



Flying High in Academia—Willingness of University Staff to Perform Low-Carbon Behavior Change in Business Travel

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This study aims to explore the factors that influence business travel decisions of university staff, in particular the extent and ways in which they are willing to reduce emission-intensive air travel, and the personal and structural barriers to such behavior change. Three strategies to reduce air travel were investigated: abstaining from particular events, substituting travel through virtual participation and mode shifting to ground-based public transport. We tested the effects of (1) specific decision factors for engaging in long-distance travel, choosing specific modes of travel and choosing virtual solutions; (2) former travel activities; (3) postponed trips due to COVID-19; and (4) sociodemographic factors, on the willingness of individuals to reduce air travel in a sample of university employees. We calculated regression models for the three strategies and added a qualitative analysis of open-ended comments. Former travel behavior as well as pro-environmental considerations play significant roles, influencing the willingness of employees to change their business travel behavior. Furthermore, we found that willingness to reduce air travel depends on the scope of behavior change. Although travel behavior is unevenly distributed across different subgroups, sociodemographic factors only play a minor role in the regression models. The present study adds to the limited body of quantitative research on the reduction potential of academic air travel, presenting an examination of university staff's willingness to change their long-distance travel behavior. Implications for university polices are discussed.

Keywords: academic air travel, behavior change, reduction potential, business travel, climate change mitigation

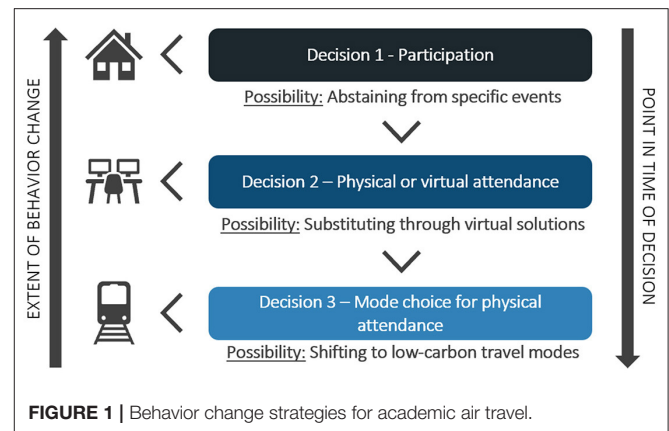
INTRODUCTION

An increasingly broad range of organizations is making efforts to incorporate different aspects of sustainability to their operations (Lozano and Garcia, 2020). Universities arguably were among the first to do so, acknowledging their role in promoting sustainable development from the 1970s onwards. These efforts were intensified around the turn of the millennium, when strategies for higher education in fostering sustainable development, as well as proposals for sustainable universities were designed (Keniry, 1995; Creighton, 1998; van Weenen, 2000). The ways in which higher education institutions contribute to sustainable development today is manifold and requires a holistic perspective, including not only research and education activities, but also broader social influence through outreach and collaboration (Lozano et al., 2015). Many universities furthermore

have committed to reduce the environmental impact of their own operations and have developed sustainability plans and implemented environmental management systems (Semeraro and Boyd, 2017; Holdsworth and Thomas, 2020; Bauer et al., 2021; Latter and Capstick, 2021). More recently, also the narrower issue of climate protection has risen to prominence in this context. As far as greenhouse gas emissions are concerned, monitoring typically focuses on scope 1 and scope 2 emissions (direct on-campus emissions and emissions from purchased energy). However, scope 3 emissions—all other indirect emissions, in particular from staff mobility—contribute significantly to the overall carbon footprint of universities (Robinson et al., 2015; Getzinger et al., 2019). One particularly relevant topic in this context is air travel, which amounts to about 3.8% of global CO₂ emissions, with increasing travel demand and emissions expected for the future (EEA, 2020; EC, 2021). Furthermore, the climate impact of air travel goes beyond CO₂ emissions, which significantly increases its effect on radiative forcing (Lee et al., 2021). So far, only few universities have started to tackle emissions from business travel, in particular business air travel. Glover et al. (2018), studying Australian universities, found that 53% ignore the topic of air travel altogether and another 16% recognize it without intervening.

