environmental Attitudes (GEA)	0.108	0.025	1	-0.109	-0.004
sig.	*<0.001*	*0.259*		*<0.001*	*0.897*
N	*1976*	*1976*		*1976*	*934*
Attitudes towards Flying (ATF)	-0.322	0.038	-0.109	1	0.142
sig.	*<0.001*	*0.094*	*<0.001*		*<0.001*
N	*1976*	*1976*	*1976*		*934*
Justifications	-0.266	0.131	-0.004	0.142	1
sig.	*<0.001*	*<0.001*	*0.897*	*<0.001*	
N	*934*	*934*	*934*	*934*	

Results SEM 2

Since providing information is only effective when the information given is 'new' to people, this second model operationalises the informational intervention as the proportion of 'new' awareness about the relative impact of flying on climate change gained by receiving information. No direct or indirect effect is found from this 'new' awareness to the intention to fly (see table 3).

4.3. Reasons to justify intended flying behaviour

The respondents who are acting against their pro-environmental values by worrying about climate change but still intend to fly, selected their reasons to justify their cognitive dissonance (N=934). Almost 90 percent of the respondents point out that they fly for leisure purposes since there is no suitable alternative present to get where one wants to go for leisure purposes. The respondents state particularly that they will not get where they want to go if they do not use the plane as travel mode. Another important reason to justify the intended flying behaviour is the desire to enjoy life and discover the world, which is selected by 72.6 percent of the respondents.

5. Discussion

This research shows that the current awareness about the impact of flying on climate change does affect people's general environmental attitudes, i.e. environmental concern, and people's need to justify their flying behaviour, but these effects do not result in a reduced intention to fly. These three findings all point to the presence of an attitude-behaviour gap in the context of air travel, which is supported by a part of the existing academic literature (Alcock et al., 2017; Bamdad, 2019; Barr et al., 2010; Baumeister, 2020; Cohen & Higham, 2011; Hanna & Adams, 2017; Hares et al., 2010; Hibbert et al., 2013; Juvan & Dolnicar, 2014; Kroesen, 2013; Lassen, 2010). This argues against the frequently used notion of obtaining a desirably change in behaviour when making people aware about the consequences of their behaviour.

Although the combination of the type of information presented and the type of framing used in this study to raise awareness does not help in reducing the expected flying frequency for leisure purposes, this does not mean that no informational intervention could help to get people out of the plane. Future research should look into the effects on the actual air travel behaviour when showing people other types of information, using different framing styles or better capture the internalisation of knowledge. Only if these future

studies do not find a reduction in air travel behaviour, it can then be concluded that an information campaign to induce voluntarily behavioural change is not enough to change people's air travel behaviour and get them out of the plane. This would support the thoughts of Wi & Chang (2019), who imply that awareness serves as a pre-condition for behavioural change, but is insufficient to actually induce action. It is still important for policy makers to make people aware of the consequences of their behaviour, so people do understand why policies are made to change their behaviour. This will create more support for the implementation of other, more invasive measures, which are necessary to create actual behavioural change (Osbaldiston & Schott, 2012).

The perceived behavioural control (PBC) is the strongest and thus most important predictor of the intention to fly in this study. This is in line with the findings of Abrahamse (2019) and Dütschke et al. (2022), and opposed to the results of the studies of Davison et al. (2014) and Oswald & Ernst (2020). It is, however, opposed to the results of all above mentioned studies that this factor accounts for almost 2/3rd of the explained variance of the intention to fly. This remarkable finding could partially be explained by the way in which this factor, as well as the other factors included in the model, are operationalized.

Despite the fact that the PBC explains more variance than found in other studies, this finding is in line with the given reasons of people to justify their intended flying behaviour. The reason 'there is no alternative present to get to the destination one wants to go' emerges from the data as most significant reason to justify the intended flying behaviour. This reason relates to the PBC, which is defined as the difficulty to reduce your flight frequency. With no perceived alternative transport mode present to get to where one wants to be, it is very hard to reduce your air travel. For this reason, it is very likely that the PBC will still be the strongest predictor of the intention to fly even when a change in operationalisation of the different factors included in the model is made. Future research should be conducted to see what policy measures are suitable to, on one hand, undermine the perceived difficulty to change your flying behaviour and, on the other hand, weaken people's current reasons to fly, especially the perception of no alternative being present to get to where one wants to go.

6. Conclusion

This study examined the role of information as a means to raise awareness about the impact of flying on climate change and, in turn, to make people voluntarily reduce their intended flying. The Ministry of Infrastructure and Water Management looks into the possibility of raising the awareness of Dutch citizens as policy measure to encourage travellers to travel in a more conscious and more climate-friendly manner. The scientific literature, however, shows contradictory results on the effectiveness of this measure. There is an ongoing academic discussion on to what extent making people aware about the consequences of their behaviour could stimulate a desirable change in that behaviour. This research tried to get a thorough understanding of the relation between information about the impact of flying on climate change and the intention to fly for leisure purposes, and, therefore, has examined via which causal pathway of socio-psychological factors information and awareness run to the intention to fly.

This research question was answered using structural equation modelling for which data is gathered with a survey among Dutch citizens. The gathered data together with a pre-defined conceptual causal model based on academic literature served as input for the path model and measurement model, which together created the structural equation model.

The main conclusion that can be drawn from this research is that becoming aware about the relative impact of flying on climate change is not enough to change people's intended flying behaviour. A possible explanation for this finding could be that this study found an in general reasonably high awareness of the relative impact of flying on climate change compared to other household- and travel activities among Dutch citizens. In fact, many respondents even overestimated the relative impact of flying on climate change. However, even when this reasonably high awareness is taken in to account, no effect is found from information to the attitudes towards flying and intention to fly.

Although the given information does not lead to any change in people's attitudes, justifications or intended flying behaviour, an interesting finding is that the current awareness about the impact of flying on climate change does affect people's attitudes and justifications. These effects, however, do not result in a change in people's intended flying behaviour. This suggests that people will change their attitude rather than their behaviour to solve the unease felt when acting against their environmental concern. So, it is likely that an attitude-behaviour gap is present in the context of air travel behaviour.

The final important conclusion that can be drawn from this research relates to the reasons used to justify the intended flying behaviour. The most common reason given by Dutch citizens to keep flying even when they are concerned about climate change is that there is no suitable alternative present to get to where one wants to go for leisure purposes. This means that either the destination of the desired trips is too far away to reach by another transport mode or people are not aware of the alternatives present.

It needs to be noted that these findings hold true only for the type and framing of the information used in this study. If future research using different type and framing of information finds similar results, it can be concluded that awareness only serves as pre-condition for behavioural change. In that case, other complementary measures are necessary to actually reduce the flying frequency among Dutch citizens.

