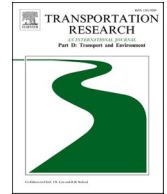




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## Reducing personal air-travel: Restrictions, options and the role of justifications

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### ABSTRACT

An integrative environmental behavior model was applied in an online survey to investigate the determinants of intentions to reduce personal air travel and corresponding perceived restrictions and options among participants in Switzerland (N = 1206). Flying habits emerged as the most powerful predictor of air travel intentions, followed by prescriptive social norms, general environmental attitudes, flight-specific personal norms, and acceptance of general justifications for environmentally negative behavior. The overall model achieved substantial explanative power (multiple R = 0.75). Availability of alternative means of transportation was most frequently mentioned as requirement for reducing personal flights, and participants proposed replacing physical business meetings with online formats. Trains were often proposed as alternative transportation mode; however, concerns regarding travel duration and price constrain their use. Faster connections, attractive pricing, and measures facilitating the enjoyment of lengthier travel times could help reduce the number of flights and contribute toward deceleration of life.

### 1. Introduction

Global air traffic has substantially increased over the last decades, and further growth has been predicted for the coming years (Federal Aviation Administration, 2016; Yang et al., 2018). These surges have contributed to increasing emissions of green-house gases that contribute to global warming (Hepting et al., 2020; Lu and Shon, 2012; Lu and Wang, 2018). Air traffic also influences global climate in this direction via cloud formations from vapor or condensation trails (EPA, 2000). Persistent contrails and intensified cirrus cloudiness induced by air traffic tend to trap outgoing longwave radiation emitted from the earth at a greater rate than they reflect incoming solar radiation (Lee et al., 2009; Ponater et al., 2005; Travis et al., 2002). Current models predict that the global economic recovery following the corona crisis will trigger a massive increase in air traffic volume (Chen et al., 2020).

Apart from global warming impacts, increasing air traffic volumes has additional negative environmental impacts. Emissions of noxious pollutants (e.g. NO<sub>x</sub>, SO<sub>2</sub>, volatile organic compounds [VOCs], CO, particulate matter [PM] and black carbon) substantially reduce air-quality in areas surrounding large airports and contribute to severe physical diseases and premature mortality (He et al., 2018; Hepting et al., 2020; Shirmohammadi et al., 2017; Targino et al., 2017). Flight-related noise emissions can cause stress, sleeping disorders, and depression and thereby threaten the health of millions of persons by reducing well-being and quality of life (Basner

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et al., 2017; Hahad et al., 2019; Soeta and Kagawa, 2020). Therefore, transformative policy measures, transportation technology and infrastructure development projects, and societal changes reorienting social norms, values and lifestyles to promote pro-environmental changes such as reducing personal flight travels are required to decrease the amount of air traffic and its negative impacts (Barr and Prillwitz, 2014; Cohen and Kantanbacher, 2020).

This study aims (i) to gain a better understanding of determinants of behavioral decisions regarding air travel, and (ii) to analyze the restrictions and options consumers perceive for reducing their air travel in order to (iii) gain insights for the development of corresponding measures, communication strategies and policy recommendations to reduce air travel.

### 1.1. Previous research and the model of justified behavior (MJB)

An obvious approach towards decreasing private air traffic is implementing policy measures to increase ticket prices such as the introduction of emission related CO<sub>2</sub> taxes for flights, additional (e.g. aircraft noise-related) eco-landing or eco-airport taxes, the removal of existing subsidies for air traffic, the abolition of frequent flyer offers, or restrictions on cheap flight offers (e.g. by enforcing minimum prices etc.; Buchert et al., 2001; Denstadli and Veisten, 2020; Gössling et al., 2017; Gössling and Nilsson, 2010; Huang and Rust, 2011). However, the effectiveness of such financial measures may be limited (cf. Gama, 2017), and they tend to primarily restrict air-travel of less wealthy persons, thereby conflicting with the social justice pillar of sustainability (Böhler et al., 2006; Hamilton, 1996; Seyfang and Paavola, 2008). Higher-income earners fly more frequently than those with lower incomes, and imposing additional taxes and increasing flight prices would enlarge this divide and further reduce the possibilities for less wealthy people to access distant locations (Bruderer Enzler, 2017).

Furthermore, relegating flying to a high-cost upper class transportation mode could also enhance the social prestige of this activity, thereby resulting in a rebound effect that may end up actually countering the effects of financial measures. In addition, public political discussions and announcements of measures to increase flight prices could trigger additional rebound effects, as some people may try to take advantage of comparably low airfares when realizing that substantial increases of prices can be expected in the near future. A corresponding environmentally negative announcement effect in connection with such measures must therefore be expected (Riekhof and Bröcker, 2017; Sprenger, 2000). According to Van der Werf and Di Maria (2011), agents “may be induced to increase their emissions in the interim phase between announcement and implementation” when they “know that at some future date emissions of carbon dioxide will be subject to a tax or cap” (p. 14).

The above-mentioned considerations indicate the need to develop and implement complementary incentive measures aiming at the improvement (e.g. of travel comfort, booking services, options to use travel time productively), acceleration (e.g. high-speed trains), and extension (e.g. more and more direct connections) of alternative mobility offers via bus, train or ship and to facilitate corresponding price reductions (e.g. through subsidies allowing lower travel prices and special offers) to increase the attractiveness of eco-friendly transportation services (Buchert et al., 2001; Dällenbach, 2020; Gama, 2017). However, addressing the problem of flight reduction by influencing individual mobility decisions may ignore the importance of broader societal transformations and social practices (Barr and Prillwitz, 2014).

Changes in mobility patterns could be regarded as co-transformations of life- and work styles involving a sustainability-based reorientation from efficiency principles towards sufficiency principles and novel approaches towards time management such as decelerations of life and mobility (Buchert et al., 2001; Chen, 2017; Lumsdon and McGrath, 2011). Therefore, when considering societal changes and social practices reflected in individual mobility choices, it is important to investigate the determinants of behaviors related to flight travel and understand in which cases or under what conditions travelers consider flights to be dispensable (Böhler et al., 2006; Gössling et al., 2019; Ölander and Thøgersen, 1995).

Previous research has shown that economic factors, social influences, and the distance of travel destinations as well as psychological variables influence choices of transport modes. Pro-environmental attitudes, norms, and values promote ecologically friendly mobility choices eschewing car or air travel (Bamberg, 2013; Böhler et al., 2006; Bruderer Enzler, 2017; Davison et al., 2014; Hunecke et al., 2001; Morten et al., 2018). These findings are in line with general environmental behavior models such as the theory of planned behavior (TPB; Ajzen, 1991, 2012; Lanzini and Khan, 2017; Morten et al., 2018; Sun, 2019), the theory of interpersonal behavior (Ibrahim et al., 2018; Triandis, 1977, 1980), or the needs-opportunities-abilities model (Gatersleben and Vlek, 1998; Reisch, 2003), which hold that attitudes, personal norms, subjectively perceived social norms, and further variables reflecting restrictions and options or perceived behavioral control influence intentions and behaviors. However, studies also evince substantial inconsistencies between environmental consciousness and values and environmental behavior in particular regarding mobility choices (BMU, 2004; Davison et al., 2014). Since environmental behaviors involve moral dimensions, it seems important to consider personal moral norms in addition to economic considerations and expected utilities (Ellemers et al., 2019; Muro-Rodríguez et al., 2017). Accordingly, some scholars have recommended adding a moral component to the TPB (e.g. Kaiser, 2006; Kaiser and Scheutle, 2003; Sun, 2019), which is currently the most frequently applied environmental behavior model. Such factors seem crucial, as feelings of moral obligation and the resulting (expected) experience of positive emotions that can accompany corresponding personal psychological and/or financial sacrifices (e.g. when accepting longer travel time and higher price for a train-ticket compared to the flight option) have been shown to motivate the relinquishment of flight travel (Araghi et al., 2014; Choi et al., 2018; Gössling et al., 2019; Schwirplies et al., 2019; Schwirplies and Ziegler, 2016). Various studies have used the neutralization theory (NT) introduced by Sykes and Matza (1957) as a lens to investigate psychological justifications as crucial determinants of environmental behavior decisions with moral implications (Andersson, 2020; Chatzidakis et al., 2007; Diekmann and Preisendörfer, 1992; Fritsche, 1999; Hansmann et al., 2006; Hansmann and Steimer, 2015, 2017; Schahn et al., 1995; Uba and Chatzidakis, 2016; Zhang et al., 2018).

Hansmann and Steimer (2015, 2017; also see Goldman et al., 2020) integrated requirements for environmental behavior models

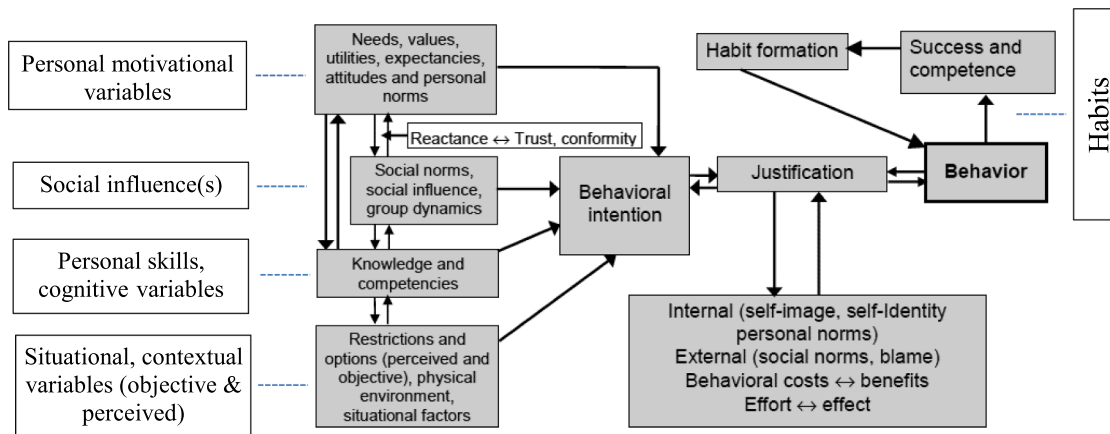


Fig. 1. Schematic depiction of the model of justified behavior developed by Hansmann and Steimer (2015, 2017) and Goldman et al. (2020) integrating different classes of causal variables determining environmental behaviors (cf. Stern, 2000) with neutralization theory (Sykes and Matza, 1957).

described by Stern (2000) with components of NT to develop the MJB, which regards personal motivational variables (e.g. attitude, values, expected utilities, personal norms), social influences (e.g. group norms and dynamics, subjectively perceived social norms, social interaction), personal skills and knowledge (Lu and Wang, 2018), situational restrictions and options (cf. Thorhaug et al., 2020), and justifications and habits (cf. Lanzini and Khan, 2017) as important determinants of behavioral intentions and environmental behavior (Fig. 1). The MJB thus incorporates various determinants of environmental behavior included in well-established models such as the norm-activation model (NAM) by Schwartz (1977; De Groot and Steg, 2009), the theory of interpersonal behavior introduced by Triandis (1977, 1980; Ibrahim et al., 2018), the TPB (Ajzen, 1991, 2012; Sun, 2019), the model motivation-opportunity-ability model (Ölander and Thøgersen, 1995; Zhang and Lang, 2018), and needs-opportunities-abilities model (cf. Gatersleben and Vlek, 1998; Reisch, 2003).

