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HAUPTBEITRÄGE – THEMENTEIL

Explaining sustainable purchase behavior in online flight booking—combining value-belief-norm model and theory of planned behavior

Timo Kortsch[1] · **Phyllis Händeler**[2]

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Abstract
This article of the journal Gruppe. Interaktion. Organisation. focuses on the factors that influence CO2 offsetting behavior when booking flights. By combining the Value Belief Norm model (VBN) and the Theory of Planned Behavior (TPB), the study investigates which factors generally influence people's willingness and behavior to make CO2 offsets for air travel. In addition, a concrete booking process is used to experimentally test how high the actual willingness to pay is in this situation and how much it depends on the representation. An online survey with a partially experimental design yielded 514 usable data sets. The results of the structural equation model essentially confirmed the assumptions of the VBN and TPB theories regarding the influence on compensation behavior, with the personal norm being the most important influencing factor. However, the specific fictitious booking process revealed the special role of price: the cheapest compensation packages always had the highest choice probabilities, and absolute price did not play a role. This was confirmed in qualitative analyses. The results expand previous knowledge on factors influencing CO2 compensation behavior and provide flight providers with important information for designing their CO2 compensation offers.

Keywords Sustainable purchase behavior · Personal norm · Value orientations · Value-belief-norm model · Theory of planned behavior · Experimental design

✉ Timo Kortsch
timo.kortsch@iu.org

[1] IU Internationale Hochschule, Juri-Gagarin-Ring 152, 99084 Erfurt, Germany

[2] Gutenswil, Switzerland

Erklärung des nachhaltigen Kaufverhaltens bei der Online-Flugbuchung – eine Kombination des Value-Belief-Norm-Modells und der Theorie des geplanten Verhaltens

Zusammenfassung
Dieser Artikel in der Zeitschrift Gruppe. Interaktion. Organisation. beschäftigt sich mit den Faktoren, die das CO2-Kompensationsverhalten bei der Flugbuchung beeinflussen. Durch die Kombination des Value Belief Norm-Modells (VBN) und der Theorie geplanten Verhaltens (TPB) wird in der Studie untersucht, welche Faktoren generell die Bereitschaft und das Verhalten von Menschen beeinflussen, CO2-Kompensationen für Flugreisen zu leisten. Zusätzlich wird anhand eines konkreten Buchungsprozesses experimentell überprüft, wie hoch die tatsächliche Zahlungsbereitschaft in dieser Situation ist und wie sehr diese von der Darstellung abhängt. Aus einer Online-Umfrage mit teilweise experimentellem Design ergaben sich 514 verwertbare Datensätze. Die Ergebnisse des Strukturgleichungsmodells bestätigen im Wesentlichen die Annahmen der VBN- und TPB-Theorien hinsichtlich des Einflusses auf das Kompensationsverhalten, dabei war die personale Norm der wichtigste Einflussfaktor. Allerdings zeigte sich im konkreten fiktiven Buchungsprozess die besondere Rolle des Preises: Die günstigsten Kompensationspakete hatten immer die höchsten Wahlwahrscheinlichkeiten, der absolute Preis spielte dabei keine Rolle. Dies wurde in qualitativen Analysen bestätigt. Die Ergebnisse erweitern das bisherige Wissen zu Einflussfaktoren auf das CO2-Kompensationsverhalten und geben Fluganbietern wichtige Hinweise zur Gestaltung ihrer CO2-Kompensationsangebote.

Schlüsselwörter Nachhaltiges Kaufverhalten · Persönliche Norm · Wertorientierungen · Value-Belief-Norm-Modell · Theorie des geplanten Verhaltens · Experimentelles Design

1 Introduction

Air travel causes high CO2 emissions. In the EU, civil aviation accounts for 13.4% of total CO2 emissions from EU transport (European Parliament 2023). To address this problem, European aviation is committed to contributing to the climate targets set by the European Union and the 2015 Paris Agreement. In 2021, it presented Destination 2050, a comprehensive concept aimed at collectively achieving these ambitious targets. Destination 2050 explores various options and their potential impact on reducing CO2 emissions within the aviation sector. One of the key aspects addressed in this plan is the utilization of Sustainable Aviation Fuels (SAF) (Destination 2050 2021). While the environmental impacts of aviation and potential solutions have been extensively researched from an industry perspective, and clear targets have been set for 2030 and 2050, questions remain about the role of consumers in this equation, in addition to questions regarding the scalability of these solutions (Mock 2012). For example, Arning et al. (2023) investigated what influences the acceptance and behavioral intentions towards CO2-based aviation fuels using an online questionnaire in four European countries (i.e. Spain, Norway, the Netherlands, and Germany). The results revealed that the behavioral intention to fly with CO2-based fuels, i.e., aviation fuels obtained through carbon capture and utilization technologies, was primarily influenced by benefit perception. Other important factors were environmental awareness, interest, risk perception regarding technical quality and maturity, and health and environmental risks. These findings were consistent across all four countries, underscoring a widespread societal readiness for CO2-based aviation fuels.

Sustainable consumption is not a new concept, and a significant portion of consumers already find carbon offsetting a reasonable practice, particularly in the short-haul air travel sector (Zimmer et al. 2022). However, sustainable consumption, especially in the context of air travel, often faces the challenge known as the 'intention-behavior gap' (IBG), which denotes the inconsistency between intention and action (ElHaffar et al. 2020). The Theory of Planned Behavior (TPB, Ajzen 1991) is one of the most widely used models for explaining individual behavior and intentions (Bosnjak et al. 2020). It has been frequently employed in research on pro-environmental behavior and intentions (Han 2021; Yuriev et al. 2020). Despite its popularity, studies have indicated that the TPB, on average, only explains 44% of the variance in intentions and 34% of the variance in behavior (Yuriev et al. 2020). This raises the question of what additional factors might account for the unexplained variance. In this study, building on prior studies tourism research (e.g., Fauzi et al. 2022; Kim et al. 2023; Meng et al. 2020) we combine the TPB with the Value-Belief Norm (VBN) model, another common framework in the study of pro-environmental behavior, to maximize the explanatory power. The coexistence of both theories—TPB and VBN—has therefore already been criticized as unsatisfactory (Bamberg et al. 2007). The VBN model, originally proposed by Stern (2000), has the potential to offer insights into environmentally conscious behavior. Although it has been applied in related tourism contexts like hotel booking (Choi et al. 2015), its application to the willingness to

compensate for air travel has been limited and inconsistent (Hinnen et al. 2017; Kim et al. 2016). Moreover, many customers may not even be aware of the option to offset their flights or have limited exposure to such offerings (Kim et al. 2016). This suggests that the VBN theory could shed light on the factors influencing the willingness to compensate when booking flights.