Appendix A

Table 5; Nine studies used to identify the 25 possible determinants of the intended flying behaviour with their characteristics

Study	Population	N	Method
Alcock et al. (2017)	UK	3923	zero-inflated Poisson regression
Arnadottir et al. (2021)	Iceland	21	interviews
Bamdad (2019)	Europe	34	interviews
Büchs (2017)	UK	52	interviews
Davison et al. (2014)	UK	560	path analysis
Dütschke et al. (2022)	Germany	991	hierarchical two-step linear regression
Morten et al. (2018)	UK	194	hierarchical multiple regression
Hansmann & Binder (2021)	Switzerland	1206	multiple linear regression
Oswald & Ernst (2020)	Europe	393	structural equation modelling

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Appendix B: Overview of possible determinants of the intention to fly

Table 12; Overview of the determinants that are proven or not to explain the intention to reduce flying or the actual flying behaviour in different western European countries using different (statistical) analysis by 10 different studies

FACTOR	STUDY	SIGNIFI-CANT	DEPENDENT VARIABLE	POPULATION	N	METHOD
General environmental attitudes	Hansmann & Binder (2021)	yes	intention to reduce their air travel	Swiss	1206	multiple linear regression
	Morten et al. (2018)	no	intention to reduce their air travel	GB	194	hierarchical multiple regression analysis
	Alcock et al. (2017)	no	flight kilometers	UK	3923	Zero-inflated Poisson regression models
	Bamdad (2019)	no	-	mixed; mostly Sweden	34	Interviews
Attitudes towards flying	Morten et al. (2018)	yes	intention to reduce their air travel	GB	194	hierarchical multiple regression analysis
	Oswald & Ernst (2020)	yes	flight kilometers	mixed, mostly German	393	SEM
Perceived behavioural control	Morten et al. (2018)	no	intention to reduce their air travel	GB	194	hierarchical multiple regression analysis
	Davison et al. (2014)	yes	intention to reduce their air travel	GB	560	path analysis
	Dütschke et al. (2022)	yes	intention to use other mode than airplane on next leisure travel	Germany	991	hierarchical two-step linear regression
	Oswald & Ernst (2020)	yes	flight kilometers	mixed, mostly German	393	SEM
Social Norm prescriptive	Hansmann & Binder (2021)	yes	intention to reduce their air travel	Swiss	1206	multiple linear regression
	Morten et al. (2018)	yes	intention to reduce their air travel	GB	194	hierarchical multiple regression analysis
	Dütschke et al. (2022)	no	intention to use other mode than airplane on next leisure travel	Germany	991	hierarchical two-step linear regression
	Oswald & Ernst (2020)	yes	flight kilometers	mixed, mostly German	393	SEM
Social Norm descriptive	Hansmann & Binder (2021)	no	intention to reduce their air travel	Swiss	1206	multiple linear regression
	Davison et al. (2014)	yes	intention to reduce their air travel	GB	560	path analysis
Personal norm	Hansmann & Binder (2021)	yes	intention to reduce their air travel	Swiss	1206	multiple linear regression

	Davison et al. (2014)	no	intention to reduce their air travel	GB	560	path analysis
	Dütschke et al. (2022)	no	intention to use other mode than airplane on next leisure travel	Germany	991	hierarchical two-step linear regression
	Oswald & Ernst (2020)	yes	flight kilometers	mixed, mostly German	393	SEM
Awareness of Consequences	Davison et al. (2014)	yes	intention to reduce their air travel	GB	560	path analysis
	Dütschke et al. (2022)	no	intention to use other mode than airplane on next leisure travel	Germany	991	hierarchical two-step linear regression
	Büchs (2017)	-	-	UK	52	semi-structured interviews
Awareness of need	Dütschke et al. (2022)	no	intention to use other mode than airplane on next leisure travel	Germany	991	hierarchical two-step linear regression
Value of Self-Direction	Büchs (2017)	-	-	UK	52	semi-structured interviews
Value of Self-Transcendence	Büchs (2017)	-	-	UK	52	semi-structured interviews
Behaviour-specific self-identity	Morten et al. (2018)	yes	intention to reduce their air travel	GB	194	hierarchical multiple regression analysis
Self-efficacy	Dütschke et al. (2022)	no	intention to use other mode than airplane on next leisure travel	Germany	991	hierarchical two-step linear regression
Justifications	Hansmann & Binder (2021)	yes	intention to reduce their air travel	Swiss	1206	multiple linear regression
	Arnadottir et al. (2021)	-	-	Iceland	21	interviews
	Dütschke et al. (2022)	no	intention to use other mode than airplane on next leisure travel	Germany	991	hierarchical two-step linear regression
Habit	Hansmann & Binder (2021)	yes	intention to reduce their air travel	Swiss	1206	multiple linear regression
	Dütschke et al. (2022)	yes	intention to use other mode than airplane on next leisure travel	Germany	991	hierarchical two-step linear regression

Non-moral aspects	Dütschke et al. (2022)	yes	intention to use other mode than airplane on next leisure travel	Germany	991	hierarchical two-step linear regression
Fear of flying	Oswald & Ernst (2020)	no	flight kilometers	mixed, mostly German	393	SEM
Financial barriers	Oswald & Ernst (2020)	yes	flight kilometers	mixed, mostly German	393	SEM
	Dütschke et al. (2022)	yes	intention to use other mode than airplane on next leisure travel	Germany	991	hierarchical two-step linear regression
Education level	Hansmann & Binder (2021)	no	intention to reduce their air travel	Swiss	1206	multiple linear regression
	Morten et al. (2018)	no	intention to reduce their air travel	GB		hierarchical multiple regression analysis
	Dütschke et al. (2022)	yes	intention to use other mode than airplane on next leisure travel	Germany	991	hierarchical two-step linear regression
Subjective knowledge	Hansmann & Binder (2021)	no	intention to reduce their air travel	Swiss	1206	multiple linear regression
Income	Hansmann & Binder (2021)	no	intention to reduce their air travel	Swiss	1206	multiple linear regression
	Morten et al. (2018)	no	intention to reduce their air travel	GB	194	hierarchical multiple regression analysis
	Dütschke et al. (2022)	no	intention to use other mode than airplane on next leisure travel	Germany	991	hierarchical two-step linear regression
Employment	Morten et al. (2018)	no	intention to reduce their air travel	GB	194	hierarchical multiple regression analysis
	Dütschke et al. (2022)	no	intention to use other mode than airplane on next leisure travel	Germany	991	hierarchical two-step linear regression
Age	Morten et al. (2018)	no	intention to reduce their air travel	GB	194	hierarchical multiple regression analysis
	Dütschke et al. (2022)	no	intention to use other mode than airplane on next leisure travel	Germany	991	hierarchical two-step linear regression
Gender	Morten et al. (2018)	no	intention to reduce their air travel	GB	194	hierarchical multiple regression analysis
	Dütschke et al. (2022)	no	intention to use other mode than airplane on next leisure travel	Germany	991	hierarchical two-step linear regression

Cars per household	Dütschke et al. (2022)	no	intention to use other mode than airplane on next leisure travel	Germany	991	hierarchical two-step linear regression
Urban area	Dütschke et al. (2022)	yes	intention to use other mode than airplane on next leisure travel	Germany	991	hierarchical two-step linear regression

Appendix C: Questionnaire

In this appendix, the questionnaire distributed to the respondents of the MPN mobility panel is shown. The questionnaire is divided into three parts, of which part 1 and 3 are shown to all the respondent and part 2 is only presented to a randomly chosen 1/3rd of the respondents. Since all members of the panel are Dutch, the survey is also written in Dutch.

Part 1: visible for all respondents

Introductie:
Welkom bij deze MPN Vakantievragenlijst. Wij stellen u graag meerdere vragen over de manier waarop u vakantie viert. Blijft u het liefst thuis met de vakantie, of vliegt u liever naar een bestemming ver weg? Wij horen hier graag meer over.

Vraag Q11/VakantiePlannen: Gaat u dit jaar op vakantie?
Toelichting: Bij een vakantie horen ook korte vakanties, zoals weekendjes weg en stedentrips.

- Ja, ik ben op vakantie geweest
- Ja, ik ga nog op vakantie
- Ja, ik ben op vakantie geweest en ik ga nog op vakantie
- Nee, ik heb geen plannen

Vraag Q12/VakantieGeschiedenisFreq: Hoe vaak bent u in de afgelopen twee jaar op vakantie geweest?

- Niet
- 1 keer
- 2 keer
- 3 keer of meer
- Weet ik niet

Conditioneel: Wanneer het antwoord op Vraag Q12 'Ja' is:
Vraag Q13/VakantiePlaats: Waar bent u in de afgelopen twee jaar op vakantie geweest?
Toelichting: Meerdere antwoorden mogelijk
Bent u alleen in Nederland op vakantie geweest? Klik alleen 'In Nederland' aan.

