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# People would rather pay more than fly less: implications for aviation decarbonisation

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## Abstract

Current policies designed to decarbonise aviation rest on the assumption that passengers will absorb higher ticket prices. Yet whether this assumption holds and how distributive design shapes public support remains largely untested. Using a randomised controlled trial ($N = 3,454$) in the United States, Switzerland, and China, we test four distributive designs of a flying surcharge and a flying budget on willingness to pay and willingness to change. Respondents are markedly more willing to pay more than to fly less, and personal fairness drives both outcomes more strongly than group-level distributive fairness, contradicting the pattern in the broader climate-policy literature. Frequent, business, and high-income flyers oppose designs that constrain flying; a uniformly applied flying fee attracts the broadest support. These results highlight a major political challenge for demand-restraint policies: across a range of countries and subgroups, passengers consistently prefer cost pass-through over flying less, and willingness to change remains low and contingent on individual climate concern.

Aviation accounts for approximately 4% of anthropogenic warming to date and is among the fastest-growing contributors to climate change.[1,2] Decarbonising the sector is particularly challenging owing to its complex non-$CO_2$ climate forcings,[3] high energy density requirements,[4] long-lived capital stock, and the currently limited availability of scalable alternatives to fossil jet fuel.[5,6] Unlike most sectors, aviation has no prospects for widespread electrification by mid-century, placing it firmly among the 'hard-to-abate' industries whose credible net-zero trajectories depend on a narrow and contested set of mitigation options expected to lead to higher costs for passengers.[7,8,9]

Sustainable aviation fuels are widely regarded as aviation's primary decarbonisation lever.[9,10] Unlike electric or hydrogen-based propulsion, sustainable aviation fuels are compatible with existing aircraft and infrastructure, making them the cornerstone of aviation climate strategies globally, including the EU's ReFuelEU Aviation mandate and the UK's Jet Zero strategy.[11,12] In the net-zero roadmap by the International Air Transport Association, sustainable aviation fuels alone are projected to deliver 70% of required emission reductions by 2050.[13] Yet this strategy is critically contingent on passengers' willingness to absorb the cost premium that sustainable aviation fuels carry over conventional jet fuel: public subsidies at this scale would be both fiscally unsustainable and regressive, given that aviation demand is concentrated among high-income travellers.[14] Airlines operating on thin profit margins[15] are unlikely to bear these costs unilaterally, making passenger willingness to pay a pivotal variable for both the commercial viability of sustainable aviation fuels and the political feasibility of SAF mandates. The fragility of this cost structure was exposed in early 2026 when geopolitical disruption caused jet fuel prices to more than double.[16]

Alongside supply-side decarbonisation, many suggest that demand restraint is an indispensable component of aviation's net-zero transition.[9,7] Demand reductions of the magnitude observed during the COVID-19 pandemic have been included in scenarios as one of 26 key mitigation 'wedges' needed to

maintain a 1.5°C pathway.[17] More modest reductions, like limiting demand growth to 1% per year against growth by 5.7% in 2025 (IATA, 2025), would substantially ease the burden on technological solutions.[1,18] Demand growth also directly amplifies non-$CO_2$ forcings such as contrail formation, which are sensitive to traffic volume.[7,19] Yet passengers' willingness to change their flying appears limited: market-based instruments such as flight contingents attract weak public support,[20] and country-level studies consistently find greater acceptance for policies targeting the aviation industry than those requiring individual behavioural change.[21,22]

A more granular picture of literature on willingness to pay reveals considerable heterogeneity among flyers and unresolved contradictions. While willingness to pay can be enhanced by increasing associated emission reductions, aggregate willingness to pay varies widely across studies, with some finding respondents willing to pay for mandatory surcharges and others reporting general reluctance to pay more.[23,24,25] Demographic and behavioural factors are also consequential: women tend to express higher willingness to pay for aviation-related environmental taxes, while frequent flyers and long-haul passengers are consistently less willing to bear additional costs.[23,22,25] Voluntary 'climate package' programmes offered by carriers reveal low opt-in rates, though these are not directly comparable to stated willingness to pay in a compulsory surcharge setting. Together, these patterns point to contextual determinants of aviation policy support that existing research has yet to characterise.

One underexplored driver of how the public responds to aviation policy is the distribution of costs. Aviation emissions are highly unequally distributed: only 11% of the global population travels by air, and the top 1% of flyers likely accounted for more than half of all passenger aviation emissions in 2018.[14] Air travel demand is also strongly income-elastic,[26,27] concentrating emissions among a small, affluent share of the global population.[28] This concentration creates several alternative ways of distributing the burden of decarbonisation, for instance across all passengers uniformly, in proportion to income or climate impact, focusing on the highest-frequency flyers or the most discretionary flights. These alternatives carry very different implications for who is asked to pay more or fly less.[29] How the public responds to such distributional choices is consequential: in the broader climate-policy literature, perceived fairness is among the most important determinants of acceptance[30] and policies seen as distributively unjust can trigger sustained public resistance and backlash.[31] Yet for aviation specifically, empirical evidence on how distributional choices shape both willingness to bear additional costs and willingness to change flying behaviour remains thin, leaving open the question of which designs could deliver the demand reductions in the short-term needed for a 1.5°C-compatible pathway while retaining public support.