Therefore, the study has several objectives. First, the study aims to investigate on a more general level which influencing factors affect the compensation intention and behavior when booking flights online. Here, assumptions from VBN theory and the TPB are built upon. Secondly, an experiment using a simulated actual flight booking process is used to uinvestigate how high the actual willingness to pay is in this booking situation and what effect the information richness on the topic of CO2 compensation and the price have. Overall, the study should provide valuable insights into the extent to which passengers are willing to offset their travel and what influences their willingness to compensate and their behavior.

2 Theory and hypotheses

2.1 Sustainable Aviation Fuels and carbon offset programs

In addition to immediate eco-friendly aviation solutions like phasing out kerosene-inefficient aircraft, adopting Sustainable Aviation Fuels (SAF) is a crucial strategy for the industry's long-term sustainability and achieving 2050 climate goals (Bohlmann 2022). SAF is considered a "savior" for its substantial potential to reduce the aviation industry's high CO2 emissions, with interest in it dating back nearly two decades, as exemplified by the use of resources like cooking oil, municipal waste, and exhaust gases in early production methods (Bohlmann 2022). The term "sustainable" in SAF denotes a commitment to emissions reduction throughout its life cycle, from sourcing raw materials to production and consumption, addressing pollutants (Montoya Sánchez et al. 2022; Destination 2050 2021). SAF can achieve greenhouse gas emission savings ranging from 25% to 95% throughout its life cycle, and sustainable fuel utilization in the aviation industry has the potential to reduce net emissions by an impressive 80% to 100% (Destination 2050[1] 2021).

However, the aviation sector must not become complacent in its pursuit of ambitious climate targets. As mentioned earlier, a coordinated approach involving various measures is imperative to achieve these goals. For instance, Montoya Sánchez et al. (2022) identify four challenges in sourcing waste materials for conversion into sustainable fuels: high demand for SAF, diverse sources of waste materials, scattered distribution of waste sources and low energy density, and the economic viability of the process (Montoya Sánchez et al. 2022). With these limitations in mind, the European Parliament is still requesting airlines to maximize the SAF usage for all flights departing from EU airports to 2% in 2025, minimum of 6% in 2030 and an overarching goal of 70% SAF usage in 2050 (Gill 2023). Airlines are in the spotlight to prove the achievements of the set targets.

In addition to SAF as a measure of direct emissions reductions, passengers can put extra money towards carbon offset programs p through environmental projects which help compensate for their flight emissions (IATA[2] 2022). A study found that several airlines and tour operators offer passengers the option to offset their flight's carbon footprint by contributing money or using airline miles (Chen 2013). However, people seem to have a rather low willingness to pay for such optional offers. In line with the low-cost hypothesis for environmentally friendly behavior (Diekmann and Preisendörfer, 1998), which assumes that environmentally friendly behavior depends on the associated costs of action, carbon offsetting should reduce the probability of the offsetting behavior as the price increases. Studies have shown that only about 20% of respondents were willing to pay significant additional costs for offers such as carbon offsets (Hinnen et al. 2017), and the median willingness to pay for compensating one ton of flight-related CO2 emissions is zero Euro (Berger et al. 2022). Suppliers, including airlines and specialized companies, often offer a hybrid compensation approach where passengers can choose to allocate funds towards both SAF and climate projects. This mixed compensation approach is currently the most widely adopted method (Compensaid 2023), not solely but also mainly due to the high cost of SAF with its direct impact through embedding purchased amounts in the daily operations versus a long-term compensation effect which is given through reforestation and other lengthy projects. One approach to increase the willingness to pay can be the variation of the presentation of the information. For example, framing and anchoring effects have already been demonstrated in the purchase of organic food Shan et al. (2020) and in aviation green tax (Kim and Hyun 2020) which could be reduced by prior knowledge.

[1] Destination 2050 is a union of airlines joining forces to achieve politically and regulatory set goals for the usage of SAF.

[2] The International Air Transportation Association is a trade association supporting advising airlines with standards and regulation in various fields like; security, safety, operations etc. (IATA 2023).

2.2 Explaining sustainable purchase behavior with the VBN Theory

The Value-Belief-Norm Theory (VBN; Stern et al. 1999) serves as a fundamental framework for assessing behavior and behavioral intentions in the context of sustainable purchasing. This model has gained significant recognition and empirical support in various studies (Stern 2000; Gupta and Sharma 2019; Jansson et al. 2011; Han 2015; Ghazali et al. 2019; Choi et al. 2015; Steg et al. 2005). In the realm of environmental and climate concerns, the VBN theory plays a pivotal role in identifying individual coping mechanisms and subsequent behavioral tendencies (Gupta and Sharma 2019). Notably, it has been found to be the most robust model for predicting environmentally conscious behavior (Stern 2000).

Extending from the Norm Activation Model (Schwartz 1977), the VBN theory asserts that personal norms trigger specific behavioral tendencies (Stern 2000). These personal norms, in turn, are influenced by a combination of factors including value orientation, ecological worldview, and beliefs, within the VBN impact pathway (Han 2015). Empirical studies have substantiated the causal relationships and effects within this model in relation to sustainable behavior (Ghazali et al. 2019). The VBN theory posits three fundamental value orientations: biospheric (concern for nature and ecosystems), altruistic (concern for the welfare of others), and egoistic (individual utility maximization). These orientations are closely linked to an individual's ecological worldview, which affects their awareness of environmental threats and resource depletion due to human activities, subsequently influencing environmentally conscious intentions and behaviors (Han 2015). The ecological worldview is also connected to beliefs, particularly awareness of consequences (recognizing the impact of one's actions on the environment) and acceptance of responsibility. These beliefs shape intentions to either improve or degrade the ecosystem. In the VBN model, value and belief orientations activate personal norms, which directly impact behavior (Stern 2000). Strong personal norms demand a sense of obligation toward ecological responsibility (Choi et al. 2015). It is important to note that personal norm development and behavior are influenced by moderating factors, including value orientations and conviction.