- In Nederland
- In Europa
- Buiten Europa
- Weet ik niet

Conditioneel: Wanneer het antwoord op Vraag Q13 'In Europa' of 'Buiten Europa' is:
Vraag Q14/VakantieGeschiedenisVliegen: Heeft u voor een van deze vakanties met het vliegtuig gereisd?

- Ja
- Nee
- Weet ik niet

Vraag Q15/IdentiteitReiziger: In hoeverre bent u het eens of oneens met de volgende stellingen:

- Ik ben een echte wereldreiziger
- Thuis voel ik mijzelf op mijn best

- Ik houd ervan om andere landen te verkennen
- Reizen is mijn hobby

Antwoordopties:
- Helemaal oneens
- Oneens
- Niet eens, niet oneens
- Eens
- Helemaal eens
- Weet ik niet

Vraag Q16/WerkzaamToerisme: Bent u (of was u) werkzaam binnen de toeristische sector?

- Ja, ik werk in de toeristische sector
- Ja, ik werkte in het recente verleden in de toeristische sector
- Nee

Vraag Q17/WerkzaamLuchtvaart: Bent u (of was u) werkzaam in de luchtvaartsector?

- Ja, ik werk in de luchtvaart
- Ja, ik werkte in het recente verleden in de luchtvaart
- Nee

Vraag Q18/Loyaliteitsprogramma: Doet u mee met een loyaliteitsprogramma van een luchtvaartmaatschappij?
Toelichting: zoals Flying Blue van KLM, SkyMiles van Delta of Miles & More van Lufthansa

- Ja
- Nee
- Weet ik niet

Vraag Q19/SocialeNormDescriptief: In de volgende 4 stellingen vragen wij u wat uw beeld is van het vlieggedrag van anderen. In hoeverre bent u het eens of oneens met de volgende stellingen:

- In mijn vriendenkring is het gebruikelijk om met het vliegtuig op vakantie te gaan
- Op sociale media lijkt het wel alsof iedereen met het vliegtuig op reis gaat
- Voor een weekendje weg stappen mensen uit mijn omgeving in het vliegtuig
- Met het vliegtuig op vakantie gaan is heel normaal geworden

Antwoordopties:
- Helemaal oneens
- Oneens
- Niet eens, niet oneens
- Eens
- Helemaal eens
- Weet ik niet

Vraag Q110/PBC_1: Nu volgen er enkele vragen over uw eigen vlieggedrag.
Voor mij is het verminderen van het aantal vliegreizen dat ik vanaf nu maak …
Toelichting: Vliegt u niet? klik dan de optie 'Ik vlieg niet' aan

- Zeer moeilijk
- Moeilijk

- Niet moeilijk, niet makkelijk
- Makkelijk
- Zeer makkelijk
- Ik vlieg niet
- Weet ik niet

Vraag Q111/PBC_2: Niet meer in het vliegtuig stappen is voor mij…

- Zeer moeilijk
- Moeilijk
- Niet moeilijk / niet makkelijk
- Makkelijk
- Zeer makkelijk
- Ik vlieg niet
- Weet ik niet

Vraag Q112/PBC_3: Wanneer ik dat zou willen, zou ik eenvoudig de afstand van mijn vliegreizen kunnen verkleinen door het bezoeken van bestemmingen dichterbij huis.

- Helemaal oneens
- Oneens
- Niet eens, niet oneens
- Eens
- Helemaal eens
- Ik vlieg niet
- Weet ik niet

Vraag Q113/PBC_4: Een vakantie vieren zonder te vliegen is voor mij …

- Zeer moeilijk
- Moeilijk
- Niet moeilijk, niet makkelijk
- Makkelijk
- Zeer makkelijk
- Weet ik niet

Vraag Q114/Milieubewustzijn: We zijn benieuwd naar hoe u tegen klimaatverandering aankijkt. In hoeverre bent u het eens of oneens met de volgende stellingen:

- Ik maak me grote zorgen over de opwarming van de aarde
- Ik zie geen noodzaak voor verduurzaming
- Klimaatverandering is een ernstig probleem
- Milieuproblemen worden zwaar overdreven

Antwoordopties:
- Helemaal oneens
- Oneens
- Niet eens, niet oneens
- Eens
- Helemaal eens
- Weet ik niet

Vraag Q115/Bewustzijn: In hoeverre bent u het eens of oneens met de volgende stellingen:

- Klimaatverandering heeft gevolgen voor het leven op aarde
- De CO_2-uitstoot van menselijke activiteiten zoals vliegen, draagt bij aan klimaatverandering
- Wanneer ik vlieg, draag ik bij aan klimaatverandering

Antwoordopties:
- Helemaal oneens
- Oneens
- Niet eens, niet oneens
- Eens
- Helemaal eens

We zijn benieuwd hoe u op dit moment de klimaatimpact van een vakantie inschat. Daar stellen we u nu een paar vragen over.

Vraag Q116/B1: Welke vakantiereis voor u samen met één vriend(in) of familielid denkt u dat het meest bijdraagt aan klimaatverandering?

Vanuit Nederland …

- vliegen naar Turkije
- met de auto naar Italië
- op cruise naar Mexico
- met de bus naar Spanje
- Weet ik niet

Vraag Q117/B2: Op welke wijze denkt u dat vliegen bijdraagt aan de opwarming van de aarde?

- Vliegen draagt niet bij aan de opwarming van de aarde
- Vliegtuigmotoren zijn warm en zo warmt de atmosfeer op
- Vliegtuigen vernietigen de ozonlaag en zo kan de straling van de zon makkelijker doordringen
- Uitlaatgassen van vliegtuigen houden straling tegen bij het verlaten van de aarde
- Weet ik niet

Vraag Q118/B3: Op welke manier is het volgens u mogelijk de klimaatimpact van een vakantiereis verkleinen?
Vink alle antwoorden aan die van toepassing zijn.

- Minder ver op vakantie gaan
- Minder vaak op vakantie gaan
- Een luxer verblijf kiezen
- Op tijd je vakantie boeken
- Minder bagage meenemen
- Een reisverzekering afsluiten
- De CO_2-uitstoot compenseren
- Weet ik niet

Vraag Q119/B4: Om de CO_2-uitstoot bij een vlucht van Amsterdam naar Barcelona te compenseren is het mogelijk een boom te planten. Hoelang denkt u dat deze boom moet groeien voordat uw

persoonlijke CO_2-uitstoot is gecompenseerd?
Toelichting: De heen- en terugreis tellen hierbij samen als één vliegreis

- 10 maanden
- 3 jaar
- 10 jaar
- 30 jaar
- Weet ik niet

Part 2: only visible for a randomly chosen 1/3rd of the respondents

Scherm 1
Vraag Q21/Ranking: Hieronder staan 7 verschillende activiteiten. Kunt u een inschatting maken van de CO_2-uitstoot van deze activiteiten?

Probeer de volgende activiteiten op volgorde te zetten van meeste CO_2-uitstoot (1) naar minste CO_2-uitstoot (7):

1. Een treinreis heen en weer maken met een vriend(in) naar Berlijn.
2. Een vliegreis heen en weer maken met een vriend(in) naar Berlijn.
3. 1000 e-mails versturen (zonder bijlage).
4. Een huishouden van 2 personen een jaar lang voorzien van elektriciteit.
5. Een jaar lang twee keer per week een bad nemen (van 120 liter).
6. Een vliegreis heen en weer maken met een vriend(in) naar Bali (Indonesië).
7. Een jaar lang vijf werkdagen per week naar werk rijden met een benzineauto van Rotterdam naar Gouda (totaal ongeveer 10.000 km).