Here we address this gap by experimentally testing how the framing of distributive justice, varying which distributive rule governs decarbonisation costs, affects passengers' willingness to pay for sustainable aviation fuels and willingness to change their flying behaviour. We operationalise four distributive justice principles as four flying surcharge designs: a uniform flying fee, an income-based fee, a frequent-flying fee, and a tourism fee; and four corresponding flying budget designs, a proportional reduction, an equal budget, a frequent-flying cap, and a tourism cap. We further examine the interplay between personal fairness perceptions and group-level fairness assessments, and how these jointly predict support for aviation climate policies. We use a post-test only randomised controlled trial design analysed with linear mixed-effects models, with data collected from a quota-based sample of 3,454 respondents in the United States, Switzerland, and China. By embedding distributional considerations into the study of aviation decarbonisation behaviour, this work contributes to both the emerging literature on justice in climate policy and the specific policy challenge of making aviation's net-zero transition politically viable.

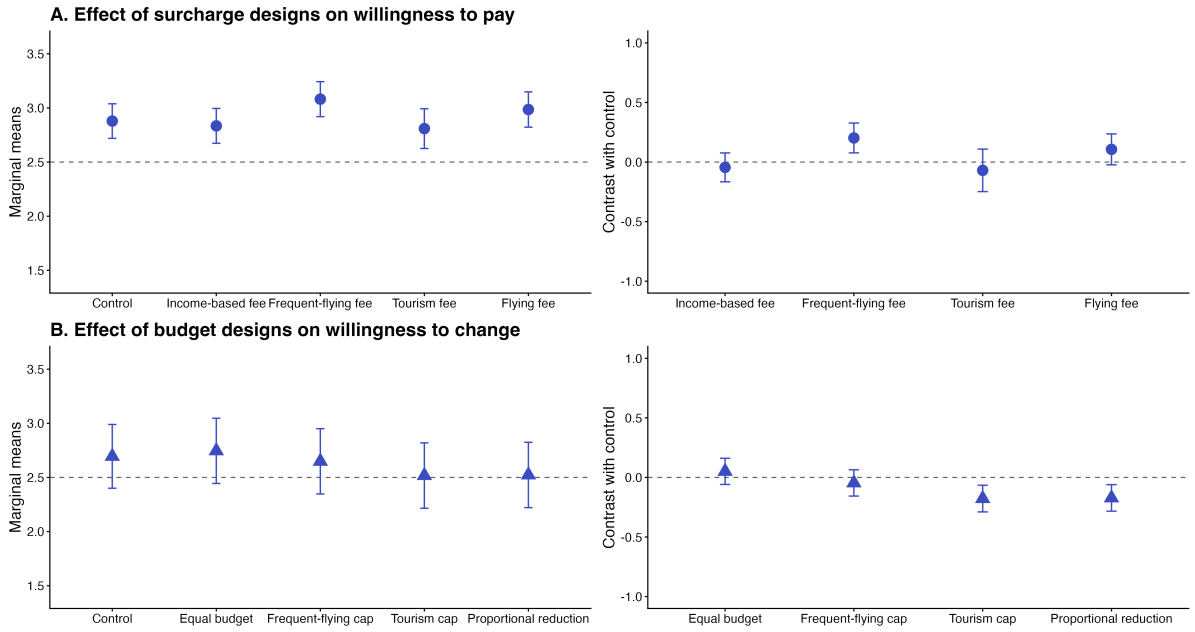



Figure 1: Estimated marginal means (left) and contrasts with the control group (right) for A. willingness to pay across the four aviation surcharge designs and the control group, and B. willingness to change across the four aviation budget designs and the control group, based on the model in Eq. 1, with more information in Supplementary Materials. The willingness-to-pay model controls for the relative added cost of the surcharges, so estimates are not confounded by differing prices across people and treatments. Confidence intervals are wider for willingness to change than for willingness to pay, reflecting greater outcome variance in the willingness-to-change measure. Error bars indicate 95% confidence intervals; circles denote willingness-to-pay estimates and triangles willingness-to-change estimates. Grey dotted lines mark the boundary between willing and unwilling on marginal-means plots and no effect relative to the control on contrast plots; a one-point difference on either equals one point on the six-point Likert scale (0–5).

# Results

## Passengers would rather pay more than fly less

No single aviation policy design is uniformly preferred across our full sample (Fig. 1). Among price-increase instruments, the flying fee and the frequent-flying fee produce positive effects on willingness to pay relative to the control, which captures respondents' baseline willingness in the absence of any explicit distributive design. The income-based fee and the tourism fee have no discernible aggregate effect. The picture is more muted for flying-budget instruments: no design raises willingness to change one's own flying behaviour above the control level. The tourism cap and the proportional reduction slightly lower willingness to change, while the equal budget and the frequent-flying cap are statistically indistinguishable from the control.

Despite the absence of a dominant design, a consistent asymmetry emerges across the two instrument families: respondents are markedly more willing to pay more than to change their flying behaviour. Marginal means for willingness to pay cluster around three on our six-point Likert scale (0 = very unwilling, 5 = very willing) across all surcharge treatments and the control, placing the average respondent in the somewhat-willing range, whereas marginal means for willingness to change cluster around 2.6, between somewhat unwilling and somewhat willing. The direction of treatment effects reinforces this gap: several surcharge designs raise willingness to pay above the control level, yet no budget design produces a comparable increase in willingness to change, and several suppress it.

Personal fairness – how fair respondents perceive a policy design to be to themselves – is the dominant predictor of willingness to pay and willingness to change (Fig. 2). Across all surcharge designs, higher perceived personal fairness translates into a higher predicted willingness to pay or change. Group fairness – how fairly respondents perceive a policy's burden to be distributed across society – is also positively associated with both outcomes, but its effect is substantially weaker. Willingness to change is additionally shaped by two further covariates: climate concern, with more concerned respondents more willing to change their flying behaviour, and recent flying frequency, with predicted willingness to change declining as the number of flights taken in the past 12 months increases.