## 2. Conceptual frame and hypotheses of this study

The MJB was applied as conceptual frame in this study because it seemed ideal to investigate a broad range of possible determinants of air travel behavior identified by previous research while also incorporating a consideration of moral aspects related to justification tendencies. The MJB also represents a somewhat open framework that allows for an explorative investigation of restrictions and options for reducing flights. On this basis, we investigated in which situations and/or under what circumstances avoiding flights seemed feasible for the study participants, which we deemed crucial for developing concrete recommendations for transformative measures and approaches including psychological, societal, and communicative as well as technological, infrastructure and management interventions. However, only selected parts of the MJB as depicted in Fig. 1 were considered in this study as no longitudinal data on behaviors, persistence of intentions, and habit formation over time were obtained in the survey.

We expected that the explanatory MJB variables considered in this study would substantially contribute to predicting the intention to reduce personal air travel. Seven hypotheses referring to different classes of causal determinants distinguished by the model were formulated to express the expectations that:

1. personal motivational variables (personal norms and general environmental attitudes; *Hypothesis 1*);
2. social influence variables (prescriptive and descriptive social norm; *Hypothesis 2*);
3. personal skills and cognitive variables (education level and environmental knowledge; *Hypothesis 3*);
4. contextual variables (income; *Hypothesis 4*);
5. justifications as a central element of the model (*Hypothesis 5*); and
6. habits (*Hypothesis 6*)

are significant predictors of participants' intention to reduce their air travel.

The relevance of these different types of variables as causal determinants of PEBs has been substantiated by previous research, as described above (cf. Stern, 2000). However, there are manifold ways to operationalize these types of variables, as a vast multitude of contested psychological constructs and situational factors are potentially relevant. Accordingly, an explorative aspect of this research was to incorporate an open question format to identify psychological and/or situational, contextual factors that open up possibilities for reducing personal air travel. A further approach to investigate the completeness of the formulated prediction model and determine whether further relevant factors for explaining intentions to reduce personal air travel need to be considered was the incorporation of demographic variables (gender, age) in the prediction model. Thus, the inclusion of gender and age in the statistical model also served an explorative purpose.

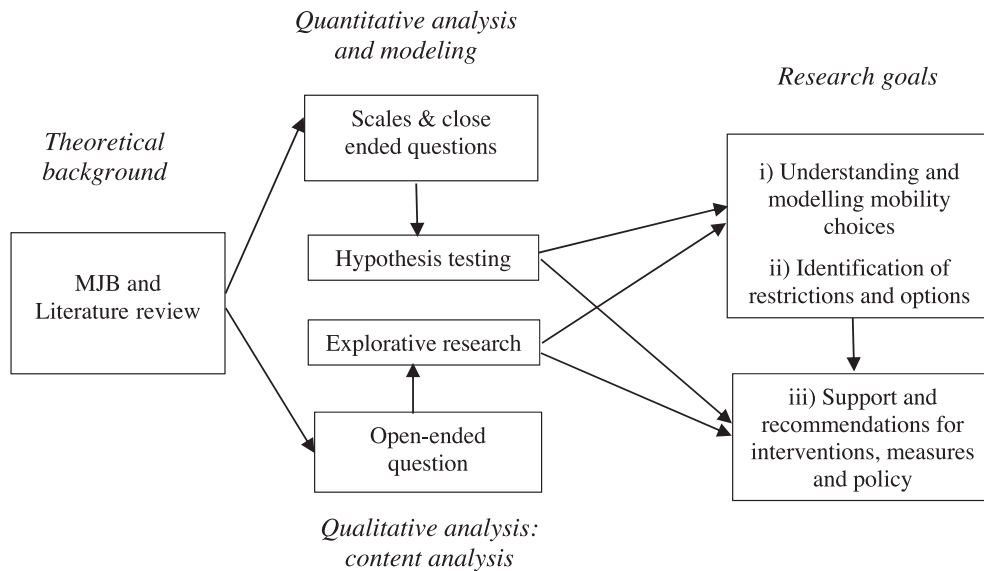


Fig. 2. Schematic representation of research design, methodology and study goals.

Two additional model-related hypotheses were formulated in relation to the personal norms of the participants. The personal norm *not* to take advantage of currently rather low flight fares under the assumption that prices will be increased in the future for pro-environmental reasons was investigated. Discussions of policy measures employing financial instruments to increase air ticket prices (e.g. taxation of flights by CO<sub>2</sub> taxes) have long been underway in Switzerland and other European countries (e.g. Baranzini et al., 2004; Denstadli and Veisten, 2020). This raises the question of whether the discussion and expectation of such measures have elicited negative environmental rebound effects (herein termed negative announcement effects) in the sense that travelers will take advantage of currently low prices and fly more frequently to amply use the time left for cheap flights, which would be diametrically opposed to reducing personal air travel. A prediction model for this personal norm was formulated using the other explanatory MJB variables as predictors. Based on process assumptions of the NT (Sykes and Matza, 1957), which represents a main theoretical basis of the MJB, two specific hypotheses were formulated in this regard.

NT assumes that rationalizations for norm violations in the past can serve as neutralizations that deactivate personal norms in relation to similar norm deviations in the future. Negative environmental behaviors may thus be stabilized over time in a hardening process and can thus become environmentally harmful habits (Agnew, 1994; Hirschi, 1969; Minor, 1984; Topalli et al., 2014). Accordingly, it was assumed that justifications and resulting habits of negative environmental behavior may weaken and deactivate positive personal norms as formulated in the following hypotheses.

7. It was assumed that justifications for negative environmental behavior would weaken the personal norm not to capitalize on low flight fares (*Hypothesis 7*).
8. It was expected that the habit of frequent flying in the past would weaken the personal norm not to exploit currently low flight prices (*Hypothesis 8*).

By testing these eight hypotheses, we aim to understand people's intention to reduce the number of their flights better and gain valuable information for the development of measures to support a corresponding behavioral change. In this regard, the MJB is used as heuristic framework to enable the specification, application and testing of an integrative explanatory model as well as to facilitate an explorative investigation of qualitative elements that may reveal novel factors helpful for the design of corresponding measures.

### 3. Method

#### 3.1. Study design, survey implementation and participants

We implemented a mixed method survey study combining quantitative modeling and hypotheses testing with explorative qualitative research methods employing an open question format to better understand mobility choices, identify restrictions and options for reducing air-travel and inform the development of corresponding measures (Fig. 2).

The online survey began on October 25th and ended November 19th 2019. The participants were recruited based on a random sample from the resident population of the German and French language regions of Switzerland restricted to persons with internet access and in the age range of 18–74 years. The prospective participants were asked whether they like to participate in a survey on environmental topics. Participation was voluntary and participants received no payment. Corresponding invitations and links for

**Table 1**  
Descriptive statistics for motivational variables, social norms, and psychological capability variables.

Scale	N	M	SD
<i>Behavioral intention</i> : Intention to do without or reduce air travel in the future for the sake of the environment <sup>a</sup>	1112	2.85	1.03
<i>Personal norm</i> : One should take advantage of current low airfares <sup>b</sup>	1156	3.40	0.88
<b>General environmental attitudes scale</b> <sup>c</sup>	1206	3.08	0.57
<i>Social norm</i> (item A, injunctive/prescriptive): Friends and acquaintances expect you to avoid or reduce air travel in the future <sup>a</sup>	1005	2.13	0.88
<i>Social norm</i> (item B, descriptive): Friends and acquaintances take advantage of the current low air fares and visit many more attractive destinations before air fares rise significantly in the coming years? <sup>b</sup>	1156	3.40	0.88
<i>Education level</i> (no degree = 0 vs. academic degree = 1)	1204	0.37	0.48
<i>Subjective knowledge</i> : Level of knowledge on environmental issues/protection compared to Swiss population <sup>d</sup>	1190	3.49	0.77
<i>Income</i> (low = 0 vs. high = 1)	1042	0.56	0.50
<b>Justification scale</b> <sup>e</sup>	1206	1.92	0.58
<i>Habit</i> : When I take a holiday, I travel by plane to my holiday destination. <sup>f</sup>	1194	3.29	1.46

Note: The responses “I do not want to respond” or “I do not know” were considered missing values; thus, *N* varies between items. Scale values were calculated including estimated missing values; accordingly, *N* = 1206.

<sup>a</sup> scale: 1 = no to 4 = yes.

<sup>b</sup> reverse scale from 1 = yes to 4 = no.

<sup>c</sup> scale from 1 = low to 4 = high environmental concern.

<sup>d</sup> scale from 1 = clearly below to 5 = clearly above average.

<sup>e</sup> scale from 1 = low to 4 = high acceptance of justifications for negative environmental behaviors.

<sup>f</sup> scale from 1 = never to 6 = very frequently.

survey participation were sent via email, and participants could choose whether they like to respond to the German or French version of the questionnaire.

A total of 1219 people filled out the survey completely. A minimum duration of six minutes for answering the survey was defined as a basic quality criterion for deliberate responses to exclude persons responding to the survey items superficially without consideration of the content of the items. The responses of thirteen participants were excluded from the data analysis since they did not meet this quality requirement. Thus, the answers of a total of 1206 persons were included in the data analysis. However, some items contained answer options such as “I do not know” or “not applicable,” which were considered missing values (or replaced by missing value estimates) in the statistical analyses.

The gender distribution was 51.1% male and 48.9% female, and ages ranged from 18 to 74 years (*M* = 47.6 years, *SD* = 15.04). The percentage of academics with university or polytechnic degrees (MSc, BSc, Diplom, Magister) was 36.6%, whereas 63.3% stated that they had no academic degree and 0.2% (*N* = 2) did not answer the question on highest completed education. The median household income of participants living with their partners or parent(s) was in the range category of 9000–12,000 CHF per month, and the median individual income of other participants was in the range from 5000 CHF to 7000 CHF per month (1 CHF ≈ 1 USD at the time of the survey). The income values were additionally divided by the number of persons living in the household to arrive at a unified measure of income per person. An integrative, dichotomous variable generated on this basis distinguished between 44.1% of the participants having less than 5000 CHF per month at their disposal (low income group) and 55.9% having 5000 CHF or more at their disposal (high income group).

### 3.2. Questionnaire content

The online survey started with socio-demographic variables such as gender, age, education level, and income, followed by various questions addressing the Fridays for Future movement and various other environmental behaviors which served research purposes not focused on in this study. Next were items specifically addressing the topic of flight travel, followed by questions assessing more general possible determinants of environmental behavior such as general environmental attitudes and acceptance of justifications for environmentally negative behaviors. The items and the scales they formed will be described according to their conceptual role within the MJB, starting with the dependent variable(s) to be predicted followed by the explanatory components, i.e. personal motivational variables, social influences, personal skills and knowledge, contextual restrictions and options, and justifications and habits. The mean values of the corresponding single item variables and scales are listed in Table 1 (for descriptive statistics of individual items within scales see Appendix Table A1).