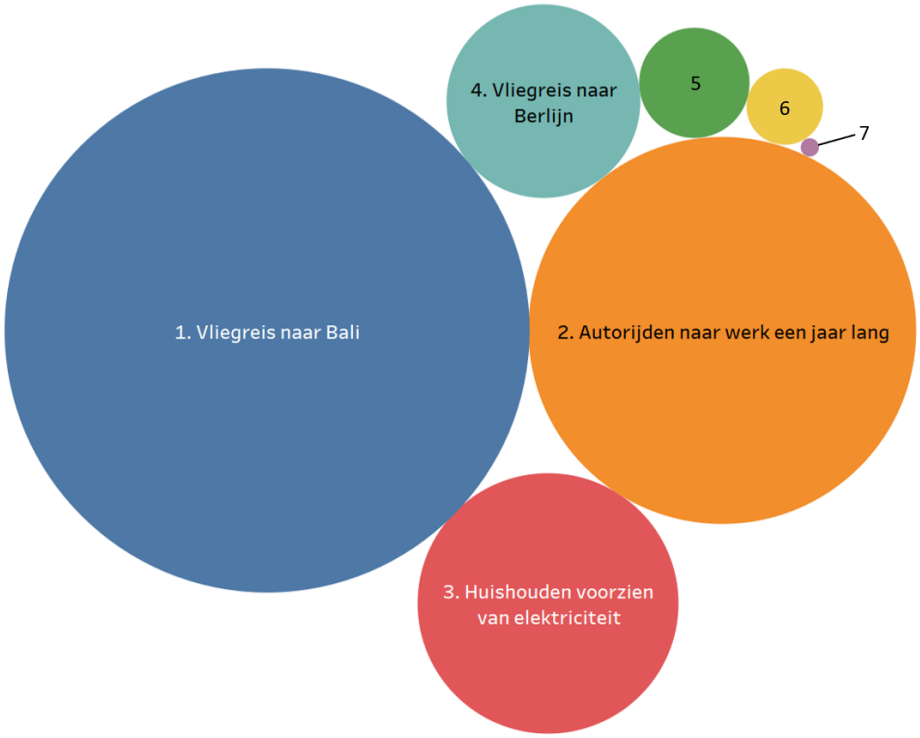
Scherm 2
Bent u ook benieuwd naar de klimaatimpact van deze activiteiten? Bekijk hier in hoeverre de CO_2-uitstoot van de activiteiten echt van elkaar verschillen.

Uw antwoord op de vorige vraag was:
1 …
2 …
3 …
4 …
5 …
6 …
7 …

Het **daadwerkelijke antwoord** is:

1. Een vliegreis heen en weer maken met een vriend naar Bali.
2. Een jaar lang vijf werkdagen per week naar werk rijden met een benzineauto van Rotterdam naar Gouda.
3. Een huishouden van 2 personen een jaar lang voorzien van elektriciteit.
4. Een vliegreis heen en weer maken met een vriend naar Berlijn.
5. Een jaar lang twee keer per week een bad nemen.
6. Een treinreis heen en weer maken met een vriend naar Berlijn.
7. 1000 e-mails versturen.

CO_2-uitstoot van de verschillende activiteiten



Scherm 3

Vraag Q22/VerwachtingUitstootVliegen: Een vliegreis naar Bali stoot het meeste CO_2 uit, namelijk 3300 kilogram. Dit is bijna twee keer zo veel als een jaar lang met uw benzineauto op en neer van Rotterdam naar Gouda rijden voor uw werk.

Door met de trein in plaats van het vliegtuig naar Berlijn te reizen kan u uw milieu-impact aanzienlijk verkleinen. Dit zorgt namelijk voor 6 keer minder CO_2-uitstoot.

Is de CO_2-uitstoot van vliegen meer of minder dan u van tevoren had gedacht?

- Veel minder dan ik van tevoren dacht
- Minder dan ik van tevoren dacht
- Gelijk aan wat ik van tevoren dacht
- Meer dan ik van tevoren dacht
- Veel meer dan ik van tevoren dacht
- Weet ik niet

Part 3: visible for all respondents

Vraag Q31/VliegenKind: Tot zover de vragen over de impact van verschillende activiteiten op het klimaat. In de volgende twee vragen vragen wij u naar uw vakantiegewoontes.

Heeft u als kind onder de 16 jaar wel eens een vliegreis gemaakt?
Toelichting: De heen- en terugreis tellen hierbij samen als 1 vliegreis

- Nee
- 1 tot 2 keer in totaal
- 3 tot 5 keer in totaal

- Meer dan 6 keer tot ongeveer jaarlijks
- Ongeveer jaarlijks
- Meerdere keren per jaar
- Weet ik niet

Vraag Q32/C_: Wat is voor u van toepassing?
Toelichting: Vink alle antwoorden aan die van toepassing zijn

- Ik heb een boot, vouwwagen, camper of caravan tot mijn beschikking
- Ik heb een vakantiehuisje in het buitenland tot mijn beschikking
- Ik heb een vakantiehuisje in Nederland tot mijn beschikking
- Er wonen familie of vrienden in het buitenland
- Ik werk of studeer in het buitenland
- Geen van bovenstaande

We willen u nu graag nog een aantal laatste vragen stellen over wat u vindt van vliegen en of u in de toekomst wil gaan vliegen. Ook als u zelf niet vliegt, vragen we u deze vragen in te vullen.

Vraag Q33/Vliegangst: Heeft u vliegangst?

-Ja
-Nee
-Weet ik niet

Vraag Q34/HoudingVliegen1: Ik vind vliegen …

Antwoordopties:
- zeer onaangenaam
- onaangenaam
- niet onaangenaam, niet aangenaam
- aangenaam
- zeer aangenaam
- weet ik niet

Vraag Q35/HoudingVliegen2: Ik vind vliegen …

Antwoordopties:
- zeer vermoeiend
- vermoeiend
- niet vermoeiend, niet verfrissend
- verfrissend
- zeer verfrissend
- weet ik niet

Vraag Q36/HoudingVliegen3: Ik vind vliegen …

Antwoordopties:
- zeer ingewikkeld
- ingewikkeld
- niet ingewikkeld, niet eenvoudig
- eenvoudig
- zeer eenvoudig
- weet ik niet

Vraag Q37/HoudingVliegen4: Ik vind vliegen …

Antwoordopties:
- zeer onbetaalbaar
- onbetaalbaar
- niet onbetaalbaar, niet betaalbaar
- betaalbaar
- zeer betaalbaar
- weet ik niet

Vraag Q38/HoudingVliegen5: Persoonlijk vind ik vliegen …

Antwoordopties:
- zeer onacceptabel
- onacceptabel
- niet onacceptabel, niet acceptabel
- acceptabel
- zeer acceptabel
- weet ik niet

Vraag Q39/IntentiePrive: Hoe vaak verwacht u de komende 2 jaar met het vliegtuig te reizen voor privé doeleinden?
Toelichting: De heen- en terugreis tellen hierbij samen als één keer.

- Niet
- 1 keer
- 2 keer
- 3 keer
- 4 of 5 keer
- 6 keer of meer

Vraag Q310/IntentieZakelijk: Hoe vaak verwacht u de komende 2 jaar met het vliegtuig te reizen voor zakelijke doeleinden?
Toelichting: De heen- en terugreis tellen hierbij samen als één keer.

- Niet
- 1 keer
- 2 keer
- 3 keer
- 4 of 5 keer
- 6 keer of meer

Conditioneel: Wanneer het antwoord op Vraag Q110 niet gelijk is aan ‘Ik vlieg niet’.
Vraag Q311/IntentieReducerenVliegen: Verwacht u in de toekomst minder vaak of vaker te vliegen voor ontspanning, vakantie, of bezoek aan familie of vrienden ten opzichte van de situatie vóór corona?