The flying fee receives the highest group-fairness rating among surcharge designs, consistent with uniform cost distribution, while the income-based fee and frequent-flying fee score higher on personal fairness (Fig. 3A). Among budget designs, the equal budget is rated the most personally fair, while the proportional reduction scores highest for group fairness (Fig. 3B). The tourism fee and the tourism cap are consistently perceived as the least fair designs on both dimensions (Fig. 3), indicating that excluding tourism from sustainable flying, despite tourism being a major driver of aviation demand, is not regarded by the public as a legitimate distributive principle.

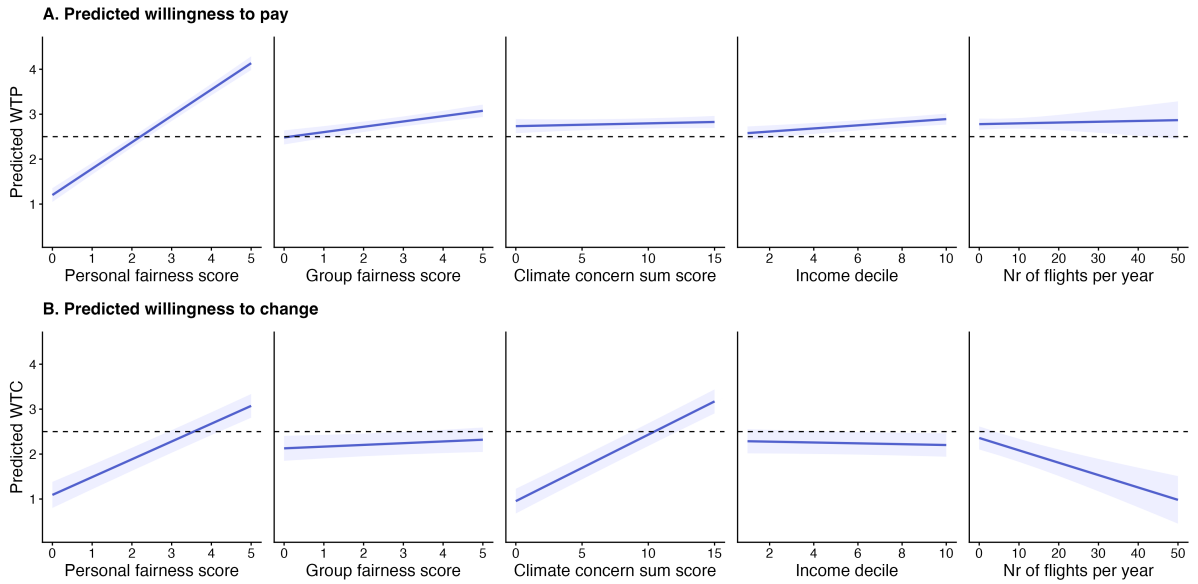



Figure 2: Predicted outcome variable scores for A. willingness to pay for flying and B. willingness to change own flying based on personal fairness, group fairness, climate concern score, income decile, and flying behaviour. Because personal and group fairness are included as covariates, the estimates for flying frequency, climate concern, and income reflect direct effects only; total effects including the indirect pathway through personal fairness are shown in Figures 4 and 5. The willingness-to-pay model additionally included the relative added cost of the surcharges. See Supplementary Materials for full model specifications. Grey dotted lines mark the boundary between willing and unwilling; a one-point difference equals one point on the six-point Likert scale (0–5).

## Respondents favour designs that grant them a personal advantage

The null aggregate effects reported above mask substantial heterogeneity across subgroups defined by flying frequency, flying purpose, and income. Disaggregating the sample reveals a systematic self-interest pattern: respondents respond more positively to designs that impose lower costs on themselves, and more negatively to designs that constrain them directly. The same design that nudges one subgroup towards higher willingness to pay or change dampens that of another, and these opposing effects largely

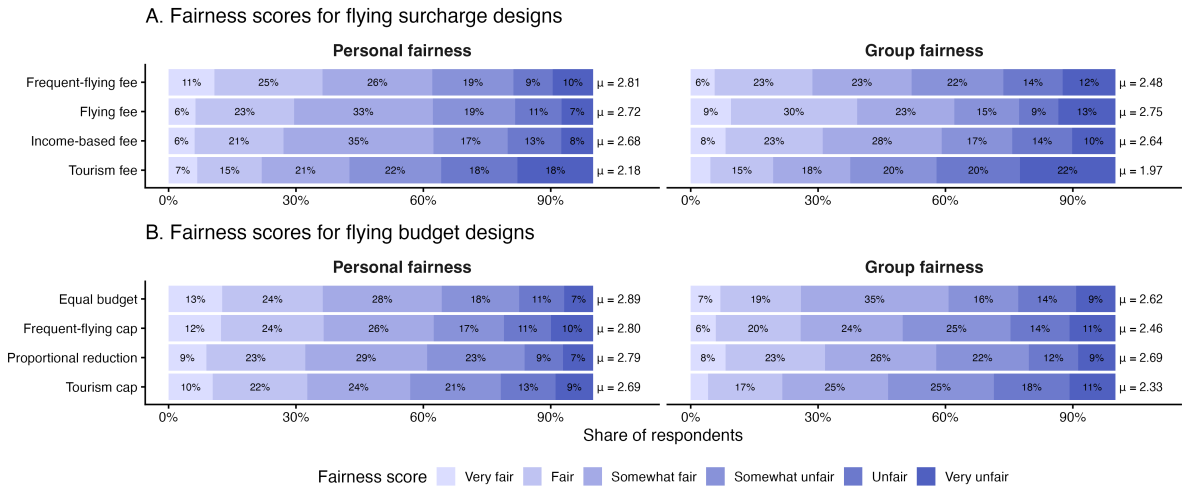



Figure 3: Fairness scores for A. flying surcharge designs and B. flying budget designs. The designs are ordered based on mean personal fairness scores.

cancel out at the aggregate level.