2.3 Integrating TPB and VBN theory

As stated earlier, in addition to the VBN model, the TPB has often been used to explain pro-environmental behaviors and intentions (Yuriev et al. 2020). The central assumptions of Ajzen's (1991) Theory of Planned Behavior are that a person's behavior is influenced by three main factors via intention: Attitude (i.e., the personal attitude or evaluation of a behavior), social norm (i.e., the perceived expectation and opinion of key caregivers), and perceived behavioral control (i.e., the individual's assessment of how easy or difficult it is to perform a behavior). However, review studies have shown that much of the variance in intentions and behavior is not explained by the predictors (Yuriev et al. 2020). With this in mind, an increasing number of studies in tourism research have recently taken the approach of combining the VBN and the TPB to increase explanatory power. Studies predicting volunteer tourism travel behavior (Meng et al. 2020), visiting a sustainable/green hotel (Fauzi et al. 2022; Kim 2023), travelers' protective behaviors at wellbeing tourism destinations (Han et al. 2023), but also hospitality and tourism employees' sustainable behaviors (Meng et al. 2022) selected their predictors from both theories. Similarly, in the context of energy saving behavior in organizations, Heib et al. (2023) found that personal norm complemented the assumptions of TPB well. While some studies used the theories rather loosely and did not properly consider central assumptions (e.g. Fauzi et al. 2022), other studies showed that even when the assumptions of both theories were consistently implemented, good model fits were achieved (e.g., Kim 2023). This study therefore takes the approach of using both theories to predict CO2 compensation behavior in online flight booking, taking into account the central assumptions of both theories.

2.4 Hypotheses and Research Model

In this section, the hypotheses derived from the theoretical explanations are presented in a research model. Part 1 consists of two blocks. Building on value belief norm theory, we hypothesize:

H1a–c: A pronounced (a) altruistic and (b) biospheric value orientation is positively related to the New Ecological Paradigm (NEP) whereas (c) the egoistic value orientation is negatively related to the NEP.
H2: The NEP is positively related to the awareness of consequences.
H3: Awareness of the consequences of consumption is positively related to the ascription of responsibility.
H4: The level of ascribed responsibility is positively related to personal norms towards sustainable consumption.
H5: A strong personal norm towards sustainable consumption is positively related to sustainable purchase behavior.

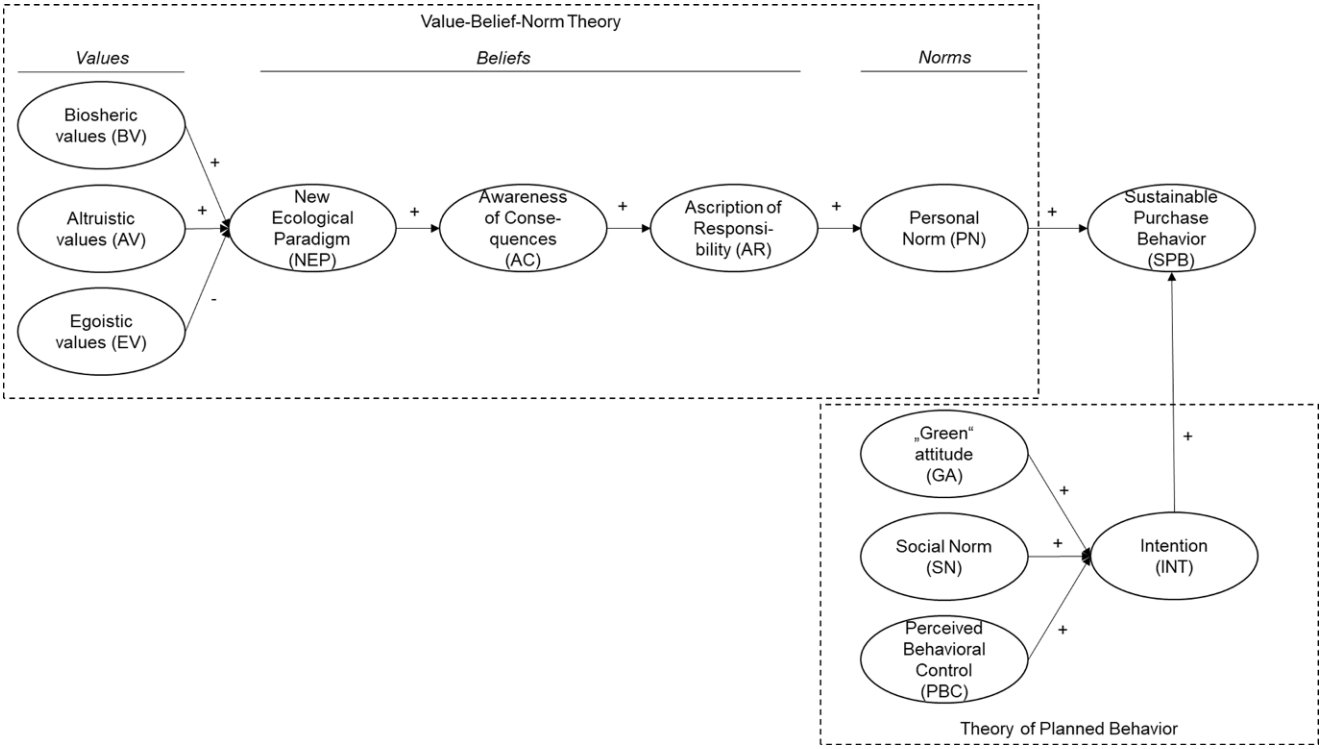

Fig. 1 Integrated Research Model

The theory of planned behavior leads to the following assumptions:

H6: A "green" (i.e., environmentally friendly) attitude is positively related to a sustainable purchase intention.
H7: The social norm is positively related to sustainable purchase intention.
H8: Perceived behavioral control is positively related to sustainable purchase intention.
H9: A sustainable purchase intention is positively related to sustainable purchase behavior.