Members of academia often consider air travel to be a prerequisite for career development and good scientific work, which makes it almost impossible for them to completely abstain from flying (Hamann and Zimmer, 2017; Nursey-Bray et al., 2019). This institutional pressure is most strongly felt by early-career researchers, as air travel enables them to establish international networks (Glover et al., 2019), among other things. However, research shows that the level of travel actually increases throughout the career stages and is especially high among professors (Arsenault et al., 2019). In general, mobility is among the biggest contributors to the carbon footprint of researchers (Achten et al., 2013; Getzinger et al., 2019; Clabeaux et al., 2020; Hölbling, 2020). Apart from the environmental impact of emissions from academic flying, it also has significant social consequences. Frequent flying can affect researchers' credibility negatively, especially those who are working on climate change and sustainability topics (Attari et al., 2016; Higham and Font, 2020). As researchers are often seen as role models or pioneers in society, several authors underline the need to encourage behavior change in academia regarding air travel (Thompson, 2011; LeQuéré et al., 2015; Higham and Font, 2020).

On the individual level, the awareness of climate change and the role of travel emissions among researchers is generally quite high (Whitmarsh et al., 2020). At the same time, carbon footprints from researchers are higher than those of average citizens (Schmitz et al., 2014) or employees (LeQuéré et al., 2015), which underlines the existence of an attitude-behavior gap in academia (Nursey-Bray et al., 2019). However, changes are occurring among university staff (Langin, 2019). For example, Whitmarsh et al. (2020) asked both experts and non-experts on climate research whether they had (a) abstained from a work-related event or (b) chosen another mode of travel within the last 12 months to reduce their carbon footprint. In general, they found higher levels of behavior change among climate experts,



namely, 29.2% (5% for non-experts) for (a) and 37.9% (16.5% for non-experts) for (b). Similarly, Haage (2020) asked whether German scientists would be willing to reduce their conference travel for the environment, and 63% responded with yes. The COVID-19 pandemic added to this apparent interest in change (Whitmarsh et al., 2021), as it temporarily halted flights and simultaneously led to an increased use of virtual solutions, especially in relation to conferences (Klöwer et al., 2020; Shelley-Egan, 2020; Viglione, 2020). Since this decline in air travel is most likely only a short-term phenomenon (Gössling et al., 2021; Gudmundsson et al., 2021), this is an opportune time to examine academic air travel dynamics and discuss possible behavior change strategies for emission reduction in the context of universities.

At the individual level, three major strategies can be distinguished (LeQuéré et al., 2015; Baer, 2018; Hamant et al., 2019; van Ewijk and Hoekman, 2020), which are illustrated at different points in time on the travel decision tree and comprise different extents of behavior change (see **Figure 1**).

The most radical approach for reducing academic air travel emissions would be to *avoid certain long-distance business trips altogether*. LeQuéré et al. (2015) described some key factors influencing academic air travel as people's desire to see parts of the world and their perception that flying less would limit their career opportunities. Wynes and Donner (2018) arrived at similar results, whereby family time/leisure and research requirements were the two dominant reasons for flying. Another option for reducing travel, and subsequently travel emissions, is to *switch from physical to virtual travel* by using information and communication technology (ICT) solutions (Julsrud et al., 2014; Wynes and Donner, 2018). Due to the COVID-19 pandemic, this strategy involuntarily became the dominant communication approach for academic purposes and led to a sharply increased use of infrastructure, tools, willingness, and capabilities for dealing with these digital solutions (Schwarz et al., 2020). The third strategy, in case of physical travel, would be to *substitute air travel with ground-based transport*, notably public transport such as trains and busses, for certain distances (e.g., for travel under 1,000 km). A range of factors influence people in their choice of

travel mode. Lassen (2006) identified time, money, and comfort as most important priorities in modal choice for business travel in knowledge organizations, while environmental considerations were sidelined. However, more recent research by Haage (2020) showed that environmental considerations ranked directly after travel time and before the comfort or costs of the business trip. While both virtual solutions and ground-based public transport also entail carbon emissions, it is clear that these are significantly lower than those of air travel (EEA, 2014; Klöwer et al., 2020; Duane et al., 2021).

A variety of qualitative studies have been carried out to address different aspects of academic air travel, placing a special focus on conference travel and the relevance of virtual solutions (e.g., Sá et al., 2019; Hauss, 2020; van Ewijk and Hoekman, 2020). However, the number of quantitative analyses related to this topic is limited, with a focus on the descriptive statistics of travel behavior (e.g., LeQuéré et al., 2015; Haage, 2020) or on emission calculations (Achten et al., 2013; Arsenault et al., 2019; Chalvatzis and Ormosi, 2020). One important exception is Whitmarsh et al. (2020) who recently conducted an international survey on the use of aviation by researchers. They found that climate change researchers fly more than those in other disciplines. However, they also found that researchers with stronger environmental values showed a greater willingness to reduce flying and support corresponding university policies.