The pattern is clearest along flying frequency (Fig. 4, left panels). Average flyers show higher willingness to pay under the tourism fee and the flying fee, with no detectable response to the income-based or frequent-flying fees. Frequent flyers react most negatively to the income-based fee, the design that targets them most directly through the link between income and flying, and most positively to the flying fee, which spreads the cost evenly across all travellers. Non-flyers show their largest positive responses to the frequent-flying fee and the flying fee, with no response to the tourism fee. The same logic extends to flying budgets (Fig. 4B, lower left panel): average flyers and non-flyers respond positively to the equal budget and the frequent-flying cap, both of which constrain frequent flyers more than they constrain these two groups, while frequent flyers show pronounced negative effects on the same designs. Frequent flyers' baseline willingness to change in the control group is also the lowest of the three subgroups, pointing to a low willingness to change regardless of treatment.

Disaggregating by flying purpose, whether respondents fly primarily for business or for leisure, reinforces and extends this picture (Fig. 4, right panels). Business flyers, whose flying is largely non-discretionary, react most strongly against designs that constrain their own flying: their willingness to change drops sharply under the equal budget and the frequent-flying cap, and the flying fee produces no positive shift in their willingness to pay. Their strongest positive response, by contrast, is to the tourism fee – the one surcharge design that explicitly exempts non-leisure travel. Leisure flyers show a more muted pattern, with only the frequent-flying fee producing a positive effect on their willingness to pay and no clear response to the budget designs.

A similar, though less pronounced, pattern emerges across income groups: all four budget designs reduce willingness to change among high-income respondents, while low- and middle-income respondents respond positively to the equal budget and the frequent-flying cap, mirroring the patterns seen for average and non-flyers (Supplementary Fig. S5), which is unsurprising given the positive correlation between income and flying frequency in our sample (Supplementary Fig. S9).

## Climate concern is the main counterweight to self-interest

Willingness to reduce flying is strongly driven by climate concern, but the effect is concentrated in baseline levels rather than in responsiveness to specific treatments. In the control group, high-concern

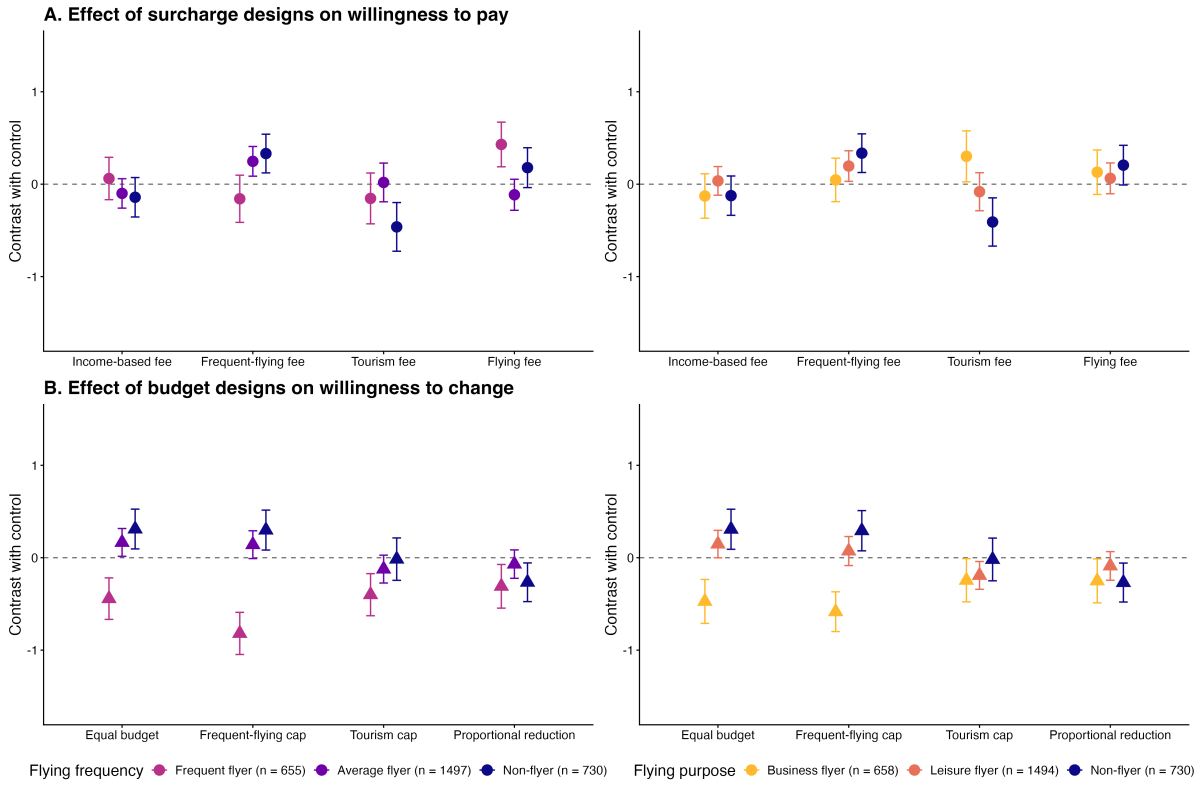



Figure 4: Contrasts with the control group for A. willingness to pay across the four aviation surcharge designs and B. willingness to change across the four aviation budget designs. Within each panel, results are disaggregated by flying frequency on the left (non-flyers, average flyers, and frequent flyers) and by flying purpose on the right (non-flyers, leisure flyers, and business flyers). The predicted scores represent total effects of each covariate, with indirect effects operating through personal fairness perceptions included in the presented results. Willingness-to-pay models control for the relative added cost of the surcharges, so estimates are not confounded by differing prices across people and treatments. See Supplementary Materials for full model specifications. Error bars indicate 95% confidence intervals; circles denote willingness-to-pay estimates and triangles willingness-to-change estimates. Grey dotted lines mark zero effect relative to the control on contrast plots; a one-point difference equals one point on the six-point Likert scale (0–5).