Antwoordopties:
- Veel minder vaak
- Minder vaak
- Even vaak

- Vaker
- Veel vaker

Conditioneel: Wanneer het antwoord op Vraag Q311 gelijk is aan ‘Veel minder vaak’ of ‘Minder vaak’.
Vraag Q312/I_: Wat is de reden dat u verwacht in de toekomst minder vaak te gaan vliegen voor privé doeleinden?
Toelichting: Meerdere antwoorden mogelijk

- Vaker gebruik maken van alternatieven in plaats van vliegen (bijv. auto of trein)
- Vanwege het klimaat
- Reisgenoten willen minder vliegen
- Gezondheidsredenen
- Vanwege de kosten
- Huidige drukte op luchthavens vermijden
- Geen van deze

Conditioneel: Vragen Q313 t/m Q318 zijn alleen zichtbaar wanneer het antwoord op Vraag Q39 niet gelijk is aan ‘Niet’ EN het antwoord op Vraag Q114 niet gelijk is aan ‘Helemaal oneens’ of ‘Oneens’.

Vraag Q313/R_A: Wat is de reden dat u van plan bent in de toekomst te gaan vliegen?
Ondanks de klimaatimpact wil ik vliegen, want…
Selecteer alle antwoorden die van toepassing zijn

- ik wil graag de wereld ontdekken
- ik heb recht op een welverdiende vakantie
- een vakantie in Nederland is voor mij geen vakantie
- ik geniet van het leven
- geen van deze

Vraag Q314/R_B: Hoewel het niet goed is voor het klimaat ga ik vliegen, want …
Selecteer alle antwoorden die van toepassing zijn

- andere mogelijkheden kosten te veel tijd
- andere vervoersmogelijkheden zijn te duur
- anders kom ik niet waar ik wil zijn
- ik moet wel blijven vliegen om de economie draaiende te houden
- geen van deze

Vraag Q315/R_C: Ondanks de klimaatimpact wil ik vliegen, want…
Selecteer alle antwoorden die van toepassing zijn

- ik compenseer mijn CO_2-uitstoot
- ik heb zonnepanelen, zonnecollectoren en/of een windmolen
- ik eet verantwoord (bijv. vegetarisch)
- ik koop zelden nieuwe spullen
- geen van deze

Vraag Q316/R_D: Hoewel het niet goed is voor het klimaat ga ik vliegen, want …
Selecteer alle antwoorden die van toepassing zijn

- andere mensen vliegen veel vaker

- andere mensen vliegen grotere afstanden
- andere mensen leven veel milieuonvriendelijker
- in Amerika vliegt iedereen
- geen van deze

Vraag Q317/R_E: De verantwoordelijkheid voor de aanpak van de klimaatschade van vliegen ligt vooral bij …
Selecteer alle antwoorden die van toepassing zijn

- luchtvaartmaatschappijen (zoals KLM)
- luchthavens (zoals Schiphol)
- overheden.
- veel-vliegers
- mijzelf
- geen van deze

Vraag Q318/R_F: Ondanks de klimaatimpact wil ik vliegen, want…
Selecteer alle antwoorden die van toepassing zijn

- mijn impact is klein
- het vliegtuig vliegt toch wel
- wanneer ik het vliegticket niet boek, doet iemand anders het wel
- de wereldwijde groei van de luchtvaart is enorm
- de luchtvaart heeft de inkomsten juist nodig om te vernieuwen
- geen van deze

Appendix D: Ranking assignment activities & calculations

Table 13; CO_2-emissions (kg) of various household- and travel activities together with the calculations and sources supporting these measurements

Activity	CO_2-emissions (kg)	Explanation	Calculation	Source(s)
Eating an apple	3 kg	Once every week	0,150kg x 0,413kgCO2eq/kg x 52 weeks	RIVM (2016)
Sending 1000 e-mails	**4 kg**	**Without attachments**	**-**	**Hansmann & Binder (2021)**
Buying a new jeans	34 kg	One piece (production included)	-	World Bank Group (2019)
Eating a hamburger	58 kg	Once every week	0,045kg x 24,6kgCO2eq/kg x 52 weeks	RIVM (2016)
Train trip to Berlin	**70 kg**	**Retour 2 persons**	**-**	**Milieu Centraal (2021)**
Trip with electric car to Berlin	110 kg	Retour 2 persons	-	Milieu Centraal (2021)
Taking a bath (120L)	**146 kg**	**Twice a week for a year**	**240L x 52 weeks x 15m3gas/2300L x 1,785kgCO2/m3 x**	**Rijksoverheid (2022) + Milieu Centraal (2022a)**
Trip with petrolic car to Berlin	260 kg	Retour 2 persons	-	Milieu Centraal (2021)
Flying to Berlin	**450 kg**	**Retour 2 persons**	**-**	**Milieu Centraal (2021)**
Elektricity for a househols of 2 persons	**815 kg**	**One year 2810 kWh**	**2810 kWh x 0,29kgCO2/kWh**	**Nibud (2022) + Rijksoverheid (2022)**
Driving to work Rot-Gouda	**1800 kg**	**5x per week 45 weeks**	**-**	**Milieu Centraal (2022b)**
Flying to Bali	**3300 kg**	**Retour 2 pers**	**-**	**Milieu Centraal (2021)**

Appendix E: Data cleaning

The following table provides an overview of the steps taken in the data cleaning and preparation process.

Table 14; Data cleaning & preparation, steps followed and actions taken

Steps taken	Points to check		Actions taken (#applicable lines)
Step 1; Completeness	All questions included?	V	
	All respondents included?	V	
	All respondents are unique?	V	
	No test-respondents present?	V	
Step 2; Horizontal Cleaning	All respondents meet requirements set for target group?	V	
	All respondents completed survey in full?	X	* Respondents who did not fill in the survey (338) are deleted. * Drop-outs (16) are deleted.
	No missing items?	V	
	No evasive response behaviour?	X	Penalties given to respondents answering 'I don't know' too often (8).
	No straightlining behaviour for matrix questions?	X	Penalties given to respondents answering four times the same for matrix questions *IdentiteitReiziger* or *MilieuBewustzijn* (145).
	No speeding?	X	Respondents answering the survey too fast based on the number of questions presented are deleted (17).
	No inconsistencies in answers?	X	Penalties given to respondents having inconsistent answers regarding statements of the *IdentiteitReizigers*, *PBC*, *MilieuBewustzijn* & *HoudingVliegen* (171).
	Good quality of ranking task?	X	*Respondents answering 1234567 or 7654321 are deleted (5). *Answers of respondents having filled in the ranking task from least to most polluting (both *Flying to Bali* as 6 or 7 and *Sending emails* as 1 or 2) are recoded (40).
Step 3; Vertical Cleaning	Only necessary variables present?	X	Unnecessary variables deleted.
	No outliers present?	V	
Step 4; Data Imputation	No missing items?	V	
	No 'I don't know'?	X	*Recoding 'I don't know' answers of variables *SocialeNorm*, *PBC*, *MilieuBewustzijn, HoudingVliegen*
Step 5; Weights	Sample representative?	V	No weights added.
Step 6; Data Enrichment	All necessary data present?	X	Other data files (MPN data) linked to SPSS file.
	All variables coded as desired?	X	Recoding variables & computing new variables.

Of the 2384 respondents asked to participate in the questionnaire, a total of 1976 respondents are left in the data set after the data preparation phase. Table 14 shows the number of respondents removed from the data set classified by the reason for removal.