The present study adds to the limited body of quantitative research on the reduction potential of academic air travel, presenting an examination of university staff's willingness to change their long-distance travel behavior for the case of the University of Graz, Austria. Three main strategies for individual behavior change are considered. By applying this approach, we seek to answer (i) which factors influence the long-distance business travel decisions of university staff, (ii) the extent and ways in which university staff is willing to reduce emission-intensive air travel, and (iii) which personal and structural barriers to behavior change exist. While the paper focuses on the propensity for behavior change of individuals, its results have important implications for the organizational level. In view of the high autonomy of university employees in travel decisions, the study provides a basis on which university managers can develop targeted intervention strategies to tackle emission reductions in staff mobility.

METHODS

To answer the research questions outlined above, an online survey was conducted in August and September 2020 among employees at the University of Graz, Austria. The questionnaire covered four main thematic areas: (1) business travel activities in 2019 and changes due to the COVID-19 pandemic in 2020, (2) decision factors for business travel, (3) future reduction potential, and (4) sociodemographic variables. Since administrative staff at universities also undertake a significant proportion of business flights, we included them in the sample with the researchers and summarized both groups under the term academic air travel.

Academic travel activities in 2019 for air travel, long-distance ground-based public transport and virtual mobility, as well as trips that had to be postponed or canceled due to COVID-19 in

2020 up to the time of the survey, were operationalized by using numeric answer boxes to fill in the number of trips. Air trips were outlined as *"a trip there and back including stopovers."* Long-distance ground-based public transport trips were defined as *"train or bus journeys for business purposes with a travel time of 6 h or more (in one direction)."* Virtual mobility was specified as the *"use of video-/teleconferencing technologies (Skype, Zoom, etc.) for one of the following business purposes: Presentation at conference or workshop, participation in conference or workshop, project meeting, giving a guest lecture, data collection (e.g., interviews), teaching."* Respondents were asked to state their willingness to reduce future academic air travel through (a) abstaining from participation in some events, (b) participating virtually, and (c) shifting the travel mode to ground-based public transport for trips under 1,000 km on four-point scales ranging from "not at all" to "to a high degree."

Corresponding influencing factors for the three proposed strategies to reduce air travel emissions comprised relevant topics for business travel. With regard to (a), factors that influenced the decision to go on long-distance business trips, such as expectations of superiors or the relevance to personal career development, were summarized (LeQuéré et al., 2015; Hopkins et al., 2016; Gärdebo et al., 2017; Storme et al., 2017). With regard to (b), factors that influenced the use of virtual solutions as described in Wynes and Donner (2018), such as the quality of the internet connection, were presented. With regard to (c), factors that influence mode choice, such as travel time or comfort, were depicted (Lassen, 2006; Hislop and Axtell, 2015; LeQuéré et al., 2015). All decision factors were rated by respondents on a four-point scale ranging from "unimportant" to "very important." Furthermore, environmental friendliness was operationalized by rating the statement "I think of myself as an environmentally friendly person" on a four-point scale ranging from "do not agree at all" to "fully agree." Originally, four statements for environmental self-identity were adapted from Whitmarsh and O'Neill (2010). As Cronbach's alpha only amounted to 0.47, only one single statement was included in the final analysis.

We measured the willingness of staff to reduce future academic air travel by (a) abstaining from participation in events, (b) using virtual solutions, and (c) shifting the travel mode for trips under 1,000 km by calculating three OLS regression models, including the respective decision factors, environmentally friendly self-image, the numbers of trips that had to be canceled/delayed due to COVID-19, the shares of different academic travel activities in overall academic travel, as well as sociodemographic data. All quantitative assessments were calculated using R software (version 1.2.1335). During the survey, respondents could state their opinions in several open-ended text fields. Using MAXQDA software (version 20.4.0), the comments were structured inductively into categories and were then analyzed to add to the quantitative analysis.

RESULTS

We collected data from $N = 338$ university employees, which corresponds to a response rate of 11.5% (see **Supplementary Material** for details). The final sample included sociodemographic information regarding gender

(52.7% male and 43.5% female, 3.8% non-binary/undisclosed), type of working contract (49.7% with fixed term and 50.3% with permanent position) and staff group (23.3% predocs, 26% advanced researchers, 29.6% professors, and 21.2% administrative personnel). It was not possible to collect additional personal information (such as faculty affiliation or research area) in order to comply with the university's data protection requirements to prevent the traceability of individuals. The most important reasons for travel identified were a conference or workshop presentation with a share of 37.9%, followed by project meetings (22.9%), conference or workshop participation (14.9%), and holding guest lectures (14%). The two least important travel reasons were data collection and teaching (5.1% each).