respondents are substantially more willing to reduce their flying than low-concern respondents (Fig. 5B, left panel). Once a budget treatment is introduced, however, none of the designs produce differential effects across the three climate concern groups, with contrasts statistically indistinguishable across low-, mid-, and high-concern respondents (Fig. 5B, right panel). Climate concern thus shifts the absolute willingness to change, but does not alter h50ow respondents react to the framing of a particular budget design.

For willingness to pay, by contrast, treatment effects vary markedly across climate concern groups (Fig. 5A). Low-concern respondents, conversely, show negative effects of the income-based fee and the tourism fee on their willingness to pay. Climate concern thus appears to be one of the few factors that motivates respondents to act against their short-term personal interest, supporting policies that raise the cost of flying even when they themselves would bear that cost.

Finally, several experimental variables for which we anticipated an effect do not produce one. The level of avoided emissions has no effect on either willingness to pay or willingness to change (Supplementary Table S2). For willingness to pay, route length – which determines the base-level ticket price – likewise has no effect (Supplementary Table S2). Country differences were largely absent: we found no

meaningful interaction effects between country and policy design (Supplementary Table S1), no differences in baseline willingness to pay across the three countries, and a half-point difference in baseline willingness to change (on the 0–5 scale), with respondents in the US scoring higher (Supplementary Figure S2).

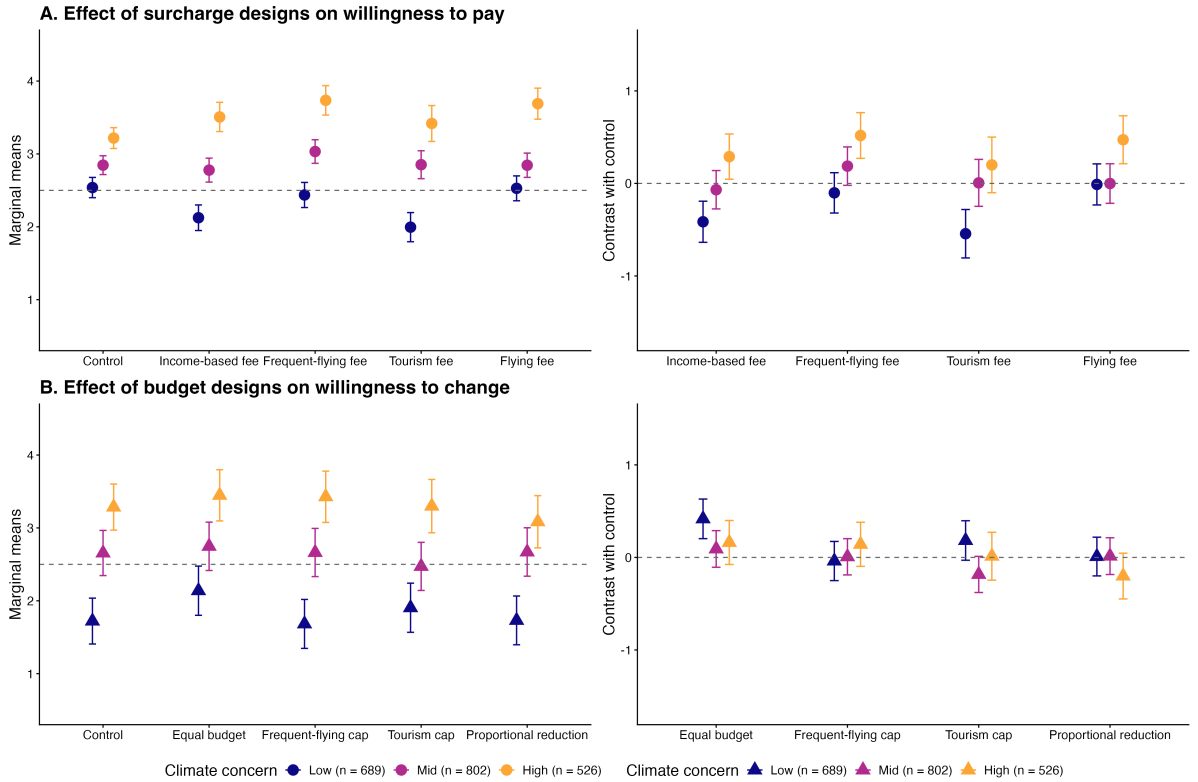



Figure 5: Estimated marginal means and contrasts with control for A. willingness to pay and B. willingness to change across groups with different levels of climate concern and the overall sample, with estimated marginal means on the left and contrasts with the control group on the right. The predicted scores represent total effects of each covariate, with indirect effects operating through personal fairness perceptions included in the presented results. Willingness-to-pay models control for the relative added cost of the surcharges, so estimates are not confounded by differing prices across people and treatments. See Supplementary Materials for full model specifications. Error bars indicate 95% confidence intervals; circles denote willingness-to-pay estimates and triangles willingness-to-change estimates. Grey dotted lines mark the boundary between willing and unwilling on marginal-means plots and no effect relative to the control on contrast plots; a one-point difference on either equals one point on the six-point Likert scale (0–5).