Table 15; Number of respondents invited for, removed from, and remained in the data set

	Exp 1	**Exp 2**	**Total (Abs.)**	**Total (%)**
Invited	*1582*	*802*	*2348*	*100*
No response	199	121	320	13.4%
Not willing to participate	13	5	18	0.8%
Dropped out	9	7	16	0.7%
Removed after cleaning	28	26	54	2.3%
Remaining (Abs.)	*1333*	*643*	*1976*	*82.9%*
Remaining (%)	*67.5*	*32.5*	*100*	

32 respondents are removed from the data set based on the penalties given for evasive response behaviour, straightlining and inconsistent answering. These respondents have all received two or more penalties in total, which is set as boundary for exclusion. The criteria speeding, having completed the survey too fast, and quality of ranking task, not made any effort to make the ranking task, are seen as major errors in a way that the respondent are removed immediately when exceeding the boundaries set up for these exclusion criteria.

Appendix F: Data preparation for SEM

Rasch analysis

This appendix shows the item information curves of the multiple-choice questions questioning respondents current awareness on the impact of flying on climate change. As explained clearly by Wood (2017), item information curves show how much "information" about the latent trait ability an item gives. A peak is shown at the difficulty value (the point where the item has the highest discrimination), with less information at ability levels farther from the difficulty estimate.

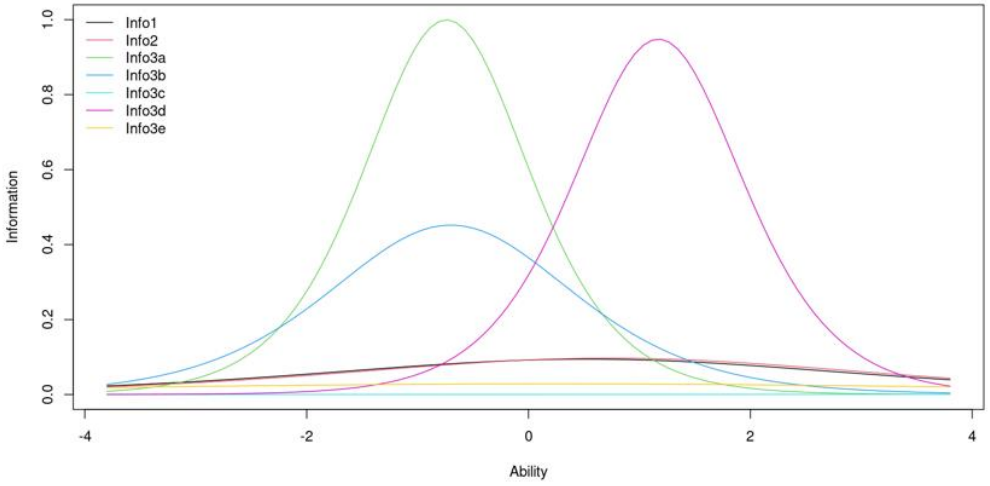


Figure 17; Item information curve of all asked questions representing the current awareness

Figure 18 shows that the third statement of question 3 does not add any information at all; a flat line is present in the plot. For this reason, this question is removed from the analysis. Figure 19 shows the final item information curve without info3c, where no flat lines are present. The resulting 'current awareness' scale shows a normal distribution among the respondents, which is shown in figure 20.

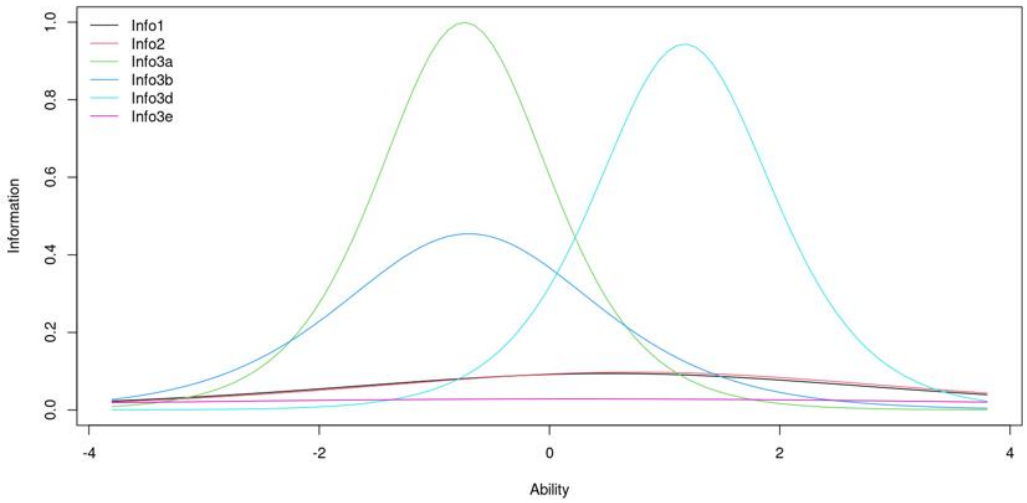


Figure 18; Final item information curve representing the current awareness

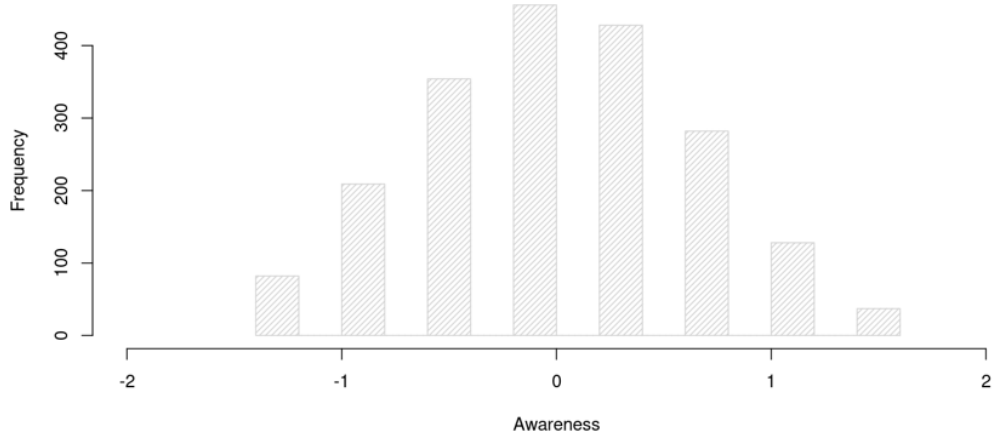


Figure 19; Normality plot variable 'current awareness about the impact flying on climate change'