#### 3.2.1. Behavioral intention and personal motivational variables

The main dependent variable was participants' intention to reduce their personal air travel in the future, which was measured through the item “Do you intend to do without or reduce air travel in the future for the sake of the environment?” (response scale 1 = no, 2 = rather no, 3 = rather yes, 4 = yes; additional response options: “I do not know” or “not applicable”).

The personal motivational constructs serving as explanatory variables were personal norms and general environmental attitude. A personal norm closely related to the reduction of personal air travel was measured through an item querying participants' level of agreement with whether “one should take advantage of the current low airfares and visit many more attractive destinations under the assumption that airfares will be increased significantly in the coming years through taxes for environmental reasons?” (scale from 1 = yes to 4 = no; with higher values thus representing a stronger pro-environmental personal norm). This personal norm also served as the



dependent variable to be explained within a separate complementary analysis focusing on the relationship between general attitudes, justifications, and habits on the one hand and personal norms on the other.

As a further personal motivational variable, general attitudes towards the environment were assessed through five items taken from an environmental concern scale by Diekmann and Preisendörfer (2001); Diekmann et al. (2009)), to which an additional item was added querying participants' level of agreement with the statement "Environmental protection is very important to me." All six items (see Appendix, Table A1) were scored using the same four-point response scale (1 = strongly disagree, 2 = somewhat disagree, 3 = somewhat agree, 4 = strongly agree).

### 3.2.2. Social influences

Subjectively perceived norms of important others in participants' social networks were measured by the two items "What do you think: Do many of your friends and acquaintances expect you to avoid or reduce air travel in the future for the sake of the environment?" (prescriptive social norm: what others expect us to do) and "What do you think: Will most of your friends and acquaintances take advantage of the current low air fares and visit many more attractive destinations before air fares rise significantly in the coming years?" (descriptive social norm: what others do). The response scale for both items ranged from 1 = yes to 4 = no for the former item and was reversed for the latter item such that in both cases higher values denoted stronger pro-environmental social norms.

### 3.2.3. Personal skills and knowledge

Participants' education level (with vs. no academic degree) and self-evaluated knowledge concerning environmental problems were assessed as measures of personal skills and knowledge. The latter was measured by the item "How do you rate your level of knowledge on environmental issues and environmental protection compared to the average Swiss population?" using a five-point response scale (1 = clearly below average, 2 = rather below average, 3 = average, 4 = rather above average, 5 = clearly above average).

### 3.2.4. Contextual restrictions and options

Participants' income level was considered as a possible contextual restriction and option for reducing flights. Persons living with their partners or parent(s) were asked about their commonly available household income and other participants were asked about their individual income. To arrive at a single predictor variable for all participants, a dichotomous variable distinguishing between high and low incomes was formed on this basis. Further contextual restrictions were explored using the open question "In which cases, respectively under which conditions could you do without air travel or reduce it?" Responses to this question were not included in the statistical behavior model but rather analyzed through a quantitative–qualitative content analysis to better understand participants' personal requirements and mental models and to thereby inform conclusions and recommendations on how to best reduce flight travel through diverse transformative measures.

### 3.2.5. Justifications and habits

Participants' justifications for environmentally harmful behaviors were examined with what we term the Justification of Negative Environmental Behaviors (JNEB) scale, which requests agreement ratings for four statements—for example, "I behave very environmentally friendly in most areas of life, so it is also okay if I pollute the environment by some behaviors" (response scale: 1 = do not agree at all, 2 = rather disagree, 3 = rather agree, 4 = I fully agree). All questionnaire items and the Cronbach's alpha reliability of the resulting justification scale are shown in the Appendix (Table A1). Participants' flying habits were measured by asking them how often they travel by plane to their vacation destinations (response scale: 1 = never, 2 = very rarely, 3 = rarely, 4 = occasionally, 5 = frequently, 6 = very frequently).

## 3.3. Statistical analyses

IBM SPSS Statistics (Version 26 for Mac) was used to analyze the data. The eight hypotheses were tested by two multiple linear regressions explaining (1) the intention to reduce flights in the future (Hypotheses 1–6), and (2) the personal pro-environmental norm of not taking advantage of currently low flight prices based on the expectation of future increases (Hypotheses 7,8). Both, non-standardized (b) and standardized ( $\beta$ ) weights of the predictors within these regression models are reported, because  $\beta$ -weights allow a better comparison between predictors and b-weights denote the concrete prediction model. Two-sided testing on the level of  $\alpha = 0.05$  was employed. To avoid an accumulation of missing values in the analyses, the responses "I do not want to respond" or "I do not know" (which were excluded from the numeric response scales) were replaced by the overall mean of numerical responses for the respective item. The same procedure was applied to numerically coded dichotomous variables (e.g. non-academics = 0 vs. academic degree coded = 1). Responses to the open question addressing options and conditions that would allow for the reduction of flights were analyzed with a qualitative and quantitative content analysis based on the formation of various mutually non-exclusive categories. The categories and assignment rules were defined partially theory-driven and partially data-driven, based on previous mobility literature and a first screening of the responses. Issues and ambiguities emerging during the subsequent coding were discussed and resolved through consensual decisions on assignments. Chi-square tests were calculated for the explorative investigation of relationships between the categories that were formed.

**Table 2**  
Results of a linear regression analysis on the behavioral intention to reduce flights.

	b	SE(b)	$\beta$	t	Sig. p	(r bivariate)
(intercept)	1.482	0.270		5.480	0.000	
<b>Personal norm</b> (not to take advantage of current cheap flights)	<b>0.201</b>	<b>0.031</b>	<b>0.169</b>	<b>6.413</b>	<b>0.000</b>	(0.45***)
<b>General environmental attitudes</b>	<b>0.423</b>	<b>0.046</b>	<b>0.239</b>	<b>9.265</b>	<b>0.000</b>	(0.52***)
<b>Prescriptive social norm</b> (highly specific for the dependent variable): Expectation of friends to reduce flights	<b>0.326</b>	<b>0.027</b>	<b>0.259</b>	<b>11.988</b>	<b>0.000</b>	(0.46***)
Descriptive social norm (less specific): Friends do not take advantage of cheap flights	-0.049	0.029	-0.038	-1.686	0.092	(0.08*)
Education level (non-academic = 0 vs. academic degree = 1)	0.009	0.046	0.004	0.202	0.840	(0.05 <sup>n.s.</sup> )
Subjective environmental knowledge	0.012	0.030	0.009	0.416	0.677	(0.21***)
Income (low = 0 vs. high = 1)	-0.029	0.048	-0.013	-0.606	0.545	(-0.05 <sup>n.s.</sup> )
<b>Justification scale</b> <sup>a</sup>	<b>-0.219</b>	<b>0.047</b>	<b>-0.122</b>	<b>-4.660</b>	<b>0.000</b>	(-0.50***)
<b>Habit</b> (traveling by plane to holiday destinations)	<b>-0.236</b>	<b>0.017</b>	<b>-0.333</b>	<b>-14.173</b>	<b>0.000</b>	(-0.52***)
Gender (male = 1, female = 2)	0.067	0.043	0.033	1.542	0.123	(0.12***)
Age (years)	-0.003	0.001	-0.041	-1.871	0.062	(0.09**)
Mult. R (R <sup>2</sup> ; adjusted R <sup>2</sup> )	0.75	(0.56;	0.55)			

Both, non-standardized (b) and standardized ( $\beta$ ) weights of the predictors within the regression model are reported. The exact *p* values (sig. *p*) of the weights within the regression model represent the basis of the hypothesis tests. Values of statistically significant predictors are printed in bold. The last column shows supplementary bivariate correlations between predictors and intention.

\**p* < .05, \*\**p* < .01, \*\*\**p* < .001 refer to the bivariate correlations (printed in brackets) that were supplementary conducted and were not considered relevant for the testing of the hypotheses.

## 4. Results

### 4.1. Descriptive statistics of dependent and explanatory variables

Participants' behavioral intention to reduce their future air travel was quite pronounced. Among the 1112 persons who provided numerically interpretable responses to the corresponding item, 66.8% responded with "yes" (32.2%) or "rather yes" (34.6%), whereas only 33.2% responded with "rather no" (18.9%) or "no" (14.3%). The average rating on the four-point scale was *M* = 2.85, which is close to the response option "rather yes" (=3).

Consistent with the above, participants broadly shared the personal norm *not* to take advantage of currently relatively low flight ticket prices. A substantial majority of 84.8% stated that one should "not" (61.1%) or "rather not" (23.7%) take advantage of low flight prices, whereas only 15.2% said that one should exploit this advantage (9.4% "rather yes" and 5.8% "yes") and visit multiple attractive destinations before prices are increased by environmental taxes.

The mean values of further explanatory variables used in the subsequent multiple regression model to predict participants' behavioral intentions to reduce personal air travel in the future are depicted in Table 1. As it shows, whereas most of these variables were measured using single items, two were assessed using scales. The mean values of responses to the single items included in the two scales are presented in Table A1 of the Appendix along with results of the corresponding Cronbach's alpha reliability analyses, which resulted in an  $\alpha$  of 0.8 for the general environmental attitude scale and 0.7 for the justification scale.

The mean value of 3.1 on the general environmental attitude scale reflects a rather high level of environmental concern, and the mean value of 1.9 on the justification scale reflects a low level of agreement with justifications for negative environmental behaviors. The mean value of 3.5 on the scale measuring participants' subjective self-evaluated knowledge of environmental issues is significantly higher than the knowledge of an average person of the Swiss population. A corresponding one sample *t*-test comparing the actual ratings to the mid-point of the five-point scale (*M* = 3) representing the knowledge of an average person of the Swiss population resulted in *p* < .001. The average rating of the frequency of participants' past holiday flights was *M* = 3.3, which corresponds to "rarely" (=3) with a tendency towards "occasionally" (=4). However, 11.6% and 7.9% of the participants stated that they "frequently" and "very frequently" travel by airplane to their holiday destinations, respectively.

### 4.2. Linear regression model for the intention to reduce flight travel

Table 2 shows the results of the linear regression model regarding the intention to reduce flight travel. Two determinants, namely habits ( $\beta$  = -0.33) and justifications ( $\beta$  = -0.12) evince significant negative beta-weights and thereby indicate higher resistance to reducing flights, and indeed, the habit variable has the highest standardized absolute beta-value of all determinants. Determinants supporting the intention to reduce flight travel are prescriptive social norms ( $\beta$  = 0.26), general environmental attitude ( $\beta$  = 0.24), and the personal norm not to take advantage of current cheap flights ( $\beta$  = 0.17), all of which are highly significant (*p* < .001). Thus, hypotheses 1, 5 and 6 were confirmed. However, hypothesis 2 referring to social influence was only partially confirmed, namely in relation to prescriptive social norms. On the contrary, descriptive social norms did not significantly contribute to the prediction of participants' behavioral intention.