# Discussion

To align the aviation sector with emission pathways consistent with the Paris Agreement, passengers fundamentally face two options: paying a premium for emission mitigation or flying less. Across all three countries, we find that respondents are markedly more willing to absorb rising costs than to change their flying behaviour. Willingness to pay sits in the somewhat-willing range across all surcharge designs, which is more favourable than studies reporting general reluctance[25,32] and consistent with those finding positive support.[33,22] The flying fee and the frequent-flying fee produce the strongest positive effects on willingness to pay: the former by spreading costs uniformly, the latter by exempting most respondents from the largest increases. No budget design raises willingness to change above the no-framing base-

line, confirming prior evidence that demand-side aviation policies attract weak public support[20,21,22] and generating new evidence that distributive justice considerations do not facilitate policy support in the realm of aviation, unlike findings from renewable energy, heating, and road transport contexts.[30,34,35] Resistance to changing flying behaviour does not seem to depend on how a constraint is framed, but reflects a more fundamental unwillingness towards demand-side limits.

These insights are largely reflected in today's design of aviation policies, which mirrors, to an extent, societal and political preferences. Today, no single policy explicitly aims at demand reduction, pointing at the societal and political challenges of this option. Our results show that no budget increases willingness to change, which implies that the design of such demand-reduction measures is unlikely to solve their underlying lack of acceptance. Conversely, today's climate policies in aviation, such as SAF mandates like ReFuelEU, carbon pricing schemes like the EU ETS and the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) of the UN International Civil Aviation Organisation, are converging on cost pass-through as the primary decarbonisation response. These policies pass costs homogeneously to passengers. This aligns with our observation that a homogeneous price distribution across passengers is the design with the highest positive effect on willingness to pay.

Personal fairness, how fair a policy is to oneself, drives both willingness to pay and willingness to change more strongly than group-level distributive fairness, contradicting the pattern in the broader climate-policy literature where distributive fairness across groups typically dominates.[30] Aviation's extreme concentration of emissions[14,28] may explain this reversal: unlike diffuse household emissions, flying trips are discrete and countable, making the personal costs of any aviation policy unusually concrete and calculable, and self-interest a more immediate consideration than distributional concerns. Personal cost is a known determinant of climate-policy support,[36,37] but its dominance over group fairness in aviation has not previously been quantified. Climate concern is the main counterweight: more concerned respondents show a substantially higher baseline willingness to change and a stronger positive response to several surcharge designs.[38,39,40]

The asymmetry in the willingness to pay vis-à-vis willingness to change of passengers, as well as the distributional justice preferences, have direct consequences for how governments should design demand-side aviation instruments. Price-based designs are more politically viable than quantity-based budgets: a uniformly applied flying fee, structured similarly to existing air passenger duties such as the UK's Air Passenger Duty or Germany's Luftverkehrsteuer, attracts the broadest support, rated the fairest at the group level and producing the largest positive aggregate effect on willingness to pay. A frequent-flying fee, in which the levy per flight escalates for passengers who exceed a set annual threshold, is also viable: non-flyers and average flyers, together the majority of the population, support it. However, policymakers should anticipate concentrated opposition from frequent and business flyers. Designs that target tourism flights specifically are perceived as the most unfair on both personal and group dimensions, despite tourism being a major driver of aviation demand,[41] and are unlikely to survive political scrutiny. While no budget design wins broad support, climate-concerned respondents' higher baseline willingness to change their flying behaviour suggests a complementary route: investments in low-carbon alternatives such as rail, virtual collaboration, and accessible domestic tourism could deliver demand reductions through this group without enforceable budgets,[42,43,41] though such shifts are insufficient on their own for a 1.5°C-compatible pathway.[18,7,17] Finally, the two mitigation pathways investigated (demand reductions and additional costs for mitigation) are not independent of each other. While demand suppression is not the main aim of additional mitigation fees, the additional mitigation costs passed to passengers are likely to lead to lower growth in demand for aviation through price elasticity. However, airlines operating at a thin margin have an incentive to reduce their operating costs, e.g. by renewing fleets to reduce fuel consumption, such to avoid passing part of the additional mitigation cost and reduce losses in demand.

Our randomised controlled trial design addresses a key weakness of prior work, which relies primarily on observational or stated-preference methods:[44] random assignment lets us attribute differences in willingness to pay and change to the policy designs themselves rather than to selection or unobserved confounds. Collecting data across the United States, Switzerland, and China extends the evidence base beyond the Western European focus of most prior aviation policy research.[21,25,22] Our design remains subject to stated-preference limitations, the intention-behaviour gap and social desirability bias likely inflate absolute levels of both outcomes,[45,46,47] but random assignment ensures any inflation applies equally across conditions, leaving the relative comparisons that form the core of our analysis unaffected. Future work should prioritise replication in low- and middle-income aviation markets, where demand growth is expected to be largest and evidence is thinnest, and examine whether people accurately perceive their own flying frequency relative to others, which is a potential contributor to the personal fairness effects we observe.

As aviation climate policies increasingly pass decarbonisation costs to passengers, whether and how the public will accept them remains poorly understood across geographically and culturally diverse markets. We show that people are markedly more willing to pay more than to fly less, and that personal, rather than group, fairness drives both, reversing the pattern documented in the broader climate-policy literature. Despite the inequalities of the aviation sector, distributive design does not seem to be the solution. However, we demonstrate that willingness to pay for sustainable aviation is not as low as commonly believed, and there may be a basis for passing the cost of aviation decarbonisation onto passengers.

# Methods

We collected online survey data from November to December 2024 in Switzerland, China, and the US. The survey was distributed on Qualtrics, using the panel provider Bilendi. We implemented a non-probability quota-based sample that is nationally representative on gender and age. Additionally, we added quotas on the German- and French-speaking language regions in Switzerland. The survey was offered in English in the US, in Simplified Chinese in China, and in German, French, and English in Switzerland.