Assessment normal distribution dependent variables

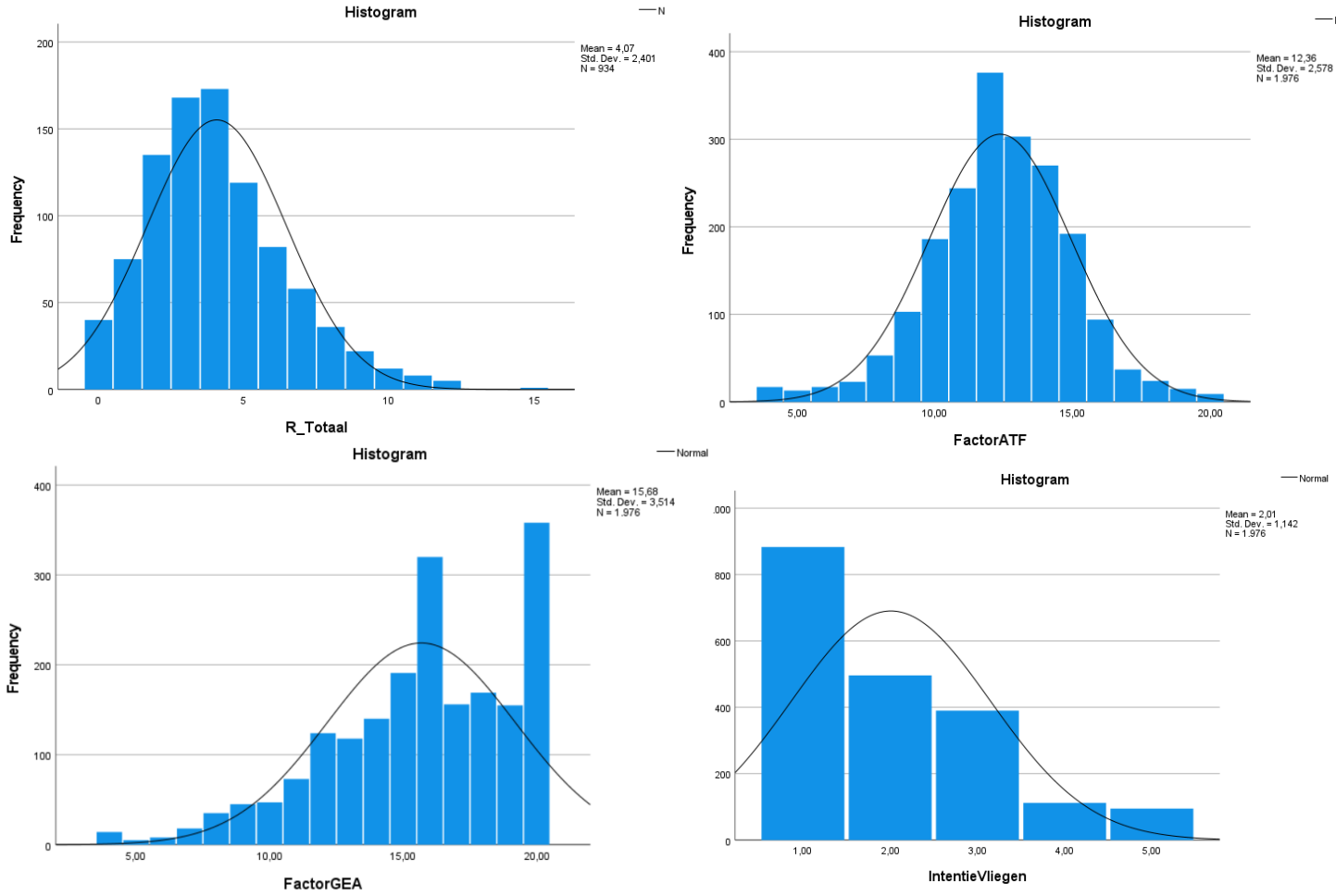


Figure 20A, 22B, 22C, 22D; Normality plots of dependent variables included in the SEMs

Appendix G: Identification of final main structural equation model

In this appendix, the steps taken and the results are shown of determining the final main model. It is unclear from theory what exact relationships exist between the general environmental attitudes, the attitudes towards flying and the intention to fly. SEMs with different sets of relations between these factors will therefore be estimated and assessed to find out which model best fit the data. Only plausible models identified in advance are tested in AMOS, for which the relationships between the three different variables all would make sense according to theory and logical thinking.

Doubt exists about the presence of a relation between the higher-end attitude, the general environmental attitudes, and the lower-end attitude, the attitudes towards flying. If there is a relation between these factors present, this relation would be pointed from the higher-end attitude to the lower-end attitude. Additionally, it is unclear if both types of attitudes affect the intention to fly or that only the lower-end attitude affects the intention to fly.

As these uncertainty only involves direct predictors of the intention to fly, a simplified model is used to explore relations between the different attitudes and the intention to fly are most plausible. This simplified model starts with two layers of factors, the predictors of the intention to fly and the intention to fly. The predictor 'justifications' is not incorporated in this model, as the questions about the justifications of the flying behaviour are not completed by all respondents. The data of all 1976 respondents who filled in the questionnaire is used to estimate the different initial models.

At first, a fully saturated model, i.e. no degrees of freedom, is estimated whereby all predictors corelate with each other and have a direct relation to the intention to fly (see figure 23A) The results show that only the general environmental attitudes is not a significant predictor of the intention to fly (β=0.026, p=0.119). This implies that there is only a direct relationship between the lower-end attitudes, the attitudes towards flying, and the intention to fly.

The next step is to check if there could be an indirect relationship present between the general environmental attitudes and the intention to fly via the attitudes towards flying. Hence, the relationship from the general environmental attitudes towards the attitudes towards flying is added (see figure 23B). All four estimated path coefficients are significant, which implies that there is an indirect relationship present from the general environmental attitudes towards the intention to fly via the attitudes towards flying. This indirect relation will be included in the final main SEM.

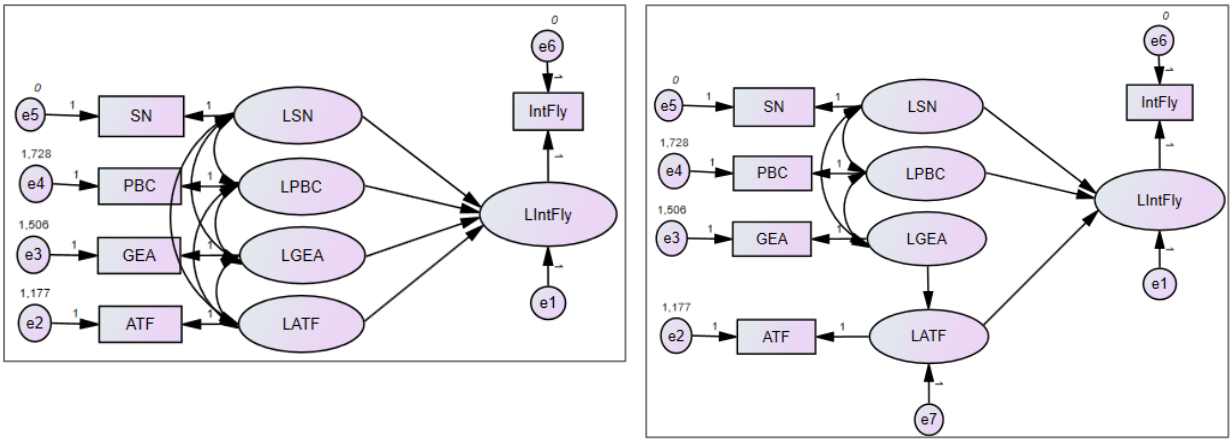


Figure 21A & 23B; Structural equation models to test relations between the general environmental attitudes (LGEA), the attitudes towards flying (LATF) and the intention to fly (LIntFly)

The final structural equation models (model 1 and model 2) build in IBM® SPSS® AMOS™ 26 Graphics are shown in figure 24 & 25.