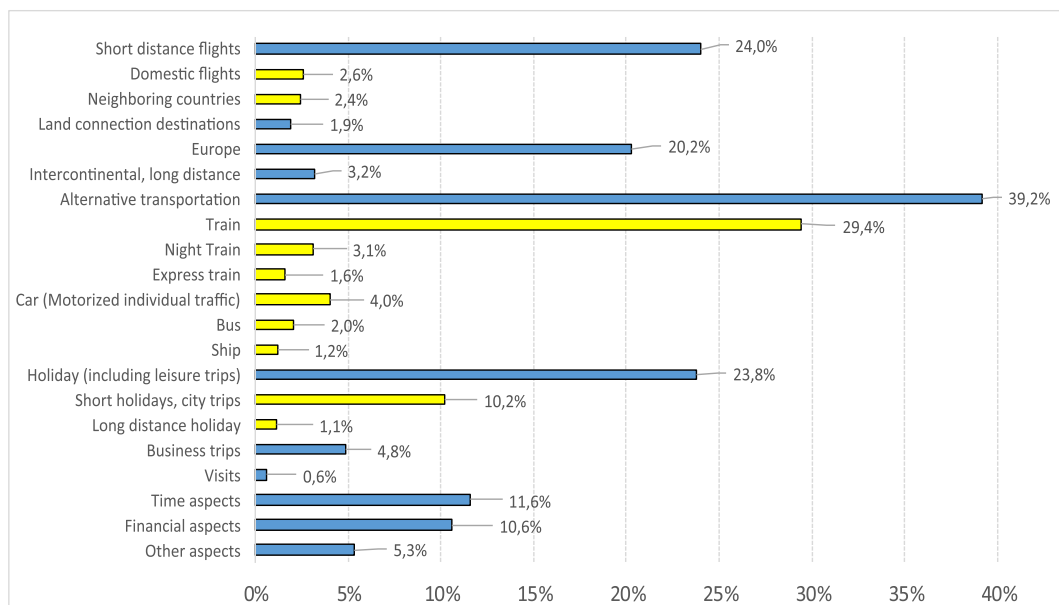
Both variables measuring personal knowledge and skills (education level, subjective environmental knowledge) and the contextual variable income did not prove to be significant predictors; therefore, hypotheses 3 and 4 are rejected. It thus turned out that only some of the MJB predictors proved to be significantly related to the intention to reduce personal flight travel within the integrative

**Table 3**  
Results of a linear regression analysis on the personal norm not to exploit currently cheap flights.

	b	SE(b)	$\beta$	t	Sig. p	(r bivariate)
(intercept)	2.094	0.243		8.620	0.000	
<b>General environmental attitudes</b>	<b>0.277</b>	<b>0.042</b>	<b>0.183</b>	<b>6.615</b>	<b>0.000</b>	(0.34***)
Prescriptive social norm (less specific for the dependent variable): Expectation of friends to reduce flights	-0.005	0.026	-0.005	-0.208	0.835	(0.15***)
<b>Descriptive social norm</b> (highly specific): Friends do not take advantage of cheap flights	<b>0.412</b>	<b>0.024</b>	<b>0.385</b>	<b>16.996</b>	<b>0.000</b>	(0.44***)
Education level (non-academic = 0 vs. academic degree = 1)	0.027	0.043	0.015	0.621	0.535	(0.02 <sup>n.s.</sup> )
Subjective <i>environmental</i> knowledge	0.014	0.028	0.012	0.499	0.618	(0.14***)
Income (low = 0 vs. high = 1)	0.030	0.044	0.016	0.674	0.501	(0.04 <sup>n.s.</sup> )
<b>Justification scale</b> <sup>a</sup>	<b>-0.118</b>	<b>0.015</b>	<b>-0.199</b>	<b>-7.851</b>	<b>0.000</b>	(-0.43***)
<b>Habit</b> (traveling by plane to holiday destinations)	<b>-0.308</b>	<b>0.042</b>	<b>-0.205</b>	<b>-7.359</b>	<b>0.000</b>	(-0.34***)
Gender (male = 1, female = 2)	0.035	0.040	0.020	0.866	0.386	(0.08**)
Age (years)	<b>0.005</b>	<b>0.001</b>	<b>0.079</b>	<b>3.289</b>	<b>0.001</b>	(0.21***)
Mult. R (R <sup>2</sup> ; adjusted R <sup>2</sup> )	0.64	(0.41; 0.40)				

Both, non-standardized (b) and standardized ( $\beta$ ) weights of the predictors within the regression model are reported. The exact p values (sig. p) of the weights within the regression model represent the basis of the hypothesis tests. Values of statistically significant predictors are printed in bold. The last column shows supplementary bivariate correlations between predictors and personal norm.

\*p < .05, \*\*p < .01, \*\*\*p < .001 refer to the bivariate correlations (printed in brackets) that were supplementary conducted and were not considered relevant for the testing of the hypotheses.



**Fig. 3.** Content analysis of responses (N = 993) to the open-ended question concerning options to avoid air travel (“In which cases would air travel be most likely to be unnecessary for you?”). Note: The response categories are not mutually exclusive, as some responses could be assigned to more than one category. Light (yellow) bars are inclusive to the antecedent dark (blue) bar (e.g. domestic flights and flights to neighboring countries were both automatically counted as short distance flights). Responses that mentioned maximum travel distances up to 3000 km and/or maximum travel times up to 4 h flight time (or 24 h travel time with an alternative means of transport) were also assigned to the short distance category. Thus, according to this classification, short distances rather correspond to official definitions of short-to-medium distance flights (cf. Mensen, 2013). This seemed appropriate for the present analysis since the responses addressing “Europe” as a whole, were considered as a generic medium distance category.

regression model. Nonetheless, the overall model fit was satisfactory with mult. R = 0.75 and an adjusted R-square value indicating the explanation of 55% of the variance of participants’ behavioral intention. Neither demographic variable (gender and age) proved to be a significant predictor; thus, they could not add to the explanatory power of the MJB model’s psychological variables. However, gender and age proved to be significantly correlated with the intention to reduce flights in bivariate analyses (Table 2, last column), which revealed higher flight reduction intentions among females than males and lower flight reduction intentions of older persons.

4.3. Linear regression model for personal norms not to exploit cheap flights

A linear regression model using explanatory variables of the MJB and demographic variables was used to predict the personal norm



of the participants not to exploit currently relatively cheap flight prices due to anticipation that prices will be increased in the near future for environmental reasons (Table 3). The overall model explained approximately 40% of the variance of the personal norm not to exploit cheap flights (mult.  $R = 0.64$ ). The habit of traveling by plane for holidays ( $\beta = -0.21$ ) and the justification scale ( $\beta = -0.20$ ) had significant negative beta weights, which means that these two variables facilitate the exploitation of cheap airfares. In contrast, descriptive social norms ( $\beta = 0.39$ ), general environmental attitude ( $\beta = 0.18$ ) and age ( $\beta = 0.08$ ) were significantly and positively related with the norm not to exploit cheap airfares. Thus, hypotheses 7 and 8 were confirmed by the analyses.

However, prescriptive social norms did not turn out to be a significant predictor of the personal norm in this regression analysis. Furthermore, neither variable measuring personal knowledge and skills (education level, subjective environmental knowledge) and the contextual variable income proved to be a significant predictor. Thus, only some MJB predictors proved to be significant predictors of the personal norm. Gender was not a significant predictor of personal norms; however, age proved to be a significant predictor whereby older participants evinced stronger personal norms not to exploit low flight prices than younger participants. Bivariate correlations (Table 3, last column) revealed additional significant relationships that did not surface in the multiple regression, namely a positive bivariate relationship between subjective environmental knowledge and personal norms and stronger personal norms of females than males.

#### 4.4. Conditions and possibilities for reducing flights

A total of 993 responses were obtained from the participants for the open question regarding possibilities and preconditions for reducing their personal flight travel. Participants' responses were assigned to various categories that were formed *a posteriori*. The resulting distribution of responses that could be assigned to one or more categories is depicted in Fig. 3. The response categories to which the responses were assigned are accordingly not mutually exclusive. This is even the case for seemingly exclusive categories such as "short distance" (entailed in 24% of responses) and "long distance" flights (3%); for example, the response "Short routes in Europe under the condition there is a good train connection. Long distance stays of less than two weeks at destinations (longer trips)" could be assigned to both categories (as well as to further ones).

As shown in Fig. 3, the most frequent response category was "if an alternative means of transportation is available," which occurred in 39.2% of the responses. The train was most frequently mentioned in responses mentioning alternative transportation modes; it was included in 75% of such statements. A considerable number of persons (3.1%,  $N = 31$ ) explicitly mentioned night trains, and at least 1.6% ( $N = 16$ ) suggested high-speed trains. Notably, various responses mentioning night trains—for example, "If the supply of night train connections increases again" or "In case night trains are (again) available"—referred to the reduction of night train connections in recent years in response to economic pressures at least partly caused by increasing cheap flight connection offers (Collet, 2016; Detig, 2016; Forster, 2016). Only 2% of responses mentioned the autobus as alternative mode of transport, and all of those respondents also described the train as an option. Ships were least frequently mentioned as an alternative mobility option (1.2%). Car travel was somewhat more commonly raised (4%), and at least one such response referred to the possibility of car-sharing: "when the journey can be made by train or carpooling."

The second most frequent response category was "short distances" (24% of responses), which were mentioned slightly more often than flights within Europe (20.2%). Both "short distances" and "European flights" were mentioned significantly more often than "intercontinental or long-distance flights" (3.2%; for both chi-square tests,  $df = 1$ ,  $p < .001$  for both comparisons).

Responses of the category "holiday and leisure flights" (23.8% of responses) occurred significantly more often than those of the category "business flights" (4.8% of responses; chi-square test,  $p < .001$ ). Responses addressing holidays and leisure trips frequently suggested changes in the holiday destinations and mode of transportation. The percentage of these responses that also explicitly mentioned alternative modes of transportation was 21.1%, and the percentage of responses suggesting alternative means of transportation to reduce business travel was in tendency, but not significantly lower at 12.5% (chi-square test,  $df = 1$ ,  $\chi^2 = 1.37$ ,  $p = .242$ ; the test considered only those responses addressing either business or holiday trips but not both). However, many comments regarding business travel proposed replacing flights with telecommunication methods such as video meetings, a suggestion that was never made in relation to holiday travel.

Time (11.5%) and financial (10.5%) factors connected to avoiding flight travels were mentioned similarly often and were in most cases related to alternative transport modes. Most responses addressing temporal issues mentioned the need for fast alternative means of transport or night trains. However, there were also a few responses citing the need for more time at one's disposal which would be required to reduce air-travel (e.g. having longer holidays, supportive travel regulations in the company, when having more time after retirement). Participants mentioning financial factors criticized the high cost of train travel and other means of public transport either in absolute terms or in comparison to lower flight prices. Some responses only criticized low flight prices and argued that increasing the financial costs of flying would be required to reduce air-travel.