The study was preregistered on the Open Science Framework (https://doi.org/10.17605/OSF.IO/UHVGF) before data collection. Detailed descriptions of the quotas we applied during sampling are available in the preregistration together with the data sources used for the quotas. The survey included three attention checks, which were implemented as trap questions, meaning failing any one of these attention checks resulted in the participant being screened out and excluded from the sample. Each of the attention checks tested a different aspect of attention: reading comprehension, task comprehension, and concept comprehension.

## Experimental design

We conducted a two-factor full-factorial post-test only randomised controlled trial. The first factor represented different justice framings based on different distributive justice principles: no justice framing ($n = 1,175$), and egalitarian ($n = 586$), limitarian ($n = 575$), prioritarian ($n = 566$), and proportional framing ($n = 550$) explained in Table 1. The second factor represented the emission reductions achieved (15%, 30% and 45%) in the US and Switzerland. Both factors were implemented as between-subject factors, using simple randomisation to assign people to a specific treatment group. In China, the achieved emissions reductions were fixed at 45%. Because the average Chinese respondent flies considerably

less than respondents in the US or Switzerland, smaller emissions reductions would have produced allocations too small to meaningfully differentiate between the justice framings. For willingness to pay, we included a third factor, assigning people randomly to either a short-haul or long-haul flight, with base-level ticket prices of $150 and $400, respectively. We calculated the additional cost of sustainable aviation fuels based on the base-level ticket price, the justice treatment and emissions reduction group of the participant, as well as the participant's profile, including their income, whether they qualified as a frequent flyer or not, and whether they took any tourism flights over the last 12 months. We measured people's willingness to pay and willingness to change only once post treatment.

| **Justice treatment** | **Flying surcharge** | **Flying budget** |
|---|---|---|
| Control: No framing | No surcharge | No allocation |
| Egalitarianism: Equal outcomes | Income-based fee | Equal budget |
| Limitarianism: Limiting frequent flying | Frequent-flying fee | Frequent-flying cap |
| Prioritarianism: Tourism is less important | Tourism fee | Tourism cap |
| Proportionalism: Equal treatment | Flying fee | Proportional reduction |

Table 1: Operationalisation of the four distributive justice principles as frameworks for a flying surcharge or flying budget. The control measures base-level willingness to pay in the surcharge case and base-level willingness to change in the budget case.

We were broadly interested in two concepts: willingness to change flying behaviour and willingness to pay for sustainable aviation. In each treatment group, we also measured group fairness – how fair is this allocation of flights or distribution of additional costs to everyone – and personal fairness – how fair is this allocation of flights or this additional cost to you personally. To measure these outcomes, we used 6-point Likert scales. Group fairness was measured after participants were shown the distribution of the treatment group they were in. Personal fairness was measured after participants were shown the personal implications of the treatment; that is, the hypothetical ticket with the additional cost in the willingness to pay section and the number of flights they could take in the next 12 months in the willingness to change section. Information on the presentation and graphical materials shown to participants for all combinations of treatments is provided in the associated preregistration.

To better understand what influences willingness to change and willingness to pay, we measured a series of control variables, including flying frequency, income decile, and climate concern. Flying frequency was measured as the number of flights taken in the past 12 months, which, at the time of data collection in late 2024, required participants to recall the number of flights they had taken over that year. Income decile was measured as a categorical variable, with ranges representative of the sampled country. We calculated the climate concern sum score based on three Likert-scale items: climate change worry, importance of reducing the number of flights, and importance of increasing the price of flights to reduce aviation's climate effect. These three variables were used for subgroup analyses by aggregating participants into groups. Based on flying frequency, participants were grouped as non-flyers, average flyers, and frequent flyers, defined as those who flew at least six times in the past year, i.e., those who belonged to the most frequently flying quartile of the sample. Income groups were defined as low for income deciles 1–3, mid for income deciles 4–7, and high for income deciles 8–10. Climate concern groups were defined as low, mid, and high based on the 33$^{rd}$ and 67$^{th}$ percentile values.

## Mixed effects modelling

To analyse the experimental data, we used linear mixed effects modelling, with fixed effects representing the two experimental variables, justice framing and emissions reduction amount, as well as any

covariates included in the models. The fixed effects include both the fixed effect of each individual variable as well as interaction effects between the justice framing and covariates. We used country-level random intercepts, as there were no significant differences between the three sampled countries. All tests were two-sided with $\alpha = 0.05$. We ran three types of models. The first includes experimental fixed effects and country-level random effects (Equation 1). The second extends this with one subgroup covariate and its interaction with the justice treatment (Equation 4). The third includes all covariates simultaneously without interaction terms, used to generate predicted outcome scores; its full specification is provided in the Supplementary Information. This progression from simple to complex separates the main experimental effects from covariate pathways: the basic model provides a clean estimate of average treatment effects from the randomised design; Type 2 models enter each covariate one at a time with an interaction term, capturing the total effect of the given covariate; and Type 3 partitions direct effects by controlling for all covariates simultaneously, allowing the relative contributions of personal fairness, group fairness, flying frequency, income, and climate concern to be compared after mutual adjustment. For willingness to pay, we additionally control for the cost of the ticket, as this is a confounding variable, being dependent on treatment and the demographic profile of the participant. We include this as the relative additional ticket cost $C$, expressed as a proportion of the base ticket price. For willingness to pay for sustainable aviation fuels, $WTP$, the model was set up as the following:

$$WTP_{ik} = \beta_0 + \beta_1 T_{ik} + \beta_2 E_{ik} + \beta_3 C_{ik} + u_k + \varepsilon_{ik} \tag{1}$$