Potential Drivers of Academic Air Travel

On average, university staff undertook 2.6 (SD = 3.9) air trips, 1.1 (SD = 1.9) ground-based trips and 1.5 (SD = 3.5) virtual trips in 2019 (one answer was excluded due to an improbably large number (150 virtual trips), where we assume that the question was misunderstood or that a typo occurred). The number of overall trips amounts to a mean value of 5.2. When examining different sociodemographic groups, across all types of trips, professors showed the highest travel volume (mean of 7.9 trips overall, SD = 7.7). On average, 2.5 trips (SD = 2.5) had to be canceled or postponed due to COVID-19 in 2020. **Table 1** gives an overview of several variables included in the regression models, stating their mean values (M) and standard deviations (SD). The highest levels of willingness can be found for a mode shift to ground-based travel. The importance of decision factors for engaging in long-distance business trips ranges from M = 2.09 for the possibility to combine business trips with private purposes, to M = 3.43 for the possibility of networking and cooperating on an international level.

Regarding the use of virtual solutions, good experiences with connections is the most important factor (M = 3.12), while the offer of training courses is perceived as the least important (M = 2.02). The importance of decision factors for mode choice ranges from M = 2.72 for travel comfort to M = 3.26 for safety as the most important aspect. Respondents generally perceived themselves as rather environmentally friendly with a mean value of 3.23.

Determinants of Willingness to Reduce Academic Air Travel

General Results

To assess the determinants of three strategies to reduce academic air travel in the future separate multiple OLS regression models were calculated (see **Table 2**). While sociodemographic factors, the influence of COVID-19, and the environmentally friendly self-image were included in all three models, they differed in terms of the decision factors considered (see section Potential Drivers of Academic Air Travel for further explanations) and in terms of the travel shares (calculated by dividing the number of travel types by the overall travel volume in 2019). The adjusted

R² as an indicator for the explanatory power range from 0.133 for model II to 0.286 for model I.

In all three models, the share of former travel had a significant influence on the willingness to reduce future air travel ($p < 0.01$ for models II and III, $p < 0.05$ for model I). This effect is positive in models II and III, whereas a negative relationship can be found in model I: The higher the share of air travel on overall business travel in the past, the lower the willingness to reduce air travel by abstaining in the future. In the comments, several respondents indicated that they are already trying to reduce their air travel emissions by, for example, flying less or only flying within Europe or by combining business trips with private holidays.

Some respondents stated that they abstain from flying altogether for environmental reasons. On the other hand, respondents also mentioned that some disciplines are generally more international than others. Therefore, the reduction potential for air travel differs between research groups, e.g., “[...] there are certainly big differences in how much air travel is necessary in each case in different disciplines.”

In general, sociodemographic factors do not seem to play a role in models II and III. However, in model I, administrative staff shows a significantly lower willingness to travel less by plane in the future as compared to early-stage researchers ($p < 0.05$). A pro-environmental self-image is a significant determinant for a higher level of willingness to reduce air travel in models I and II ($p < 0.01$). As a separate decision factor is included regarding the environmental friendliness of the trip in model III, which is highly significant ($p < 0.01$), this moderation may explain the missing effect for the variable in this model. The impact of COVID-19 has a negative effect in models I and III: The more trips had to be postponed or canceled due to the current pandemic, the less people were willing to reduce air travel by shifting their mode of travel ($p < 0.01$) or abstaining from travel ($p < 0.05$) in the future.

Strategy 1: Abstaining From Specific Events

In model I, the importance of long-distance travel for doing one's job well as well as for developing one's career had a negative effect on the willingness to reduce future air travel ($p < 0.01$). This result is also supported by several comments throughout the survey. Especially early-stage researchers and those with fixed-term contracts perceived a tension between career development and university expectations, on the one hand, and climate protection on the other. At the same time, people in permanent positions and advanced researchers, such as professors, were perceived as having a greater potential to reduce their air travel. Furthermore, respondents that found it important to combine business trips with private purposes were more willing to reduce their air travel in the future ($p < 0.05$). Several respondents commented that they try to combine business and private trips, e.g., “In recent years, I have increasingly combined business trips [...] with private stays of at least 1 week. I think such an approach is in the interest of climate protection if it ‘saves’ a separate leisure trip.”