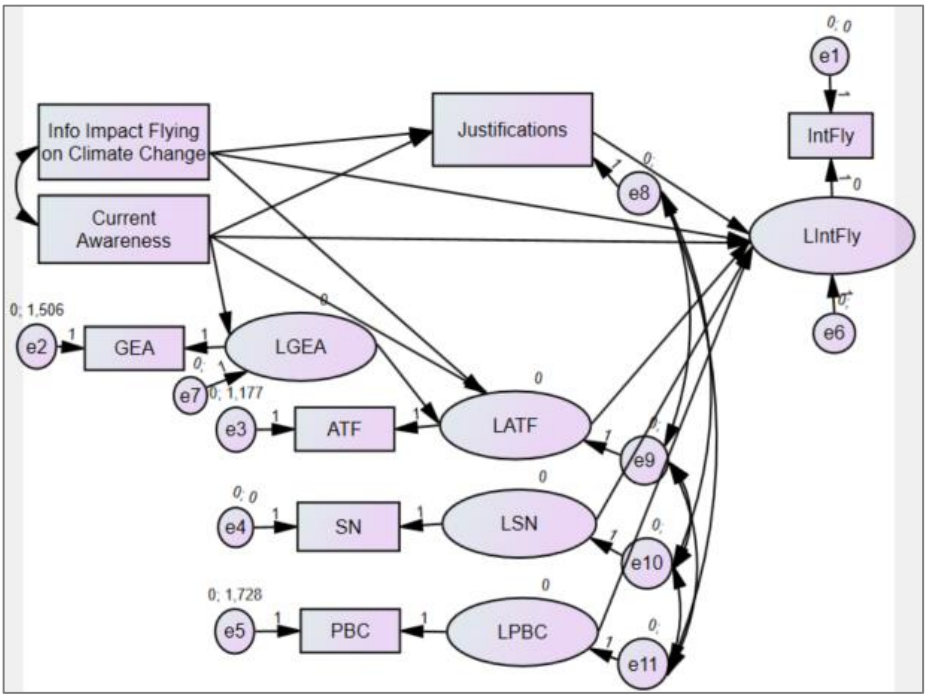


Figure 22; Structural equation Model 1 (input model)

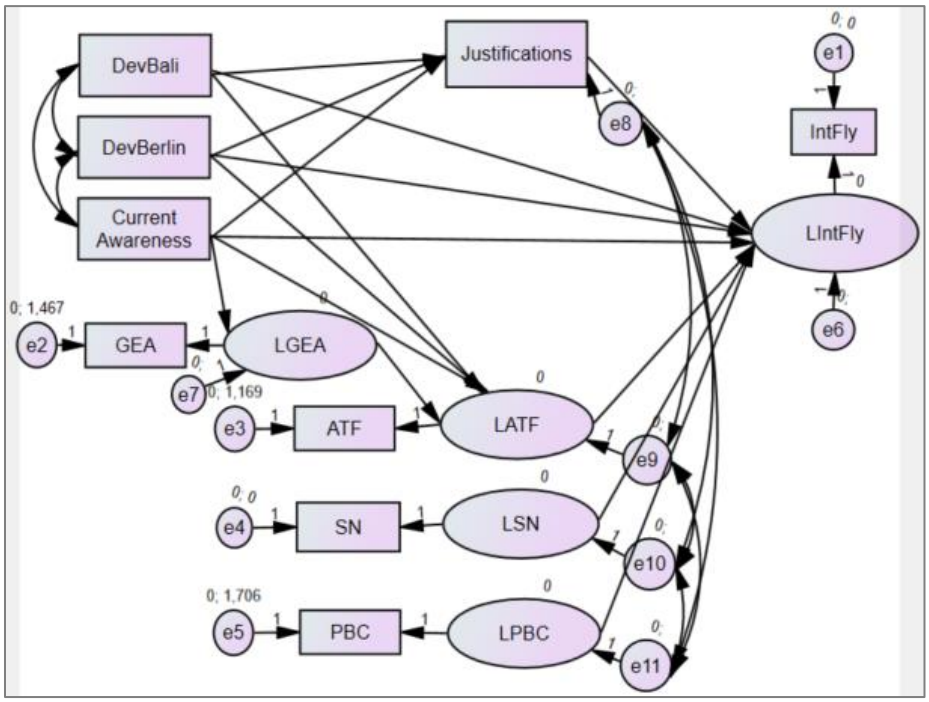


Figure 23; Structural equation Model 2 (input model)

Appendix H: Estimation of standardized total, direct and indirect effects of SEMs

Table 16; Standardized total, direct and indirect effects for model 1

Variable (Factor Label)*	General Environmental Attitudes (LGEA)			Justifications			Attitudes towards flying (LATF)			Intention to fly		
	Total	*Direct*	*Indirect*	*Total*	*Direct*	*Indirect*	*Total*	*Direct*	*Indirect*	*Total*	*Direct*	*Indirect*
Information about the relative impact of flying on climate change	-	-	-	0	0	-	0	0	-	0	0	0
Current Awareness impact flying on climate change	0.415	0.415	-	0.147	0.147	-	0	0	0	0.043	0.043	0.001
Justifications	-	-	-	-	-	-	-	-	-	0	0	-
Attitudes towards flying (LATF)	-	-	-	-	-	-	-	-	-	0.087	0.087	-
General Environmental Attitudes (LGEA)	-	-	-	-	-	-	-0.080	-0.080	-	-0.007	-	-0.007
Social Norm (LSN)	-	-	-	-	-	-	-	-	-	0.059	0.059	-
Perceived Behavioural Control (LPBC)	-	-	-	-	-	-	-	-	-	-0.697	-0.697	-

*direction of effects: from row variables to column variables; all insignificant relationships are 0.

Table 17; Standardized total, direct and indirect effects for model 2

Variable (Factor Label)*	General Environmental Attitudes (LGEA)			Justifications			Attitudes towards flying (LATF)			Intention to fly		
	Total	*Direct*	*Indirect*	*Total*	*Direct*	*Indirect*	*Total*	*Direct*	*Indirect*	*Total*	*Direct*	*Indirect*
Deviation ranking position Bali	-	-	-	0	0	-	0	0	-	0	0	0
Deviation ranking position Berlin	-	-	-	0	0	-	0	0	-	0	0	0
Current Awareness impact flying on climate change	0.434	0.434	-	0.191	0.191	-	0	0	0	0.086	0.087	-0.001
Justifications	-	-	-	-	-	-	-	-	-	0	0	-
Attitudes towards flying (LATF)	-	-	-	-	-	-	-	-	-	0.103	0.103	-
General Environmental Attitudes (LGEA)	-	-	-	-	-	-	0	0	-	-0.004	-	-0.004
Social Norm (LSN)	-	-	-	-	-	-	-	-	-	0	0	-
Perceived Behavioural Control (LPBC)	-	-	-	-	-	-	-	-	-	-0.700	-0.700	-

*direction of effects: from row variables to column variables; all insignificant relationships are 0.

Appendix I: Full analysis justifications items & categories

Table 18; The number of answers selected by the respondents per justification and justification category, together with the number of respondents that did or did not select a justification per category, whereby N = 934

	Number of answers selected		Number of respondents	
	Abs.	**%**	**Abs.**	**%**
1. Having the right to fly	**914**	**100**	**678**	**72.6**
I would like to discover the world	472	52		
I am entitled to a well-earned holiday	111	12		
A holiday in the Netherlands is not a real holiday for me	88	10		
I enjoy life	243	27		
None of the above reasons	-	-	*256*	*27.4*
2. No suitable alternative is present	**1091**	**100**	**832**	**89.1**
Alternative transport modes take too much time	257	24		
Alternative transport modes are too expensive	141	13		
Otherwise I won't get to where I want to be	693	64		
None of the above reasons	-	-	*102*	*10.9*
3. Compensate for flying emissions	**845**	**100**	**485**	**51.9**
I offset for my CO2 emissions	189	22		
I have solar panels, solar collectors and/or a wind turbine	243	29		
I eat responsibly (e.g. vegetarian)	199	24		
I rarely buy new stuff	214	25		
None of the above reasons	-	-	*449*	*48.1*
4. Others are more environmentally unfriendly	**279**	**100**	**158**	**16.9**
Other people fly much more often	107	38		
Other people fly longer distances	54	19		
Other people live much more environmentally unfriendly	88	32		
In America everyone flies	30	11		
None of the above reasons	-	-	*776*	*83.1*
6. Having no impact*	**572**	**100**	**404**	**43.3**
My impact is small	222	39		
The plane will fly anyway	225	39		
If I don't book a ticket for the plane, someone else will	125	22		
None of the above reasons	-	-	*530*	*56.7*

*Category 5 excluded because of the different way of measuring this category.