Other responses explained that a high level of comfort with sufficient space and a good view of landscapes could compensate for the longer duration of train or boat travel. In some of these cases, the act of travelling is apparently considered an enjoyable aspect of an excursion or holiday. Quality aspects such as punctuality, having possibilities for eating and working, and sleeping well during travel are also mentioned as pre-conditions for reducing flights through the use of alternative transportation means. Better booking systems—in particular for international longer distance train journeys spanning various countries—was an additional wish that was expressed at least three times. At least one person suggested the provision of bicycle compartments in international trains as an option to reduce flights.

Rather few participants shared restrictive policy-oriented proposals such as limiting continental flights (e.g. per person and year) by law or even more radically to completely eliminate short distance air traffic connections between neighboring cities. One person

mentioned limiting all flying activities such that each person takes only one flight per year. These suggestions complement purely financially oriented policy suggestions such as subsidizing train traffic and introducing CO2 taxes for flights.

Choosing exclusively direct non-stop flights and making at least a certain part of an intercontinental long-distance journey by train were additional suggestions to reduce flights broached by one person each. Another participant considered directly connecting trains to all airports as a means to reduce domestic flights within Switzerland. Some responses denounce specific types of flights such as air freight transportation of non-essential and luxury goods, military flights, air shows, pleasure flying in light aircraft, private jet flights, or star-traveling to award ceremonies as unnecessary.

## 5. Discussion

### 5.1. Main findings of the model to predict environmental behavior intentions

In this study, the determinants of personal intentions to reduce air travel were investigated through the lens of the integrative MJB. General environmental attitudes were shown to be the strongest positive predictors of intentions to reduce flights, followed by prescriptive social norms representing corresponding expectations of friends, and the personal norm not to exploit cheap flight prices. In contrast, the habit of traveling by plane to holiday destinations and the acceptance of justifications for negative environmental behaviors proved to be significantly negatively related to the intention to reduce flights.

The MJB explained 55% of the variance of participants' intentions to reduce their flights which represents a rather high level of explanative power. For example, according to a meta-analysis by Armitage and Conner (2001) based on 185 studies the TPB achieved to explain on average only 27% of variance of behavior and 39% of the variance in behavioral intentions in a broad variety of domains of environmental behaviors. Accordingly, it would seem promising to also apply the MJB approach to investigate further transportation and mobility behaviors (e.g. car use, purchasing of electronic vehicles) and other environmentally significant behaviors in distinct domains such as sustainable food consumption, recycling or energy use.

### 5.2. Habits and justifications as barriers for change

Participants, who frequently travel by plane to their holiday destinations, proved less willing to reduce their flights in the future than those who used other means of transport or rarely travelled for vacations. This seems somewhat discouraging, as it implies that those with greater potential to reduce the number of their holiday flights seem to be only willing to do so to a rather limited extent. This result aligns with findings in a broad range of environmental behavior domains, thereby reinforcing the conclusion that habits are connected to psychological inertia and personal self-concepts and therefore tend to be rather persistent and difficult to change (Gao et al., 2020; Goldman et al., 2020).

The persistence of holiday flying habits obviously somewhat lowers expectations of positive environmental effects due to corresponding self-limiting behavior changes. However, diverse intervention methods and techniques to change environmentally destructive habits could start with raising awareness and providing insights regarding the negative environmental consequences of current habits and thereafter use financial incentives, group activities, competitions or other approaches to induce people to try alternative transport modes (Dahlstrand and Biel, 1997). The design of corresponding communication activities needs to consider previous research on the effectiveness of different presentation and framing strategies. For example, findings of Avineri and Waygood (2013) suggest that framing information on the consequences of traveling for the environment in terms of environmental losses incurred by harmful mobility choices may be more effective than framing it in terms of positive effects achieved by environmentally friendly transportation choices. Furthermore, awareness for the need to change environmentally harmful mobility habits may be increased by informing travelers about the social dilemma connected to traveling choices where behavior aiming to maximize the own benefit (apparent individual rationality), can result in negative overall consequences on the collective level (Hardin, 1968; Milinski et al., 2008).

Intentions to reduce flights were weakened by the acceptance of justifications for environmentally negative behaviors. This confirms the important role justifications play as in allowing people to behaviorally deviate from their personal norms and values by protecting themselves from self- and social blame (Chatzidakis et al., 2004, 2007; Diekmann and Preisendörfer, 1992; Hansmann et al., 2006; McGregor, 2008; Sykes and Matza, 1957).

Previous research has consistently demonstrated that the acceptance of domain-specific justifications has a negative effect on a broad range of corresponding environmentally significant behaviors ranging from recycling to car use (e.g. Gruber and Schlegelmilch, 2014; Hansmann et al., 2006; Uba and Chatzidakis, 2016; Zhang et al., 2018). The present study adds to these findings by showing that a general justification tendency as measured by the JNEB scale developed for this study proved to be a significant (negative) predictor of intentions to reduce the frequency of own flights. In addition, the present study confirmed previous findings showing that personal attitudes, social norms, and justifications are significantly related with personal norms (De Groot and Steg, 2009; Garcia-Valinas et al., 2012; Stern, 2000; Schwartz, 1977).

The mounting evidence base for justification processes playing a central role in behavioral decision-making processes in morally relevant domains through legitimizing attitudinal-behavioral inconsistencies is thus further enlarged by this study (e.g. Antonetti and Maklan, 2014; Chatzidakis et al., 2004, 2007; Cheng et al., 2014; Gruber and Schlegelmilch, 2014; McGregor, 2008). Communication and education strategies should therefore reduce the acceptance of justifications for frequent flying, and political measures and infrastructure and technology development should be designed in ways that likewise counteract corresponding justifications (e.g. by decreasing the cost and time required for alternative modes of transportation, respectively).

### 5.3. The potential of positive social and personal norms and attitudes for triggering change

Participants' general environmental attitudes and personal norms related to flight reduction proved to be substantial predictors of intentions to reduce personal air travels. A further powerful determinant of intentions to reduce flights was the subjectively perceived prescriptive social norm representing the (assumed) expectations of important others that one should accomplish such a self-limiting behavior change. This reinforces our understanding of humans as social beings thoroughly embedded in personal social relationships and networks with certain values and practices. Personal attitudes and norms are influenced by the surrounding social values and norms, which highlights the importance of efforts toward achieving pro-environmental behavior changes such as reducing flight travel within the broader context of a sustainability-oriented transformation of society at large.

Presumably, few individuals will exclude themselves from encompassing changes in social practices if descriptive and prescriptive social norms positively and synergistically interact in a congruent direction (Sowden et al., 2018; Thøgersen, 2008). Accordingly, in connection with future policy measures to increase the price of flight travels, the specific social norm not to exploit comparably low airfares ahead of corresponding price increases should be promoted to prevent negative announcement effects.

### 5.4. Subjectively perceived options for reducing personal air travel

The responses regarding preconditions and opportunities for reducing or avoiding flights revealed a strong desire for viable, attractive, comfortable, and cost- and time-efficient mobility alternatives as principal routes to reducing air-traffic. Responses related to financial aspects suggest eliminating existing subsidies, increasing the taxation of air traffic, and imposing restrictions on cheap flight offers or frequent flyer programs while concomitantly taking policy measures to decrease the price of more environmentally friendly transportation modes (Buchert et al., 2001; Denstadli and Veisten, 2020; Gössling et al., 2017; Gössling and Nilsson, 2010; Huang and Rust, 2011). However, both, measures that increase the costs of flying, as well as those reducing the cost of alternative, eco-friendly modes of transportation are financial approaches which may eventually not strongly influence wealthy frequent flyers, and could furthermore negatively impact social justice aspects regarding the options of less wealthy people for flying (Bruderer Enzler, 2017; Gama, 2017).

The most frequently mentioned alternative by far was traveling by train, which indicates the need to reduce train pricing, enable faster connections, improve comfort and service quality, and generate better options to productively use travel time (Dällenbach, 2020; Gama, 2017). The further development of night-trains and high-speed train connections to replace short-distance and intra-European flights merits special attention in this regard. Train connections that are even faster than current conventional high-speed trains could be offered by possible future underground magnetic levitation (Maglev) train systems operating in vacuum tunnels (Saracoglu, 2016; Spielmann et al., 2008). A corresponding project planning denoted as Swissmetro was developed in Switzerland; however was ultimately not realized. Reduced energy consumption could be expected for underground train systems operating in a near vacuum tunnel system in comparison with conventional high-speed trains and above-ground Maglev trains such as the German Transrapid due to the reduced air pressure in the tunnels (Baumgartner et al., 2000; Vuchic and Casello, 2002). In addition, underground railway lines would mean significantly reduced land consumption relative to above-ground railways. According to Saracoglu (2016), train systems like Swissmetro could therefore offer some advantages regarding environmental protection and climate change mitigation as well as safety issues and land use policy and could also be economically viable in the long term in light of fast transport performance and moderate operating and maintenance costs. However, a Swissmetro project would likely result in ecologically negative rebound effects, as increased travel speed can lead to greater travel distances (Spielmann et al., 2008). Furthermore, underground transportation may be less attractive and pleasant compared with above-ground railways or air travel, which offer daylight and pleasing views of sky, clouds, or landscapes.

It seems clear that there is no single "best" mobility solution for all situations and travelers, as some may consider that "the way is the goal" and prefer slow, comfortable motion, whereas others strive for reaching the goal of their journey as rapidly as possible.

Enjoyable private space and time represent important luxury goods, and their significance may increase further in the future (Chen, 2017; Reisch, 2001). As is the case for physical time, psychological or subjectively perceived time is also relative, and the analogy between physical and psychological time seems particularly close in the behavioral domain of traveling, where both are measured relative to space and movement. Hansmann and Kilchling (2005) distinguished two psychologically distinct categories of individuals, namely time functionaries and time jugglers, who may also be considered two types of travelers. Time functionaries tend to have a linear understanding of time and focus on acceleration qualities such as speed, efficiency, punctuality, and diligence, whereas time jugglers tend to perceive time in a cyclic and event-oriented way and focus on deceleration aspects such as patience, slowness, stamina, endurance, and awareness (Kilchling, 2003). However, these two types of time relatedness may not solely be considered as fixed time-personalities; the same person may be in a deceleration mode during one journey and in an acceleration mode during another.

Both rapid acceleration-oriented as well as comfort-, joy-, and experience-oriented alternative transportation modes need to be facilitated, promoted, and further developed to effectively reduce air traffic. In this context it needs to be acknowledged that trains are not the sole means of reaching long-distance destinations. Increasing the role and attractiveness of ship traffic likewise represents an essential option. In addition, participants' responses indicated that replacing physical meetings with electronically mediated formats is an important, and rather well-accepted approach for reducing business-related passenger air traffic.