TABLE 1 | Overview of selected variables.

	Mean	SD
Willingness to reduce air travel		
(1—not at all; 4—to a high degree)		
Reducing future business air travel for journeys under 1,000 km by choosing other means of transport (e.g., train)	3.13	0.95
Reducing future business air travel by making greater use of video/teleconferencing instead of physical travel	2.80	0.93
Reducing future business air travel by abstaining from participation in particular events	2.20	0.97
Decision factors for long-distance business trips		
(1—unimportant; 4—very important)		
Importance of international networking and cooperation for career development	3.43	0.78
Long-distance business trips as a prerequisite for doing my job well	3.33	0.83
Importance of conference attendance for career development	3.10	0.93
Expectation of the university that I am internationally mobile	2.54	0.92
Expectation of my superior or colleagues that I am internationally mobile	2.47	0.96
Possibility to combine long-distance business trips with private purposes	2.09	0.89
Decision factors for use of virtual solutions instead of a business trip		
(1—unimportant; 4—very important)		
Experiences with the quality of video-/teleconference connections	3.12	0.76
Availability of IT support	2.74	0.95
Access to the university's videoconferencing room at the desired time	2.24	1.00
Preference for or dislike of the software provided by the university	2.23	0.90
Possibility to combine event participation with care or supervision obligations	2.08	1.06
Offer of training courses on the use of the software provided by the university	2.02	0.84
Decision factors for mode choice		
(1—unimportant; 4—very important)		
Duration of the trip	3.09	0.87
Safety	3.26	0.82
Environmental friendliness of trip	3.14	0.73
Costs of the trip	2.99	0.72
Possibility to work while traveling	2.97	0.77
Ease of the booking process	2.76	0.87
Travel comfort	2.72	0.73
Environmentally friendly self-image		
(1—low; 4—high)		
I think of myself as an environmentally friendly person	3.23	0.57

Strategy 2: Using Virtual Solutions Instead of Business Trips

Regarding model II, positive effects can be found for the quality of connections ($p < 0.05$) as well as the possibility to combine virtual mobility with care duties ($p < 0.01$): The more important these factors were for respondents, the higher their willingness was to substitute future air travel with virtual trips. In the comments, distinguishing between different travel purposes was considered as essential: While regular project or administrative meetings in virtual formats are perceived as adequate, the replacement of conference and workshop participation through virtual solutions was criticized: *"I am more willing to use video conferencing for meetings, but find that they do not work well for conferences. Attending conferences in person is much better for networking."* Some remarks also pointed out that fieldwork often cannot be performed virtually: *"The purpose of my business trips is to examine material that cannot be exported from the*

destination countries. It is simply impossible for me to perform data collection via video/teleconference." In addition, several respondents emphasized the difficulty associated with applying virtual solutions to mimic face-to-face exchanges and the lack of efficiency that online solutions offered as the complexity of a topic increased. Regarding the relevance of combining virtual mobility with care duties, several respondents reported that they struggle with taking the required time away from their family when they are on business trips. Finally, some respondents mentioned the positive role of the pandemic, citing that it created considerably more opportunities to participate in events virtually and improved the ability of university staff to use them.

Strategy 3: Low-Carbon Travel Mode Choice

Apart from the environmental-friendliness of the trip ($p < 0.01$), safety was also found to be a significant decision factor for

TABLE 2 | OLS regression models on willingness to reduce air travel through abstaining, taking virtual trips, and shifting travel modes.