The integrated research model in Fig. 1 summarizes the hypotheses H1–H9.

Part 2 of the hypotheses:

H10: The higher the compensation costs, the lower the willingness to pay for CO2 compensation of the flight travel.
H11: The provision of information on SAF leads to a greater willingness to pay more for CO2 offsetting (including through SAF-related surcharges) of flight travel.
H12: The higher the absolute price for the flight (and thus for the compensation costs), the lower the willingness to pay for the CO2 compensation of the flight travel.

3 Method

3.1 Research design

A cross-sectional online survey with a partial-experimental design was conducted. Participants were randomly assigned to one of four conditions that differ in the richness of information presentation (rich vs. reduced) and travel distance (medium vs. long) in the context of a fictitious booking process. Travel distance has been chosen according to comparable WTP and routings that do not offer a realistic intermodal or other mode of transportation options, such as train. Participants receiving the rich information survey were specifically informed on emissions impact for their fictitious flight and SAF was demonstrated as a key driver in more sustainable air travel. In contrary, participants of the reduced information group received no further information other than flight price, flight emissions overview and compensation package for their choice. Therefore, the latter group might have underestimated the effectiveness of SAF. Apart from this variation, the rest of the questionnaire was identical. The online questionnaire was distributed between February and April 2023 via personal and professional social networks (e.g. LinkedIn) as well as via a questionnaire platform for students in distance learning program at a private German university. The students studied primarily part-time alongside their jobs.

3.2 Sample

557 persons participated in the study of which 514 completed the survey (92.28%). Of the 514 participants, 22.2% were recruited via social networks and 77.8% via the university. These participants formed the final sample. Concerning gender, 4 participants did not provide any information, 76.08% of the others were women and 27.72% men. The mean age was 27.18 years (SD = 8.75). 87.06% of the participants were from Germany, each 5.69% from Austria and Switzerland and 1.57% from other countries (e.g., Italy). Concerning education, 53.53% had an A-level, 12.94% have vocational training and 28.67% have a university degree, 4.9% indicated another degree. Of the respondents, 56.58% were students, 35.95% were employees or civil servants, and about 4% each were self-employed or other. Respondents came from very diverse industries, e.g., 5.9% from the aviation industry, 2.86% from the tourism industry, and 2.05% from the automotive industry. The largest industries were medical/healthcare industry (26.59%) and social and cultural services (17.59%) and others (34.77%). In terms of income, more than two thirds of the respondents (69.61%) stated that they had a maximum monthly net income of 3000 EUR, while one tenth of the respondents (9.61%) had an income of 8500 EUR or more.

3.3 Instruments (questionnaire part 1)

The questionnaire consisted of two parts. The first part consisted of several established scales to investigate hypotheses 1 to 9, as well as questions on sociodemographic variables (i.e., age, gender, education, net household income classified into income ranges, country). The instruments are presented below. When calculating scale values for each construct, reverse-coded items were recoded first.

Value orientations: Biospheric (5 items), altruistic (4 items), and egoistic (5 items) value orientation were assessed using translated items from Ciocirlan et al. (2020). A seven-point Likert type response format from (1) strongly disagree to (7) strongly agree was used. Sample items were "I am concerned about environmental issues because of the consequences for plants" (biospheric value orientation; $\alpha = 0.94$), "I am concerned about environmental issues because they will affect my future" (egoistic value orientation; $\alpha = 0.84$), and "I am concerned about environmental issues because of the consequences for future generations" (altruistic value orientation; $\alpha = 0.91$).

New Ecological Paradigm: To assess New Ecological Paradigm six items adapted from Ciocirlan et al. (2020) were used. A seven-point Likert scale has been applied. An example item is: "Plants and animals have as much right as humans to exist." Two items were reverse coded "The balance of nature is strong enough to cope with the impacts of modern industrial nations" and "The so-called 'ecological crisis' facing humankind has been greatly exaggerated." The reliability was $\alpha = 0.77$.

Awareness of consequences: To assess the awareness of consequences, six items adapted from Choi et al. (2015) were used on a seven-point Likert scale from (1) strongly disagree to (7) strongly agree. An example item was: "Global warming is a problem for society". One item was reverse coded (AC06: "It is not certain that global warming is a real problem"). The reliability was $\alpha = 0.77$.

Ascription of responsibility: To assess ascription of responsibility, six items adapted from Steg et al. (2005) were used on a seven-point Likert scale from (1) strongly disagree to (7) strongly agree. An example item was: "I feel partly responsible for the depletion of non-renewable energy sources. Two items were reverse coded (AR04: 'My contribution to the energy problem is negligible', AR06: 'In principle, individuals at their own cannot contribute to the reduction of energy problems'"). The Cronbach's alpha value was $\alpha = 0.80$.

Personal norm: Personal norm was assessed with nine items adapted from Steg et al. (2005) with a seven-point Likert scale response format from (1) strongly disagree to (7) strongly agree. A sample item was: "I feel a personal responsibility to offset as much CO2 as possible." One item was reverse coded (PN07: "I have no bad feeling at all when I buy a flight without CO2 compensation"). The reliability for the scale was $\alpha = 0.91$.

Injunctive Social Norm: Injunctive social norm was assessed with three items adapted from Choi et al. (2015) on a five-point Likert scale from (1) strongly disagree to (5) strongly agree. One example item was: "Most people I care about believe I should offset as much CO2 as possible". The Cronbach's alpha value for the scale was $\alpha = 0.91$.

Perceived behavioral control: Perceived behavioral control was assessed with three items adapted from Fielding et al. (2008). The five-point scale varied in wording depending on the question from (1) "very difficult" to (5) "rather very easy", and "none at all" to "a lot", a sample item was "How much control do you have over the extent to which you behave sustainably?". The reliability for the scale was $\alpha = 0.72$.

"Green" attitude: "Green" attitude was assessed with four items adapted from Varah et al. (2021) on a five-point Likert scale from (1) strongly disagree to (5) strongly agree.