$$u_k \sim \mathcal{N}(0, \sigma^2_{\text{country}}) \tag{2}$$

$$\varepsilon_{ik} \sim \mathcal{N}(0, \sigma^2) \tag{3}$$

where $\beta_0$ is the intercept, and $\beta_1$ and $\beta_2$ the effects of the justice treatment and the emissions reduction amount for observation $i$ and country $k$, and $\beta_3$ the coefficient for relative added cost. $u_k$ is the country-specific random intercept assumed to follow $\mathcal{N}(0, \sigma^2_{\text{country}})$; and $\varepsilon_{ik}$ is the individual-level error term assumed to follow $\mathcal{N}(0, \sigma^2)$. We modelled willingness to change flying behaviour in the same way, excluding the cost term as it was only relevant to willingness to pay. We did not include interaction between the experimental variables in our final models, as the interaction effect between the justice treatment and emissions reductions was small and highly collinear with the justice treatment.

For subgroup analyses based on flying frequency, flying purpose, income group, and climate concern, we included each of the covariates in these models one at a time as fixed effects with interaction with the justice treatment. The willingness to pay model for the interaction between the justice treatment $T$ and flying frequency group $F$ was set up as the following:

$$WTP_{ik} = \beta_0 + \beta_1 T_{ik} + \beta_2 F_{ik} + \beta_3 (T \times F)_{ik} + \beta_4 E_{ik} + \beta_5 C_{ik} + u_k + \varepsilon_{ik} \tag{4}$$

where $\beta_3$ is the coefficient of the interaction between the justice treatment and the subgroup of interest, in this instance, flying frequency group. To generate predicted outcome scores, the third model included personal fairness, group fairness, income decile, flying frequency (number of flights in the past 12 months), climate concern (sum score of climate change worry, importance of reducing flights to reduce emissions, and importance of raising flight prices to reduce emissions), and emissions reduction level. For willingness to pay, relative added cost was additionally included.

We use maximum likelihood estimation to estimate the parameters in our models. We implemented this in R using the `lme4` package for parameter estimation and the `emmeans` package to calculate marginal means and treatment-vs-control contrasts.[48,49] To check whether our assumption of normally distributed

residuals and random effects held in our models, we used the `performance` package.[50]

## Sample description

Our sample ($N = 3,454$) was collected in the US ($n = 1,254$), Switzerland ($n = 1,100$), and China ($n = 1,100$). We excluded one participant as an outlier based on the reported number of flights taken in the last 12 months (235 flights). Although this number may be realistic, it was the only observation in the three-digit range. In Switzerland, the share of non-flyers, i.e. those who did not fly in 2024, was 36.9% and the median number of flights taken in the year 2024 was 2 (25$^{th}$ percentile: 0 flights; 75$^{th}$ percentile: 4 flights; 90$^{th}$ percentile: 6 flights). This translates to 1 round-trip on average. In the US, the share of non-flyers was 47.7% and the median number of flights taken in the year 2024 was 1 (25$^{th}$ percentile: 0 flights; 75$^{th}$ percentile: 3 flights; 90$^{th}$ percentile: 5 flights). In Switzerland and the US, the share of non-flyers is nationally representative. In China, flyers were overrepresented, with a share of non-flyers of 18.1% and a median of 4 flights taken in 2024 (25$^{th}$ percentile: 2 flights; 75$^{th}$ percentile: 6 flights; 90$^{th}$ percentile: 10 flights). For more details on the distribution of flying frequency, see Supplementary Figures S7 and S9. The most often reported purpose for flying in the last 12 months was tourism in all three countries (Supplementary Fig. S8). In the US and Switzerland, visiting family was the second-most reported purpose for flying, followed by business. In China, business was the second-most often reported purpose.

The distributions of age, sex, and region of the Swiss language are within 2% of the target quotas in all three countries. In Switzerland and the US, the highest income deciles are undersampled, whilst in China the lowest income deciles are undersampled. The full description of the sample is given in Supplementary Table S7.

To understand the effects of under- or oversampling some groups, we ran robustness checks, calculating estimated marginal means and control-treatment contrasts with and without the highest income decile in the Swiss and US subsamples, using the model set-up introduced in equation 1. We ran identical analysis with and without the lowest four income deciles in all countries, and with and without non-flyers in China. To understand the effect of speeders, defined as the fastest 5% of the respondents, we estimated marginal means and control-treatment contrasts for willingness to pay and willingness to change with and without speeders in the sample. The results of these robustness checks are given in Supplementary Tables S3–S6. We did not see substantial effects on the results.

# Inclusion & ethics

The recruitment, data collection and storage procedures, and the survey instrument were approved by the ETH Zurich Ethics Commission (Project 24 ETHICS-327).

# Data availability

Original data supporting the findings of this study are openly available at the following URL/DOI: 10.5281/zenodo.19038624.[51]

# Code availability

The code to reproduce the results and all analysis steps are publicly available as a reproducible workflow at the following URL/DOI: 10.5281/zenodo.22179609.[52]

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**Kristiina Joon**: Conceptualisation, Investigation, Data curation, Formal analysis, Visualisation, Writing – Original draft. **Courtney Leung**: Conceptualisation, Investigation. **Susanne Hanger-Kopp**: Conceptualisation, Writing – Review & editing. **Anthony Patt**: Funding acquisition, Supervision, Writing – Review & editing. **Tim Tröndle**: Conceptualisation, Supervision, Writing – Review & editing. **Nicoletta Brazzola**: Conceptualisation, Funding acquisition, Writing – Original draft, Writing – Review & editing.

# Competing interests

The authors declare no competing interests.

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