Model I: abstaining			Model II: virtual trips			Model III: modal shift		
	b (se)	Beta		b (se)	Beta		b (se)	Beta
Gender (male)	0.141 (0.109)	0.072	Gender (<i>male</i>)	−0.045 (0.117)	−0.024	Gender (<i>male</i>)	0.066 (0.106)	0.034
Working position (early-stage researchers)			Working position (early-stage researchers)			Working position (early-stage researchers)		
Administrative staff	−0.381 (0.160)*	−0.154*	Administrative staff	0.151 (0.164)	0.064	Administrative staff	−0.173 (0.163)	−0.072
Advanced researchers	−0.012 (0.145)	−0.006	Advanced researchers	0.101 (0.148)	0.049	Advanced researchers	0.171 (0.133)	0.081
Professors	−0.120 (0.165)	−0.057	Professors	0.122 (0.154)	0.061	Professors	−0.073 (0.139)	−0.036
Pro-environmental self-image	0.323 (0.084)**	0.184**	Pro-environmental self-image	0.302 (0.095)**	0.181**	Pro-environmental self-image	0.010 (0.094)	0.006
Number of postponed trips (COVID-19)	−0.053 (0.025)*	−0.135*	Number of postponed trips (COVID-19)	−0.033 (0.023)	−0.088	Number of postponed trips (COVID-19)	−0.057 (0.022)**	−0.151**
Share of air travel	−0.307 (0.144)*	−0.117*	Share of virtual travel	0.460 (0.177)**	0.153**	Share of ground-based travel	0.363 (0.139)**	0.127**
Doing my job well	−0.183 (0.069)**	−0.144**	Quality of connections	0.191 (0.077)*	0.156*	Duration of the trip	−0.108 (0.067)	−0.099
Expectations superior/colleagues	0.063 (0.075)	0.062	Availability of IT support	−0.094 (0.072)	−0.097	Costs of the trip	0.089 (0.069)	0.069
Expectations university	−0.068 (0.083)	−0.063	Access to rooms	0.030 (0.066)	0.032	Safety	−0.182 (0.062)**	−0.157**
Career development: conferences	−0.281 (0.071)**	−0.270**	Offer of training courses	0.134 (0.080)	0.122	Environmental friendliness of trip	0.481 (0.081)**	0.367**
Career development: networking	−0.264 (0.086)**	−0.199**	Preference software	0.000 (0.061)	0.000	Ease of the booking process	−0.013 (0.061)	−0.012
Combination with private purposes	0.120 (0.057)*	0.109*	Combination with obligations	0.181 (0.052)**	0.204**	Possibility to work while traveling	0.053 (0.071)	0.041
						Travel comfort	0.030 (0.077)	0.023
Adj. R-squared	0.286	Adj. R-squared	0.133	Adj. R-squared	0.267			

* $p < 0.05$; ** $p < 0.01$. Note: The table presents unstandardized regression coefficients. Constant omitted; robust standard errors in parenthesis for models I and III due to heteroskedasticity (see **Supplementary Material** for regression diagnostic). Standardized regression coefficients are depicted in separated columns. For gender, "male," serves as basis category, for working position "early-stage researchers." F-test for models: ** $p < 0.01$; $n = 283$ for each model.

switching to more ground-based public transport in the future, but with a reversed effect: The more important trip safety was for the respondents, the less willing they were to reduce future air travel through mode shift ($p < 0.01$). This was also underlined by a number of respondents in the comments section, especially in relation to night trains: "As a woman, I don't want to travel overnight, even in a sleeping coach." Furthermore, respondents shared their concerns regarding the implied increased costs (as the university usually does not fully cover travel expenses for most trips by academic staff and only provides travel subsidies instead) and time of a potential mode shift. In addition to the expressed goal to reduce time away from the family, other problems such as missing or poor train connections, risks of delay, time away from work, or inconvenient travel hours were pointed out. Some of these aspects are directly related to travel comfort, which is again perceived to be lower in conventional train coaches. Several respondents also indicated that, under the existing university policies, the additional travel time required when taking the train instead of the plane is usually not counted as working time, making such a switch unattractive. One respondent noted: "Long train journeys take up several working days, which may not be counted as working time. I do not want to give up my free time to travel for the university."

DISCUSSION

In our investigation of important determinants for long-distance business travel, we discovered several interesting findings and significant effects related to the willingness of university staff to reduce air travel by applying different reduction strategies and to potential barriers that block behavior change.

First, one key finding is that the scope of the potential behavior change matters. As **Table 2** shows, the more radical the change, the less willing university staff are to change their behavior: The willingness to reduce flights by mode shift (maintaining physical participation in events) was highest, the willingness to shift to virtual solutions (maintaining participation but abstaining from physical presence) was somewhat lower and the strategy of completely abstaining from some events was least favored. This is not surprising, as more extensive changes in behavior have generally been found to be more difficult than smaller, more incremental ones (Whitmarsh, 2009; Gifford, 2011; Gifford et al., 2011). This could also be an indication of the limits of individual agency and the need to accompany individual behavioral changes with structural changes at the level of universities and scientific communities. While not attending events is challenging for structural reasons (e.g., career development, networking)

(Nursey-Bray et al., 2019; Rödder and Braun, 2021), one can argue that mode choice is more of an individual decision.