One example item was: "It's a good idea to buy an environmentally friendly product". The Cronbach's alpha value for the scale was $\alpha = 0.81$.

Sustainable purchase intention: Sustainable purchase intention was assessed with three items adapted from Choi et al. (2015) on a seven-point Likert scale from (1) strongly disagree to (7) strongly agree. One example item was: "I plan to travel on a sustainable airline on my next flight". The reliability for the scale was $\alpha = 0.92$.

Sustainable purchase behavior: Sustainable purchasing behavior was assessed using three items created specifically for this study. The aim was to assess the extent to which the respondents have already financially compensated for the CO2 emissions they cause when flying and other behaviors (e.g., online orders, other purchases with compensation options), e.g., through CO2 compensation payments. The respondents rated the statements on a seven-point Likert scale from (1) strongly disagree to (7) strongly agree. One example item was "I have already financially compensated CO2 emissions when booking a flight". The reliability for the scale was $\alpha = 0.77$.

3.4 Experimental design (questionnaire part 2)

To test hypotheses 10 to 12, an experimental design was implemented in the online questionnaire (part 2). Participants in the study were randomly assigned to one of four groups after completing part 1 of the questionnaire. These differed in the presented information on SAF (rich vs. no information) and the presented travel distance (medium: Frankfurt—New York—Frankfurt vs. long: Frankfurt—Seoul—Frankfurt) of the fictive booked flight. Thereby, the travel distance was an operationalization of the absolute costs, which amounted to EUR 770 for the trip Frankfurt—New York—Frankfurt and EUR 1200 for the trip Frankfurt—Seoul—Frankfurt. The vignettes illustrating the booking processes can be found in the supplementary material. At the end of the presentation, the participants had to indicate the probability (slider from 0 to 100%) that they would choose each of the three options[3]: option 1 (8 years: 20% SAF, 80% projects; 130 EUR for the New York trip or 190 EUR for the Seoul trip in addition to the ticket price), option 2 (5 years: 50% SAF, 50% projects; 300 EUR or 445 EUR in addition to the ticket price) and option 3 (2 years: 80% SAF, 20% projects; 480 EUR or 700 EUR in addition to the ticket price). In addition, they had to make a forced choice of one of the three options and provide a justification as free text.

3.5 Analysis

The statistical program JASP is used to perform descriptive and simple statistical analyses as well as the 3-way mixed ANOVA with 2 between-subjects factors (information richness, distance/price absolute) and 1 within-subjects factor (compensation model: option 1, option 2, option 3) to investigate hypotheses 10 to 12. R (version 4.1.0, R Core Team 2018) and the packages "lavaan" (version 0.6-8, Rosseel 2012) and semTools (version 0.5-4, Jorgensen et al. 2021) were used for confirmatory factor analysis and structural equation modeling.

4 Results

4.1 Descriptive statistics

Table 1 shows the descriptive statistics of the included scales.

4.2 Separability of the constructs

To show the validity and separability of all included constructs (cf. Fig. 1), we performed a confirmatory factor analysis. A confirmatory factor analysis (full information maximum likelihood) of all eleven included constructs where their respective items only loaded on the assumed factor revealed an acceptable fit for the assumed eleven-factor model ($X^2 = 3683.40$, df = 1473, $p < 0.001$, CFI = 0.88, RMSEA = 0.05, SRMR = 0.06). A latent correlation of 0.93 of NEP and AC led us to believe that both constructs can be understood as one factor. The 10-factor model had a similar model fit ($X^2 = 3733.03$, df = 1484, $p < 0.001$, CFI = 0.88, RMSEA = 0.05, SRMR = 0.06), that was significantly better than the 11-factor model ($\Delta X^2 = 49.63$, df = 11, $p < 0.001$). However, in line with the theoretical assumptions we decided to separate NEP and AC.

4.3 Structural equation model

Initially, structural equation models were calculated separately for the VBN model and the TPB in order to assess the individual explanatory value in each case. An unsatisfactory fit was obtained for the VBN model with $X^2 = 2501.52$, df = 892, $p < 0.001$, CFI = 0.88, RMSEA = 0.06, SRMR = 0.09. In contrast, a good fit was obtained for the TPB with $X^2 = 229.797$, df = 97, $p < 0.001$, CFI = 0.96, RMSEA = 0.06, SRMR = 0.07. In this model, social norm

[3] The calculation for the flight scenarios have been all calculated with the specific travel dates and route through the Compensaid algorithm (Compensaid 2020). Compensaid is considering factors like; flight distance, aircraft, kerosene consumption, seat load factor (expected) as well as average weight of passenger plus baggage and flight class.

Table 1 Descriptives and correlations of the included scales

Scale	M	SD	1	2	3	4	5	6	7	8	9	10	11
1. Biospheric value orientation[a]	5.70	1.23	–	–	–	–	–	–	–	–	–	–	–
2. Altruistic value orientation[a]	5.74	1.24	0.64	–	–	–	–	–	–	–	–	–	–
3. Egoistic value orientation	4.92	1.20	0.45	0.61	–	–	–	–	–	–	–	–	–
4. New ecological paradigm	5.84	0.88	0.62	0.55	0.40	–	–	–	–	–	–	–	–
5. Awareness of consequences	5.50	0.92	0.53	0.57	0.42	0.68	–	–	–	–	–	–	–
6. Ascription of responsibility	4.48	1.10	0.38	0.41	0.23	0.38	0.40	–	–	–	–	–	–
7. Personal norm	4.31	1.22	0.50	0.48	0.32	0.42	0.46	0.59	–	–	–	–	–
8. Green attitude	3.72	0.70	0.42	0.39	0.24	0.45	0.47	0.40	0.49	–	–	–	–
9. Social norm	2.71	0.92	0.25	0.29	0.21	0.14	0.26	0.37	0.52	0.34	–	–	–
10. Perceived behavioral control	3.28	0.71	0.21	0.15	0.08 ns	0.14**	0.17	0.24	0.31	0.31	0.21	–	–
11. Intention	4.98	1.27	0.46	0.39	0.25	0.35	0.32	0.42	0.71	0.48	0.40	0.30	–
12. Sustainable purchase behavior	2.38	0.85	0.33	0.29	0.13**	0.22	0.24	0.33	0.58	0.34	0.37	0.26	0.54

Notes. *M* mean value, *SD* standard deviation. All scales—except for social norm and perceived behavioral control (1 to 5)—had a response format from 1 to 7. All correlations are significant at the 0.001 level except those marked with a **(0.01 level) or with ns for "not significant"

($\beta = 0.242$, $p < 0.001$), green attitude ($\beta = 0.416$, $p < 0.001$), perceived behavioral control ($\beta = 0.156$, $p < 0.01$) predicted intention, which in turn predicted sustainable purchase behavior ($\beta = 0.579$, $p < 0.001$).