### 5.5. The corona crisis as trigger of change

Since this survey was conducted, the corona crisis has imposed a reduction of flight traffic worldwide. It has showed that depending

**Table A1**

Descriptive statistics and Cronbach alpha values of the scales measuring general environmental values and Justification of Negative Environmental Behaviors (JNEB).

Items	N	M	SD	r (Item scale)	Cronbach's $\alpha$ (if item deleted)
<b>General environmental attitudes scale</b>					
					Cronbach's alpha
					$\alpha =$
1. If we continue as we have been doing, we are heading for an environmental disaster.	1127	3.24	0.83	0.67	0.74
2. In my opinion, many environmentalists greatly exaggerate the importance of the environmental problem. <sup>a</sup>	1129	2.97	1.00	0.61	0.76
3. For the sake of the environment, we should all be prepared to reduce our current standard of living.	1164	3.01	0.85	0.57	0.77
4. Environmental protection measures should be enforced even if they result in job losses.	1066	2.64	0.89	0.55	0.77
5. It is still the case that politicians do far too little for the environment.	1146	3.13	0.88	0.50	0.78
6. The protection of the environment is very important to me.	1191	3.49	0.59	0.46	0.79
<b>JNEB scale</b>					Cronbach's alpha
					$\alpha =$
1. There are more important things in life than protecting the environment, so to a certain extent it is justified to pollute the environment.	1164	1.56	0.78	0.45	0.61
2. The impact of a single person's environmental behavior is small, so it is not worth limiting oneself for the environment.	1169	1.59	0.80	0.43	0.62
3. I behave very environmentally friendly in most areas of life, so it is okay if I pollute the environment with some behaviors (such as going on holiday now and then).	1128	2.43	0.88	0.41	0.64
4. Environmentally friendly behavior is often more expensive than environmentally unfriendly behavior, so it is okay if I pollute the environment through some behaviors (such as flying to a holiday destination now and then instead of travelling more expensively by train).	1120	2.06	0.90	0.53	0.55

Items on both scales used a four-point Likert scale (1 = do not agree at all, 2 = rather disagree, 3 = rather agree, 4 = I fully agree). The responses "I do not want to respond" or "I do not know" were treated as missing values and N accordingly varies between items.

<sup>a</sup> For this statement, the response scale coding was reversed to enable its inclusion in the General Environmental Attitude scale. Reported means (M) for these items show the reversely poled scaling such that high values represent positive environmental attitude.

on situational and societal requirements, flight traffic can indeed be reduced and partly substituted. Moreover, the corona crisis has highlighted the importance of the health and safety aspects of flying, which were barely mentioned by respondents of this survey but have since gained tremendous consideration.

Many of the options for reducing flights addressed in this study—such as replacing face-to-face business meetings with online meetings, or choosing short- rather than long-distance holiday destinations—have substantially contributed to air traffic reduction during the corona crisis. However, some options need longer term planning and preparation, such as the installation of faster train connections using high-technology trains such as Maglev or Swissmetro. In addition, policy measures for better surface public transport connections with more comforts and amenities, shorter travel times, and more affordable prices are needed (Gama, 2017; Dällenbach, 2020). Complementary, there is a need for the development of better technological tools for virtual meetings and online encounters. In addition, possibilities and options for more environmentally friendly air transportation technologies should not be overlooked.

### 5.6. Limitations and future research needs

One limitation of this study is that it only measured participants' stated intentions and preferences, which have been demonstrated to deviate from actual behavioral decisions regarding individual mobility (Wardman, 1988). Further studies using longitudinal measures based on observations or self-monitored behaviors are needed to validate and elaborate upon the present findings.

An additional limitation of the current study is that except for general environmental attitudes and justifications, which were measured by short scales, psychological constructs were measured by single items, which could have limited their explanatory power. In similar vein, the four items of the JNEB scale may likewise be supplemented by further ones to arrive at a more encompassing scale. NT (Sykes and Matza, 1957) distinguished five different types of justifications, namely (1) denial of responsibility, (2) denial of injury, (3) denial of the victim, (4) condemnation of the condemners and (5) appeal to higher loyalties, which are not fully covered by the current four-item scale. An item addressing condemnation of the condemners is missing in the JNEB scale as it stands now and may thus represent an important supplementation to be tried and tested (e.g. an item asking for agreement to the statement that "persons, who criticize frequent flyers, are usually the ones flying frequently themselves"). Further types of neutralization techniques may also be considered in the scale. For example, Kaptein and van Helvoort (2019) recently developed a circumplex model with four categories of neutralizations (distorting the facts, negating the norm, blaming the circumstances, and hiding behind oneself) each containing three neutralization techniques and more specific sub-techniques. Uba and Chatzidakis (2016) likewise identified some novel neutralization techniques which have not been described previously and may hence inform an extension of the JNEP scale. For example they observed various justifications arguing that one person alone cannot make a difference as long as the others do not change their behavior, and assigned these statements to a novel separate neutralization technique named "change - locus of control argument". In addition, the latter study opened up an important perspective for future research as it investigated the formulation and functioning of counter-neutralizations in the sense of affirmations that confront or weaken neutralizations and may hence promote positive environmental behavior and narrow the norm-behavior gap.

An additional issue not addressed in this study is compensation schemes for negative externalities (CO<sub>2</sub> emissions, noise) caused by airplanes (Babakhani et al., 2017; Blasch and Farsi, 2014; Choi et al., 2018; Székely et al., 2016). Investigations into this approach seem important as many flights will presumably (at least subjectively) remain indispensable for many individuals. Finally, it needs to be considered that this study was conducted in Switzerland, an affluent, technologically highly developed western country of rather small geographical size. The findings of this study were influenced by the Swiss context, which limits to some extent their generalizability. Nevertheless, the findings and recommendations identified in this study may inspire the search for strategies to facilitate sustainable mobility patterns in other countries.

### CRedit authorship contribution statement

**Ralph Hansmann:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Validation, Visualization, Writing - original draft, Writing - review & editing. **Claudia R. Binder:** Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Writing - original draft, Writing - review & editing.

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### Appendix

See Appendix [Table A1](#)

### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.trd.2021.102859>.

### References

- Agnew, R., 1994. The techniques of neutralization and violence. *Criminology* 32, 555–580.
- Ajzen, I., 1991. The theory of planned behavior. *Organ. Behav. Human Dec.* 50, 179–211. [https://doi.org/10.1016/0749-5978\(91\)90020-T](https://doi.org/10.1016/0749-5978(91)90020-T).
- Ajzen, I., 2012. Values, attitudes, and behavior. In: Salzborn, S., Davidov, E., Reinecke, J. (Eds.), *Methods, Theories, and Empirical Applications in the Social Sciences*. VS Verlag für Sozialwissenschaften, Wiesbaden, pp. 33–38. [https://doi.org/10.1007/978-3-531-18898-0\\_5](https://doi.org/10.1007/978-3-531-18898-0_5).
- Andersson, A., 2020. Is climate morality the answer? Preconditions affecting the motivation to decrease private car use. *Transp. Res. Part D* 78, 102198. <https://doi.org/10.1016/j.trd.2019.11.027>.
- Antonetti, P., Maklan, S., 2014. Feelings that make a difference: how guilt and pride convince consumers of the effectiveness of sustainable consumption choices. *J. Bus. Ethics* 124, 117–134. <https://doi.org/10.1007/s10551-013-1841-9>.
- Araghi, Y., Kroesen, M., Molin, E., van Wee, B., 2014. Do social norms regarding carbon offsetting affect individual preferences towards this policy? Results from a stated choice experiment. *Transp. Res. Part D* 26, 42–46.
- Armitage, C.J., Conner, M., 2001. Efficacy of the theory of planned behaviour: A meta-analytic review. *Brit. J. Soc. Psychol.* 40, 471–499. <https://doi.org/10.1348/014466601164939>.
- Avineri, E., Waygood, E.O.D., 2013. Applying valence framing to enhance the effect of information on transport-related carbon dioxide emissions. *Transp. Res. Part A* 48, 31–38. <https://doi.org/10.1016/j.tra.2012.10.003>.
- Babakhani, N., Ritchie, B., Dolnicar, S., 2017. Improving carbon offsetting appeals in online airplane ticket purchasing: testing new messages, and using new test methods. *J. Sustain. Tourism* 25 (7), 955–969. <https://doi.org/10.1080/09669582.2016.1257013>.
- Bamberg, S., 2013. Applying the stage model of self-regulated behavioral change in a car use reduction intervention. *J. Environ. Psychol.* 33, 68–75.
- Baranzini, A., Thalman, P., Gonseth, C., 2004. Swiss climate policy: Combining VAs with other instruments under the menace of a CO<sub>2</sub> Tax. In: Baranzini, A., Thalman, P. (Eds.), *Voluntary Approaches in Climate Policy*. Edward Elgar, Cheltenham, pp. 249–277.
- Barr, S., Prillwitz, J., 2014. A smarter choice? Exploring the behaviour change agenda for environmentally sustainable mobility. *Environ. Plann. C* 32, 1–19. <https://doi.org/10.1068/c1201>.
- Basner, M., Clark, C., Hansell, A., Hileman, J.I., Janssen, S., Shepherd, K., Sparrow, V., 2017. Aviation noise impacts: State of the science. *Noise Health* 19 (87), 41–50. [https://doi.org/10.4103/nah.NAH\\_104\\_16](https://doi.org/10.4103/nah.NAH_104_16).
- Baumgartner, T., Tietje, O., Spielmann, M., Bandel, R., 2000. *Ökobilanz der Swissmetro. Umweltwirkungen durch Bau und Betrieb (Teil 1) und durch induzierte Aktivitäten (Teil 2). Materialienband M29. BBL/EDMZ, Bern, p. 801.678.d.*
- Blasch, J., Farsi, M., 2014. Context effects and heterogeneity in voluntary carbon offsetting – a choice experiment in Switzerland. *J. Environ. Econ Policy* 3 (1), 1–24. <https://doi.org/10.1080/21606544.2013.842938>.
- BMU—Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (Eds.) 2004. *Umweltbewusstsein in Deutschland 2004*. Berlin, Bonn: BMU.
- Böhler, S., Grischkat, S., Hausteiner, S., Hunecke, M., 2006. Encouraging environmentally sustainable holiday travel. *Transp. Res. Part A* 40 (8), 652–670. <https://doi.org/10.1016/j.tra.2005.12.006>.
- Bruderer Enzler, H., 2017. Air travel for private purposes. An analysis of airport access, income and environmental concern in Switzerland. *J. Transp. Geography* 61, 1–8. <https://doi.org/10.1016/j.jtrangeo.2017.03.014>.