As our results show, reducing air travel by abstaining from participation in events is especially difficult for those whose travel behavior consists mainly of flying. This could be due to a psychological effect: Those who mainly depend on air travel to perceive the suggestion to abstain from events that cannot otherwise be reached as a greater threat than those who already regularly attend events using other travel options. This seems to hold true even if the “abstaining strategy,” as we described it in the survey, only includes a reduction in air travel and not an abstention from all events that can only be reached by plane. This finding relates to what Nursey-Bray et al. (2019) refer to as “the fear of not flying:” “[...] while academics may worry about their impact on climate change, they fear the career consequences of not flying or reducing their flying for academic purposes even more.” Even for mode choice, where individual agency is in principle highest, we found a range of barriers at the structural and individual level, such as cost, time, and safety concerns. The issue of safety has already been discussed in the literature, especially in relation to female travelers. For example, Gardner et al. (2017) found formal surveillance (through personnel) to be effective in increasing the sense of safety for women in public transport.

Interestingly, the relevance of combining business travel with private purposes seems to have a positive effect on the willingness to reduce air travel by abstaining from events. Together with the qualitative comments, this indicates that combinations of business trips with private purposes are predominantly used to reduce overall travel, rather than taking more business trips than necessary for sightseeing reasons. In other words, the individual agency that university staff do have over the decision to engage in physical travel already seems to be used to reduce the volume of their total travel. This could be a result of the overall high scores for pro-environmental self-image, which has a positive effect on the willingness to reduce flying. However, previous studies have shown that neither environmental awareness (Árnadóttir et al., 2021), nor stated behavior intentions necessarily translate into actual behavior changes (Gehlert et al., 2013; Nikolić et al., 2021). Therefore, it is questionable whether the higher willingness we found in this study is truly indicative of a greater degree of actual behavior change.

Another key finding is that previous experience matters. Those whose past travel behavior already displays greater shares of virtual and ground-based travel are also more likely to shift even further in that direction. In some ways this is counterintuitive, as one could assume that they have already exhausted a larger amount of the potential for behavior change. But our results suggest that experiences with virtual solutions and ground-based travel do indeed lead people to evaluate these alternatives more favorably. This affirms previous findings concerning the relevance of past experience and the establishment of routines (Bamberg et al., 2003; Gifford et al., 2011; Kurz et al., 2015), and indicates that encouraging university staff to experiment with alternatives may have lasting effects.

Regarding the willingness to reduce air travel by switching to virtual solutions, the possibility to combine participation with care duties is another important factor. The challenge within

academia to reconcile conference travel with care obligations is especially pronounced for women (Cohen et al., 2020). Therefore, offering more virtual participation options as an alternative to air travel could also have the added benefit of making events more inclusive (Wakefield and Dismore, 2015; Haage, 2020; Leask, 2020). However, according to our qualitative findings, the type of event plays a decisive role in the perceived suitability of virtual solutions: While project meetings and to a lesser extent conferences can be held online, this is not possible for field work and data collection in the majority of cases. Furthermore, even *in situations* where online solutions can principally be used, concerns were raised about the lack of social interactions and networking opportunities. This finding is similar to that of Storme et al. (2017), who argued that meetings of established groups of academics with close ties can more easily be reproduced virtually than meetings of large and loosely connected groups. One solution for this could be to have hybrid or multi-site conferences conference settings (Sá et al., 2019; van Ewijk and Hoekman, 2020).

Furthermore, when examining the descriptive results, we found that air travel and academic travel were highly skewed and unevenly distributed across different subgroups, with the highest proportion of air travel occurring among professors. This finding is consistent with previous research and adds to the frequently voiced criticism that the frequent flyers within academia are mostly senior researchers who are the least dependent on air travel for their career progression (Arsenault et al., 2019). In addition to the career stage, our qualitative findings suggest that disciplinary affiliation also influences the amount of academic flying, as some scientific communities are more strongly globally connected, and some disciplines depend on fieldwork in distant locations (Whitmarsh et al., 2020). Interestingly, no differences between gender or staff type were found in the models. One explanation for this could be that the sociodemographic differences were overshadowed by the strength of the environmental factors (namely, pro-environmental self-image and relevance of environmental considerations for mode choice). An exception is the significantly lower willingness of administrative staff to abstain from air travel as compared to early-stage researchers. This might be explained by a lower autonomy of administrative staff in terms of business travel decisions.