A structural equation model was computed using the full information maximum likelihood procedure which handles missing values as good as imputation procedures (Collins et al. 2001). There were $n = 2$ missing patterns which could not be handled because of too little information. The model had an unacceptable model fit ($X^2 = 4198.10$, df = 1513, $p < 0.001$, CFI = 0.86, RMSEA = 0.06, SRMR = 0.12). Following the approach of Saris et al. (2009), we therefore used the parameters expected parameter change (EPC) in combination with the modification index (MI) to search for meaningful model modifications. This resulted in one additional path (intention to personal norm, EPC = 0.470, MI = 133.945). This model had a slightly better model fit, which was now also close to the usual cut-off values (see Hu and Bentler 1999) in terms of SRMR ($X^2 = 3932.345$, df = 1512, $p < 0.001$, CFI = 0.87, RMSEA = 0.06, SRMR = 0.09). The detailed results were shown in Fig. 2. Contrary to the assumptions regarding hypothesis 1, the effect of egoistic value orientation was also positive, so that hypothesis 1 can be considered only partially confirmed. Apart from that, as assumed, all paths showed significant and confirmed hypotheses 2 to 9 in this respect.

4.4 Analysis of variance

We performed a three-way mixed ANOVA with two between-subjects factors (information richness, distance/price absolute) and one within-subjects factor (compensation model) to investigate hypotheses 10 to 12. The dependent variable was the probability (0–100%) of choosing the different compensation options. The analysis revealed a significant effect of the within-subjects factor ($F(2, 556) = 171.93$, $p < 0.001$, $\eta^2 = 0.21$): the more expensive the compensation models were the lower was the average probability (option 1: M = 59.11% > option 2: 41.77% > option 3: 25.96%). The between-subjects factors information richness ($F(1, 278) = 3.67$, $p = 0.06$) and distance ($F(1, 278) = 0.69$, $p = 0.41$) were not significant.

The conditions were manipulated so that compensation option 2 for the Seoul trip (long distance; 445 EUR) had a very similar price to compensation option 3 for the New York trip (short distance; 480 EUR) and in this respect the probabilities should be similar. However, an exploratory t-test comparing the two groups in terms of choice probabilities revealed a significant difference ($t(336) = -2.32$, $p = 0.021$, d = 0.26): The 445 EUR compensation option had a significantly higher probability value (M = 35.47%, SD = 24.56%) than the 480 EUR option (M = 28.89%, SD = 27.18%).

Regarding the interaction effects, all two-way interaction effects were not significant ($p > 0.05$). Only the three-way

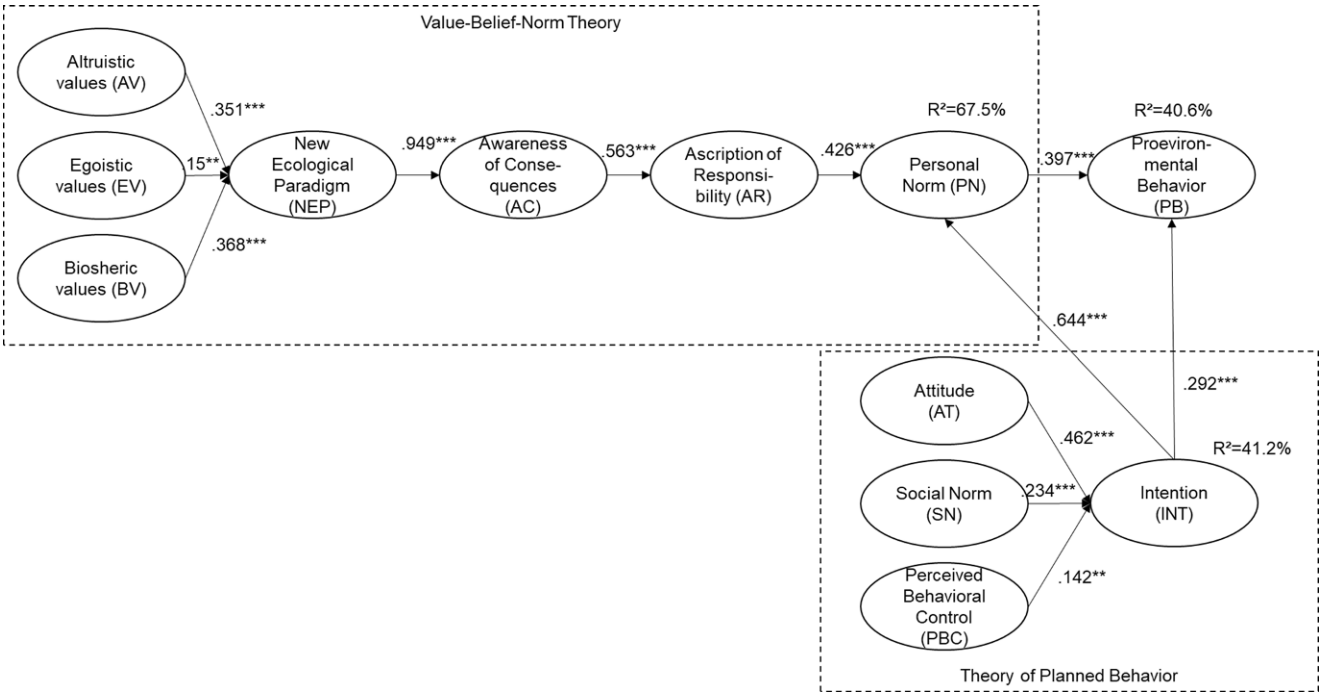

Fig. 2 Results of the SEM

interaction (F(2, 556) = 4.21, $p = 0.02$) also became significant. Approximately half of the Holm-adjusted post-hoc tests became significant ($p < 0.05$); however, no clear pattern of significant pairwise comparisons emerged. Descriptive results of the three-way mixed ANOVA are presented in Table 2.