- Buchert, M., Loose, W., Hochfeld, C., Schmied, M., Wiener, U., Dopfer J. 2001. Last Minute für den Umweltschutz - Perspektiven für die Zukunft des Reisens [Last minute for environmental protection - perspectives for the future of travel]. Freiburg i. Bsg.: Öko-Institut e.V. Freiburg.
- Chatzidakis, A., Hibbert, S., Mitussis, D., Smith, A., 2004. Virtue in consumption? *J. Market. Manage.* 20 (5/6), 526–543.
- Chatzidakis, A., Hibbert, S.A., Smith, A., 2007. Why people don't take their concerns about fair trade to the supermarket: The role of neutralisation. *J. Bus. Ethics* 74 (1), 89–100. <https://doi.org/10.1007/s10551-006-9222-2>.
- Chen, J.-H., Wei, H.-H., Chen, C.-L., Wei, H.-Y., Chen, Y.-P., Ye, Z., 2020. A practical approach to determining critical macroeconomic factors in air traffic volume based on K-means clustering and decision-tree classification. *J. Air Transport Manage.* 82, 101743 <https://doi.org/10.1016/j.jairtraman.2019.101743>.
- Chen, X., 2017. Deceleration: A mobility designed to be slow. MA thesis. Umeå: Umeå University, Institute of Design.
- Cheng, L., Li, W., Zhai, Q., Smyth, R., 2014. Understanding personal use of the Internet at work: An integrated model of neutralization techniques and general deterrence theory. *Comput. Hum. Behav.* 38, 220–228.
- Choi, A.S., Ritchie, B.W., Gössling, S., 2018. Economic valuation of voluntary carbon offsets using forced choices. *Transp. Res. Part D* 62, 225–235.
- Cohen, S.A., Kantanbacher, J., 2020. Flying less: personal health and environmental co-benefits. *J. Sustain. Tourism* 28 (2), 361–376. <https://doi.org/10.1080/09669582.2019.1585442>.
- Collet, V., 2016. La SNCF se désengage des trains de nuit, Le Figaro vom 19.02.2016, Groupe Dassault, Paris. <http://www.lefigaro.fr/societes/2016/02/19/20005-20160219ARTFIG00170-trains-intercites-la-sncf-va-investir-pres-de-2milliards-deuros.php>, Mai 2016.
- Dällenbach, N., 2020. Low-carbon travel mode choices: The role of time perceptions and familiarity. *Transp. Res. Part D* 86, 102378.
- Dahlstrand, U., Biel, A., 1997. Pro-environmental habits: Propensity levels in behavioural change. *J. Appl. Soc. Psychol.* 27 (7), 588–601.
- Davison, L., Littleford, C., Ryley, T., 2014. Air travel attitudes and behaviours: The development of environment-based segments. *J. Air Transp. Manage.* 36, 13–22.
- De Groot, J.I.M., Steg, L., 2009. Morality and prosocial behavior: The role of awareness, responsibility, and norms in the norm activation model. *J. Soc. Psychol.* 149 (4), 425–449. <https://doi.org/10.3200/SOCP.149.4.425-449>.
- Denstadli, J.M., Veisten, K., 2020. The flight is valuable regardless of the carbon tax scheme: A case study of Norwegian leisure air travelers. *Tourism Manage.* 81, 104150 <https://doi.org/10.1016/j.tourman.2020.104150>.
- Detig, R., 2016. Eine Zukunft für die Nachtreisezüge in Europa. Masterarbeit Studiengang Raumentwicklung und Infrastruktursysteme, Institut für Verkehrsplanung und Transportsysteme (IVT), ETH Zürich, Zürich.
- Diekmann, A., Meyer, R., Mühlemann, C., Diem, A., 2009. Schweizer Umweltsurvey 2007: Analysen und Ergebnisse - Bericht für das Bundesamt für Statistik (BFS) und das Bundesamt für Umwelt (BAFU). ETH Zürich, Professur für Soziologie, Zurich.
- Diekmann, A., Preisendörfer, P., 1992. Persönliches Umweltverhalten. Diskrepanzen zwischen Anspruch und Wirklichkeit. *Kolner Z. Soziol. Soz.* 44, 226–251. <https://doi.org/10.1007/s11577-017-0420-y>.
- Diekmann, A., Preisendörfer, P., 2001. Umweltpsychologie. Eine Einführung. Rowohlt, Reinbeck bei Hamburg.
- Ellemers, N., van der Toorn, J., Paunov, Y., van Leeuwen, T., 2019. The psychology of morality: A review and analysis of empirical studies published from 1940 through 2017. *Pers. Soc. Psychol. Rev.* 23 (4), 332–366. <https://doi.org/10.1177/1088868318811759>.
- EPA (United States Environmental Protection Agency), 2000. Aircraft contrails factsheet. EPA430-F-00-005. September 2000. Air and Radiation (6205J). Washington, DC: EPA.
- Federal Aviation Administration (FAA), 2016. Aerospace forecast. [https://www.faa.gov/data\\_research/aviation/aerospace\\_forecasts/media/FY2016-36\\_FAA\\_Aerospace\\_Forecast.pdf](https://www.faa.gov/data_research/aviation/aerospace_forecasts/media/FY2016-36_FAA_Aerospace_Forecast.pdf).
- Forster, C., 2016. Nachtzüge sind nicht überall auf dem Abstellgleis, Neue Zürcher Zeitung vom 12.01.2016, NZZ Mediengruppe, Zürich, <http://www.nzz.ch/schweiz/nachtzuegesind-nicht-ueberall-auf-dem-abstellgleis-1.18675643>, Juni 2016.
- Fritsche, I., 1999. Die Erhebung von Rechtfertigungen umweltschädigenden Verhaltens: Eine experimentelle Studie zur Validität der Fragebogentechnik. *Umweltpsychologie* 3 (1), 68–80.
- Gama, A., 2017. Own and cross-price elasticities of demand for domestic flights and intercity trains in the U.S. *Transp. Res. Part D* 54, 360–371.
- Gao, K., Yang, Y., Sun, L., Qu, X., 2020. Revealing psychological inertia in mode shift behavior and its quantitative influences on commuting trips. *Transp. Res. Part F* 71, 272–287. <https://doi.org/10.1016/j.trf.2020.04.006>.
- Garcia-Valinas, M.A., Macintyre, A., Torgler, B., 2012. Volunteering, pro-environmental attitudes and norms. *J. Socio-Econ.* 41 (4), 455–467. <https://doi.org/10.1016/j.socrec.2011.07.001>.
- Gatersleben, B., Vlek, C., 1998. Household consumption, quality of life, and environmental impacts: A psychological perspective and empirical study. In: Noorman, K. J., Uiterkamp, T.S. (Eds.), *Green Households? Domestic Consumers, Environment, and Sustainability*. Earthscan Publications, London, pp. 141–183.
- Gössling, S., Fichert, F., Forsyth, P., 2017. Subsidies in aviation. *Sustainability* 9 (8), 1295.
- Gössling, S., Hanna, P., Higham, J., Cohen, S., Hopkins, D., 2019. Can we fly less? Evaluating the 'necessity' of air travel. *J. Air Transp. Manage.* 81, 10722.
- Gössling, S., Nilsson, J.H., 2010. Frequent flyer programmes and the reproduction of mobility. *Environ. Plann. A* 42, 241–252.
- Goldman, D., Hansmann, R., Cincera, J., Radović, V., Telesienė, A., Balžekienė, A., Vávra, J., 2020. Education for environmental citizenship and responsible environmental behavior. In: Hadjichambis, A.C., Reis, P., Paraskeva-Hadjichambis, D., Cincera, J., Boeve-de Pauw, J., Gericke, N., Knippels, M.-C. (Eds.), *Conceptualizing Environmental Citizenship for 21st Century Education*. Springer Nature, Cham, pp. 115–137. [https://doi.org/10.1007/978-3-030-20249-1\\_8](https://doi.org/10.1007/978-3-030-20249-1_8).
- Gruber, V., Schlegelmilch, B.B., 2014. How techniques of neutralization legitimize norm- and attitude-inconsistent consumer behavior. *J. Bus. Ethics* 121, 29–45. <https://doi.org/10.1007/s10551-013-1667-5>.
- Hahad, O., Kröller-Schön, S., Daiber, A., Münzel, T., 2019. The cardiovascular effects of noise. *Deutsches Arzteblatt international* 116 (14), 245–250. <https://doi.org/10.3238/arztebl.2019.0245>.
- Hamilton, C., 1996. Generational justice: The marriage of sustainability and social equity. *Australian J. Environ. Manage.* 3 (3), 163–173. <https://doi.org/10.1080/14486563.1996.10648353>.
- Hansmann, R., Bernasconi, P., Smieszek, T., Loukopoulos, P., Scholz, R.W., 2006. Justifications and self-organization as determinants of recycling behavior: The case of used batteries. *Resour. Conserv. Recycl.* 47, 133–159. <https://doi.org/10.1016/j.resconrec.2005.10.006>.
- Hansmann, R., Kilchling, P., 2005. Zeitfunktionäre und zeitjougler - Eine zeitbezogene typisierung und ihre implikationen für die arbeitswelt [Time functionaries and time jugglers - A time-related typification and its implications for the world of work]. *Wirtschaftspsychologie* 7 (3), 73–80.
- Hansmann, R., Steimer, N., 2015. Linking an integrative behavior model to elements of environmental campaigns: An analysis of face-to-face communication and posters against littering. *Sustainability* 7, 6937–6956.
- Hansmann, R., Steimer, N., 2017. Subjective reasons for littering: A self-serving attribution bias as justification process in an environmental behaviour model. *EREM* 73 (1), 8–19.
- Hardin, G., 1968. The Tragedy of the Commons. *Science* 162 (3859), 1243–1248. <https://doi.org/10.1016/10.1126/science.162.3859.1243>.
- He, R.-W., Shirmohammadi, F., Gerlofs-Nijland, M.E., Sioutas, C., Cassee, F.R., 2018. Pro-inflammatory responses to PM 0.25 from airport and urban traffic emissions. *Sci. Total Environ.* 640, 997–1003.
- Hepting, M., Pak, H., Grimme, W., Dahlmann, K., Jung, M., Wilken, D., 2020. Climate impact of German air traffic: A scenario approach. *Transp. Res. Part D* 85, 102467.
- Hirschi, T., 1969. *Causes of Delinquency*. University of California Press.
- Huang, M., Rust, R.T., 2011. Sustainability and consumption. *J. Acad. Mark. Sci.* 39, 40–54. <https://doi.org/10.1007/s11747-010-0193-6>.
- Hunecke, M., Blöbaum, A., Matthies, E., Höger, R., 2001. Responsibility and environment—ecological norm orientation and external factors in the domain of travel mode choice behavior. *Environ. Behav.* 33, 845–867.
- Ibrahim, A., Knox, K., Rundle-Thiele, S., Arli, D., 2018. Segmenting a water use market: Theory of interpersonal behavior insights. *Soc. Market. Quart.* 24 (1), 3–17. <https://doi.org/10.1177/1524500417741277>.
- Kaptein, M., van Helvoort, M., 2019. A model of neutralization techniques. *Deviant Behav.* 40 (10), 1260–1285. <https://doi.org/10.1080/01639625.2018.1491696>.