Another relevant aspect is the impact of the COVID-19 pandemic on behavioral willingness. The more frequently trips had to be canceled or postponed, the greater the desire these employees exhibited to travel again, and especially to fly (see models I and III). In model II (substitution by virtual solutions), this effect may be counterbalanced by learning effects during the pandemic concerning the potentials of videoconferencing. Indeed, literature already suggested that experiences made by academics with virtual solutions during the pandemic could support a lasting shift toward virtual mobility. While videoconferencing supplemented rather than substituted physical travel before, academics now appear to be more willing to modify the ways meetings are conducted in favor of online or hybrid formats (Schwarz et al., 2020; Shelley-Egan, 2020).

Although this study focused on the individual perspective, our results also demonstrate the limits of relying solely on individual behavior change, as the willingness and ability at the employee level is closely linked to support and commitment at the organizational level. Although universities need to acknowledge that it is challenging for their employees to drastically cut their business air travel, they should also realize that there is considerable willingness to reduce it in principle, which they can build on. Our findings suggest several entry points for universities to assist their employees in shifting to more sustainable ways of long-distance business travel. The key barriers to switching to rail travel are the costs involved, longer travel times and safety issues. Potential measures to support rail travel could include: (i) full cost coverage for ground-based public transport, possibly including 1st class tickets for trips exceeding a certain duration, (ii) accounting for travel time as actual working time, and (iii) cost coverage for single-compartments in night-train sleeping coaches to improve travel comfort and safety perception. Such incentives for ground-based travel could also be complemented by disincentives for air travel, e.g., limiting or even denying cost coverage for air travel when ground-based public transport is available and travel time does not exceed a certain limit. Regarding virtual trips, a good internet connection was found to be an essential aspect, as was the possibility to combine conference attendance with caregiving duties at home. Therefore, providing good infrastructure and further improving virtual options could be potential measures. In particular, universities could strive to push the use of virtual trips for project meetings and encourage hybrid or multi-site conference formats. Another potential approach could be to find new ways to enable combinations of business travel with private holidays, as this seems to be one way to limit overall employee travel. Finally, and most importantly, if far-reaching measures are to be taken to limit emissions from long-distance travel, including the abstention from specific events, profound changes in the understanding of universities themselves will also be required. This means that we need to discuss more broadly what constitutes good scientific research and under what circumstances physical travel should be considered essential (see also Glover et al., 2017; Hoolohan et al., 2021). Based on our findings, an additional question concerning these circumstances would be to ask “for whom” certain forms of academic travel are necessary, thus differentiating between staff groups based on their needs and vulnerabilities (e.g., especially supporting early-stage and fixed term employees, expanding virtual participation options for people with care duties).

As in other studies, the present study also has certain limitations. Some of these, such as the focus on behavioral intention and the resulting potential gap to actual changes in behavior, have already been pointed out. Another aspect is the case study design of the study. We collected data for staff at the University of Graz, Austria. The situation may differ at universities located in other countries. Even within the same country, local circumstances may differ, for example, as university staff in the capital may have access to better train connections, but also immediate access to airports. In

addition, the participation in the survey was voluntary, and we could not reproduce the exact structure of sociodemographic groups in the university population. Finally, the explanatory power of model II (virtual stay) is comparatively low. One explanation for this could be the different characteristics of virtual as compared to physical travel or specific factors (such as the type of event) that we did not include in the model.

CONCLUSIONS

In this study, we asked whether the emissions from academic air travel could be reduced by proposing three different strategies. We found a general willingness among university employees to reduce their air travel, mostly by switching to ground-based travel, but also by using virtual solutions, or abstaining from certain events. However, all three strategies also have specific drawbacks and barriers that go beyond the scope of individual choices and agency. Future research on the individual level could further elaborate on how to enable deep behavior change, such as abstaining from flying, which is particularly relevant but at the same time very difficult to tackle. While we focused on the individual level of behavior change, the ongoing climate challenge requires change at multiple levels at the same time. Therefore, action at the institutional level is also called for. For example, in order to help university staff overcome structural barriers, universities need to adapt their travel policies in favor of and to incentivize green travel (Wynes and Donner, 2018; Whitmarsh et al., 2020), and scientific communities should consider virtual or hybrid conference settings (Klöwer et al., 2020; Parncutt et al., 2021; Sarabipour et al., 2021).

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because to comply with the university's data protection requirements written down in a mutual agreement for this study, the dataset is restricted for internal use only.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

AT: conceptualization, methodology, software, formal analysis, writing—original draft, writing—review and editing, and visualization. AS: conceptualization, methodology, and writing—review and editing. AP: conceptualization, methodology,

writing—review and editing, and supervision. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

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