4.5 Additional explorative analysis

To gain deeper insights into the factors influencing participants' choices of compensation packages, we analyzed the comments provided in a free-text field where participants were asked to explain their reasons for selecting a specific compensation option (under forced choice conditions). Out of the 514 survey participants, a total of 384 individuals offered comments in free-text format regarding their decision-making process for the compensation package. Three distinct categories emerged from these responses: 'environmentally conscious,' 'price conscious,' and 'skeptical.' Whereas the matching of the answers within the first two categories was due to strong opinions and argumentation, replies for the group 'skeptical' were sometimes two- or multi-folded, showing skepticism towards politics, meaning ascription of accountability, but also towards airlines and the effectiveness of the offered compensation measures. The assignment of each comment to one of these categories was based on the prevailing argument that guided their choice of compensation. For example, comments classified as 'Price conscious' included remarks like 'Financially not feasible, in the future with more salary, etc., I'd rather choose option 2,' or 'Probably due to lack of financial resources at the current moment of booking.' Some comments, such as 'If one had more financial leeway, I would prefer option 3, (...). Here you can see that you can contribute something good even with little money' showed elements of environmental awareness but were primarily motivated by financial considerations. In cases where comments were unclear, we cross-referenced them with the chosen compensation package. For instance, a comment like 'Although I would like to spend more money on the environment, it is not financially possible for me during my studies and in this economy' was categorized as 'Price conscious' because compensation package 1 (option 1) was chosen. For further examples, please refer to Table 3.

In total, we identified 71 statements falling under the 'environmentally conscious' category (18.45%), 269 statements in the 'price conscious' category (70.01%), and 44 statements in the 'skeptical' category (11.46%). Within the most represented category, 'price conscious,' several comments were exclusively centered around financial considerations, while others also factored in the price-sensitive nature of their occupation and, consequently, their disposable income.

Table 2 Descriptive results of the three-way mixed ANOVA (reported is the probability for the compensation options chosen by the participants)

Compensation model	Long Distance/High price	Information richness	N	M	SD
20% SAF (option 1)	No	Rich	66	56.44	27.10
	No	Reduced	69	64.93	26.32
	Yes	Rich	73	61.48	27.67
	Yes	Reduced	74	53.60	31.94
50% SAF (option 2)	No	Rich	66	44.92	27.46
	No	Reduced	69	43.88	23.88
	Yes	Rich	73	40.14	21.53
	Yes	Reduced	74	38.14	25.77
80% SAF (option 3)	No	Rich	66	31.67	29.62
	No	Reduced	69	25.33	23.23
	Yes	Rich	73	24.89	25.48
	Yes	Reduced	74	21.95	23.24

Table 3 Results of qualitative analysis on participants' reasons for choosing the compensation package

Category	Examples	Number of comments that primarily mentioned this reason
Environmentally conscious	"Fairness towards both projects, price-performance and bad conscience about high CO2 emissions during long-distance flights, costs rather irrelevant—environmental thought wins."	71
Price conscious	"The cheapest might be conceivable, but financially difficult at the moment."	269
Skeptical	"What does the compensation look like in concrete terms? I want to know what exactly the added value is used for: Purpose and goal." "Am not financially responsible for climate protection, this must be done through legal regulations and subsidies by the state."	44

5 Discussion

The study aimed to gain insights into the extent to which passengers are willing to compensate for their air travel and what influences their willingness and behavior to compensate. To this end, the study used a two-part questionnaire in which a structural equation model tested the combined assumptions of VBN theory and TPB. Essentially, all the assumptions of both theories could be confirmed: Personal norm as well as the three TPB factors social norm and attitude and behavioral control—these three mediated by intention—had a significant effect on behavior. The effect of the personal norm in addition to the social norm was also evident in other studies on the TPB model (e.g., Heib et al. 2023; White et al. 2009), with the effects of VBN theory (personal norm and the preceding effect chain) on behavior being stronger than the effects of TPB. However, surprisingly, egoistic value orientation also had a positive effect on NEP (and then ultimately on buying behavior via the effect chain according to VBN theory), whereas altruistic and biospheric value orientation having the larger effects. These found effects of the value orientations of the general compensation behavior were not consistent with the results from the second part of the study on the willingness to pay when booking a specific flight: Here, it was found that mainly the level of the price was decisive for the probability of choosing the compensation packages: the cheaper the package was, the higher the probability of choosing this package was which is consistent with previous findings on the low willingness to pay for such offers (Berger et al. 2022; Hinnen et al. 2017).

Further qualitative analysis of the responses to the open-ended questions confirmed that price sensitivity was by far the most frequently cited reason for choosing the offset package (for 70% of respondents it was the dominant reason), while environmental awareness was the decisive factor in only almost one in five cases. However, the analysis of variance showed no main effect of price (operationalized by flight distance): Regardless of whether participants were presented with the scenario with a with a medium flight and a ticket price of EUR 770 (with EUR 130–480 compensation costs depending on the option) or a long flight at a price of EUR 1200 (EUR 190–700 compensation costs), they chose the three compensation options offered with similar probabilities, although the prices differed in some cases by several hundred euros (EUR 220 for option 3). This is in line with the low-cost hypothesis of Diekmann and Preisendörfer (1998). Furthermore, it suggests an anchoring

effect due to the presented price for the booked flight (cf. Kim and Hyun 2020; Shan et al. 2020) and would at least question the generally low willingness to pay assumed so far. Overall, the results indicate in this respect that in concrete booking processes, the decision tends to fall on the option that appears to be the cheapest, regardless of how expensive it actually is.