- Kaiser, F.G., 2006. A moral extension of the theory of planned behaviour: norms and anticipated feelings of regret in conservationism. *Personal. Individ. Differ.* 41, 71–81.
- Kaiser, F.G., Scheuthle, H., 2003. Two challenges to a moral extension of the theory of planned behavior: moral norms and just world beliefs in conservationism. *Personal. Individ. Differ.* 35, 1033–1048. [https://doi.org/10.1016/S0191-8869\(02\)00316-1](https://doi.org/10.1016/S0191-8869(02)00316-1).
- Kilchling, P., 2003. Rund um die Uhr: Im Spannungsfeld zwischen Uhren und Zeiten. [Around the clock: In the field of tension between clocks and times.] MA thesis. Universität der Künste, Berlin.
- Lanzini, P., Khan, S.A., 2017. Shedding light on the psychological and behavioral determinants of travel mode choice: A meta-analysis. *Transp. Res. Part F* 48, 13–27. <https://doi.org/10.1016/j.trf.2017.04.020>.
- Lee, D.S., Fahey, D.W., Forster, P.M., Newton, P.J., Wit, R.C.N., Lim, L.L., Owen, B., Sausen, R., 2009. Aviation and global climate change in the 21st century. *Atmos. Environ.* 43, 3520–3537. <https://doi.org/10.1016/j.atmosenv.2009.04.024>.
- Lu, J.-L., Shon, Z.Y., 2012. Exploring airline passengers' willingness to pay for carbon offsets. *Transp. Res. Part D* 17, 124–128.
- Lu, J.-L., Wang, C.-Y., 2018. Investigating the impacts of air travellers' environmental knowledge on attitudes toward carbon offsetting and willingness to mitigate the environmental impacts of aviation. *Transp. Res. Part D* 59, 96–107.
- Lumsdon, L.M., McGrath, P., 2011. Developing a conceptual framework for slow travel: a grounded theory approach. *J. Sustain. Tourism* 19 (3), 265–279. <https://doi.org/10.1080/09669582.2010.519438>.
- McGregor, S.L.T., 2008. Conceptualizing immoral and unethical consumption using Neutralization Theory. *Family Consum. Sci. Res. J.* 36 (3), 261–276.
- Mensen, H., 2013. *Handbuch der Luftfahrt*. 2., neu bearbeitete Auflage. Berlin, Heidelberg: Springer. <https://doi.org/10.1007/978-3-642-34402-2>.
- Milinski, M., Sommerfeld, R.D., Krambeck, H., Reed, F.A., Marotzke, J., 2008. The collective-risk social dilemma and the prevention of simulated dangerous climate change. *Proc. Natl. Acad. Sci.* 105, 2291–2294.
- Minor, W.W., 1984. Neutralization as a hardening process: Considerations in the modeling of change. *Soc. Forces* 62, 995–1019.
- Morten, A., Gatersleben, B., Jessop, D.C., 2018. Staying grounded? Applying the theory of planned behaviour to explore motivations to reduce air travel. *Transp. Res. Part F* 55, 297–305. <https://doi.org/10.1016/j.trf.2018.02.038>.
- Muro-Rodríguez, A.I., Perez-Jiménez, I.R., Gutiérrez-Broncano, S., 2017. Consumer behavior in the choice of mode of transport: A case study in the Toledo-Madrid corridor. *Front. Psychol.* 8, 1011. <https://doi.org/10.3389/fpsyg.2017.01011>.
- Ölander, F., Thøgersen, J., 1995. Understanding of consumer behaviour as a prerequisite for environmental protection. *J. Consum. Policy* 18, 345–385.
- Ponater, M., Marquart, S., Sausen, R., Schumann, U., 2005. On contrail climate sensitivity. *Geophys. Res. Lett.* 32 (10), 5 pp. <https://doi.org/10.1029/2005GL022580>.
- Reisch, L.A., 2001. Time and wealth. The role of time and temporalities for sustainable patterns of consumption. *Time Soc.* 10, 387–405.
- Reisch, L.A., 2003. Consumption. In: Page, E.A., Proops, J. (Eds.), *Environmental Thought*. Edward Elgar, Cheltenham, pp. 217–242.
- Riekhof, M.-C., Bröcker, J., 2017. Does the adverse announcement effect of climate change matter? - A dynamic general equilibrium analysis. *Clim. Chang. Econ.* 8 (2), 1750007. <https://doi.org/10.1142/S2010007817500075>.
- Saracoglu, H., 2016. The Feasibility of the Swiss Metro Project. Master of Project Management Program Department of Civil and Environmental Engineering. McCormick School of Engineering and Applied Science. Northwestern University, Evanston, Illinois.
- Schahn, J., Dinger, J., Bohner, G., 1995. Rationalisierungen und Neutralisationen als rechtfertigungsstrategien: Ein Vergleich zwischen Umwelt- und Delinquenzbereich. *Z. für Differentielle und Diagnostische Psychologie* 16, 177–194.
- Schwartz, S.H., 1977. Normative influences on altruism. *Adv. Exp. Soc. Psychol.* 10, 221–279. [https://doi.org/10.1016/s0065-2601\(08\)60358-5](https://doi.org/10.1016/s0065-2601(08)60358-5).
- Schwirplies, C., Dütschke, E., Schleich, J., Ziegler, A., 2019. The willingness to offset CO2 emissions from traveling: Findings from discrete choice experiments with different framings. *Ecol. Econ.* 165, 106384. <https://doi.org/10.1016/j.ecolecon.2019.106384>.
- Schwirplies, C., Ziegler, A., 2016. Offset carbon emissions or pay a price premium for avoiding them? A cross-country analysis of motives for climate protection activities. *Appl. Econ.* 48 (9), 746–758. <https://doi.org/10.1080/00036846.2015.1085647>.
- Seyfang, G., Paavola, J., 2008. Inequality and sustainable consumption: bridging the gaps. *Local Environ.* 13 (8), 669–684. <https://doi.org/10.1080/13549830802475559>.
- Shirmohammadi, F., Sowlat, M.H., Hasheminassab, S., Saffari, A., Ban-weiss, G., Sioutas, C., 2017. Emission rates of particle number, mass and black carbon by the Los Angeles International Airport (LAX) and its impact on air quality in Los Angeles. *Atmos. Environ.* 151, 82–93.
- Soeta, Y., Kagawa, H., 2020. Three dimensional psychological evaluation of aircraft noise and prediction by physical parameters. *Build. Environ.* 16, 106445. <https://doi.org/10.1016/j.buildenv.2019.106445>.
- Sowden, S., Koletsis, S., Lymberopoulos, E., Militaru, E., Catmur, C., Bird, G., 2018. Quantifying compliance and acceptance through public and private social conformity. *Conscious. Cogn.* 65, 359–367.
- Spielmann, M., de Haan, P., Scholz, R.W., 2008. Environmental rebound effects of high-speed transport technologies: a case study of climate change rebound effects of a future underground maglev train system. *J. Clean. Prod.* 16 (13), 1388–1398. <https://doi.org/10.1016/j.jclepro.2007.08.001>.
- Sprenger, R.U., 2000. Market-based instruments in environmental policies: The lessons of experience. In: Andersen, M.S., Sprenger, R.U. (Eds.), *Market-based instruments for environmental management: Policies and institutions*. Edward Elgar, Cheltenham, pp. 3–26.
- Stern, P.C., 2000. Toward a coherent theory of environmentally significant behavior. *J. Soc. Issues.* 56, 407–424. <https://doi.org/10.1111/0022-4537.00175>.
- Sun, W., 2019. Toward a theory of ethical consumer intention formation: re-extending the theory of planned behavior. *AMS Rev.* <https://doi.org/10.1007/s13162-019-00156-6>.
- Sykes, G.M., Matza, D., 1957. Techniques of neutralization: a theory of delinquency. *Am. Sociol. Rev.* 22, 664–670. <https://doi.org/10.2307/2089195>.
- Székely, N., Weinmann, M., vom Brocke, J., 2016. Nudging people to pay CO2 offsets - The effect of anchors in flight booking processes. *Research in Progress Papers* 62. <http://aisel.aisnet.org/ecis2016.rip/62>.
- Targino, A.C., Machado, B.L.F., Krecl, P., 2017. Concentrations and personal exposure to black carbon particles at airports and on commercial flights. *Transp. Res. Transport Environ.* 52, 128–138.
- Thøgersen, J., 2008. Social norms and cooperation in real-life social dilemmas. *J. Econ. Psychol.* 29, 458–472.
- Thorhauge, M., Kassahun, H.T., Cherchi, E., Hausteine, S., 2020. Mobility needs, activity patterns and activity flexibility: How subjective and objective constraints influence mode choice. *Transp. Res. Part A* 139, 255–272. <https://doi.org/10.1016/j.tra.2020.06.016>.
- Topalli, V., Higgins, G.E., Copes, H., 2014. A causal model of neutralization acceptance and delinquency: Making the case for an individual difference model. *Crim. Justice Behav.* 41 (5), 553–573.
- Travis, D.J., Carleton, A., Lauritsen, R.G., 2002. Contrails reduce daily temperature range. *Nature* 418, 601. <https://doi.org/10.1038/418601a>. PMID 12167846.
- Triandis, H.C., 1977. *Interpersonal Behaviour*. Brooks/Cole, Monterey, CA.
- Triandis, H.C., 1980. Values, attitudes, and interpersonal behavior. In: Howe, H.E., Page, M. (Eds.), *Nebraska symposium of motivation*. University of Nebraska Press, Lincoln, pp. 195–259.
- Uba, C.D., Chatzidakis, A., 2016. Understanding engagement and disengagement from pro-environmental behaviour: The role of neutralization and affirmation techniques in maintaining persistence in and desistance from car use. *Transp. Res. Part A* 94, 278–294.
- Van der Werf, E., Di Maria, C., 2011. Unintended detrimental effects of environmental policy: the green paradox and beyond. CESifo Working Paper 3466. CESifo, Munich.
- Vuchic, V., Casello, J.M., 2002. An evaluation of Maglev technology and its comparison with high speed rail. *Transport. Quart.* 56 (2), 33–49.
- Wardman, M., 1988. A comparison of revealed preference and stated preference models of travel behaviour. *J. Transp. Econ. Policy.* 22 (1), 71–91.

- Yang, X., Cheng, S., Lang, J., Xu, R., Lv, Z., 2018. Characterization of aircraft emissions and air quality impacts of an international airport. *J. Environ. Sci.* 72, 198–207.
- Zhang, H., Chen, W., Zhang, Y., Buhalis, D., Lu, L., 2018. National park visitors' car-use intention: A norm-neutralization model. *Tourism Manage.* 69, 97–108. <https://doi.org/10.1016/j.tourman.2018.06.001>.
- Zhang, R., Lang, C., 2018. Application of motivation-opportunity-ability theory in the consumption of eco-fashion products: Were Chinese consumers underestimated? In: Xu, Y., Chi, T., Su, J. (Eds.), *Chinese Consumers and the Fashion Market*. Springer Series in Fashion Business. Springer, Singapore, pp. 119–141.