5.1 Theoretical implications

Several theoretical implications can be derived from the study. First, the study provides further confirmation for the assumptions of VBN and TPB in the context of sustainable flight booking and shows that integrating the two theories increases variance explanation. With respect to VBN, however, there are two limitations: a) The egoistic value orientation, like the other value orientations, also had a positive effect. This is in contrast with prior research (Steg et al. 2005). One reason here could be that due to the increasingly concrete consequences of climate change, which can be experienced more and more frequently (e.g. more frequent heavy rainfall events such as the flood disaster in the Ahr valley in 2021, which can be attributed to climate change, see Tradowsky et al. 2023), sustainable behavior such as compensation behavior is now viewed as egoistic action. However, there is still a need for further research here. b) It was shown that New Ecological Paradigm and Awareness of consequences are virtually indistinguishable even at the latent level, with a latent correlation of 0.95, and to that extent the added value of this distinction can be questioned. Second, we were able to show that both theories can be combined. The study showed that different established theories such as TPB and the VBN can also be combined and lead to higher explained variance. Thus, the study can contribute to overcoming the unsatisfactory situation of the coexistence of two theories (cf. Bamberg et al. 2007) by showing that both can be combined to explain sustainable behavior in the context of flight booking. In this study, both theories were implemented according to the respective assumptions, thus going beyond the initial findings of previous studies (e.g., Fauzi et al. 2022). It also shows that the VBN constructs explains the greater proportion of variance for the behavior studied and thus, regarding norms, the personal norm appears to be more important than the social norm. This is in line with other findings, which also show that the personal norm is more important than the social norm for example for energy-saving behavior at universities (Heib et al. 2023). Therefore, an extension of the TPB to include the personal norm may be useful.

5.2 Practical implications

Several practical implications for flight providers can be derived from the study's findings. First, the results suggest that the pricing and structure of flight compensation packages have a significant impact on passengers' decisions. Airlines should design their prices and compensation packages to be affordable for customers. It seems that a lower price increases the likelihood that customers will choose to offset. Second, it appears that although price has a strong influence on passengers' decisions, the personal norm (and especially the preceding altruistic and the biospheric value orientations) plays a particularly important role—even compared to the social norm. Airlines should include carbon offset information in their booking processes and be transparent about the environmental impact of flying to encourage customers to choose offset options when they are better informed about the environmental impact. Previous research has also shown that normative framing is most effective (e.g., Hafner et al. 2019). Third, the study shows that customers often choose the option that seems cheapest, regardless of how expensive the flight is. So, customers may not always consider the real environmental impact of their actions. Airlines could work to align the perception of price with environmental impact by emphasizing the positive environmental impact of offsetting, even if it is slightly more expensive. This could help raise awareness of environmental impacts and motivate customers to make more conscious choices about environmentally friendly options. Lastly, it should be said that as the scalability of SAF production and therefore usage of the special fuel is as of today very limited, the industry is looking into further ways of reducing the impact on the environment by offering to end consumers also carbon offset programs, but also to reduce emissions within operations directly by optimizing onboard materials of the hard product and aircraft technology enhancements (ICAO 2019). Overall, major savings depend largely on major political and practical changes in air travel (Scott et al. 2010).

5.3 Limitations and future directions

A key limitation of the study is the cross-sectional design, which limits the interpretation of the SEM's chain of effects. Future studies should, if possible, re-examine this chain of effects longitudinally in order to enable causal statements to be made. The analysis of willingness to pay via the experimental design is not affected by this limitation: Here, a randomized assignment to four conditions took place, so that the interpretation here can be causal. Potential confounding variables should have been largely eliminated by the complete randomization.

There are also a few aspects relating to the instruments used that should be taken into account in future studies through various adjustments and considerations. With regard to value orientations, the items used by Ciocirlan et al. (2020) assume that people are concerned about environmental issues while trying to measure value orientation (which may not apply to some people). Other operationalizations formulate the items without this prerequisite (e.g. Snelgar 2006). There are also reasons for using a general attitude (i.e. green attitude) to predict a specific behavior (i.e. co2 compensation behavior) (e.g. exogeneity, which is important for causal inferences, see Kroesen and Caurus 2018), but it contradicts the correspondence principle (e.g. Kaiser et al. 1999). The same considerations also apply to the variables awareness of consequences, the ascription of responsibility, and perceived behavioral control.

Additionally, it should also be noted that the sample did not correspond to the normal population in terms of composition of gender (predominantly female), age (rather young) and education (very high level of education) as well as in terms of professions (medical/healthcare industry and social and cultural services accounted for more than 40%). Female gender (which is more often associated with part-time employment) and young age (professional experience may not yet be as high) may be related to below-average income and thus confound the results.

Furthermore, the results on willingness to pay must be interpreted in the context of increased price sensitivity due to high inflation during the survey period (e.g., 7.4% in March 2023, see Statistisches Bundesamt, 2023b). In addition, the income of the respondents was predominantly EUR 3000 and below. Even if this is in the range of the average income in Germany (about 2300 EUR in 2022, Statistisches Bundesamt, 2023a), the shown prices of 770 or 1200 EUR plus the compensation package make up a very high proportion given the high cost of living at that time. It is possible that the prices were so high for the respondents in the survey situation that additional expenditures for CO2-saving compensation packages were not realistic. Another reason may be that the external costs are currently not adequately priced into most products (see e.g. for agricultural products Michalke et al. 2023), which can lead to increased price sensitivity for such "true costs", as recently became clear in a field experiment at the large German food retailer Penny (Universität Greifswald, 2024). Future studies could solve these problems by several measures: They should explicitly assess if participants can actually pay such an expensive flight ticket in their current life situation, ensure that the sample is representative in terms of income and additionally use case vignettes with lower flight prices (e.g. for significantly shorter flights). It would also be interesting to offer the option of not selecting any of the compensation options.

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Prof. Dr. Timo Kortsch studied psychology and teaches as Professor of Business Psychology at IU International University. His research focuses on learning and learning culture in companies, happiness at work, interventions for stress prevention and sustainability. He also advises companies with scientifically sound approaches for the successful implementation of transformation projects.

Phyllis Händeler studied Aviation Management and Organisational Psychology at IU International University. While currently working for one of the largest European airline groups focusing on enhancing and increasing adaptation of new distribution solutions, recent thesis unified the passion for aviation and the interest on creating a more sustainable way of flying for generations to come.