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Climate justice orientation is linked to preferences for decarbonisation policy design

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Abstract

Policy acceptance is one of the biggest hurdles to climate action and is heavily driven by people's perceptions of fairness. Here we investigate which distributive justice principles people prefer and whether these distributive preferences are linked to policy preferences along three policy characteristics: stringency, redistribution, and instrument type. Using an online survey experiment ($N = 2,230$), we assess agreement with four justice principles relevant to the decarbonisation context – equal outcomes, sufficientarianism, limitarianism, and utilitarianism – and identify groups with distinct justice orientations. Using data from two choice experiments, we show that climate justice orientation is associated with distinct policy preferences, with most individuals supporting a combination of principles and being sensitive to redistribution in policy design. This study provides further evidence on the widely noted observation that justice is a key aspect in the public's policy assessment. We suggest this justice orientation should be considered in both policymaking and policy-driven research.

Introduction

Low public acceptance is one of the biggest hurdles to climate policy implementation.^{1,2} Survey experiments have shown that higher perceived fairness of a policy instrument increases its support;^{3,4} together with perceived policy effectiveness, fairness has been shown to be the most important determinant of acceptance.⁵ Decarbonisation policies imply a distribution of their impact across the population between and within countries,^{6,7} which can cause resistance and even backlash to climate policy implementation.⁸ The Yellow Vests movement in France, for instance, started out as opposition to a proposed increase in the French carbon tax, with perceived unfairness of the tax increase being a key reason for resistance.⁹ This shows how distributive concerns play a key role in successful policy implementation.

The positive and negative impacts of decarbonisation policies include questions, such as who is affected, to what extent, and who has access to policy benefits. In economic terms, these effects can be framed as benefits and costs, which can be regressive in nature, with proportionally higher costs placed upon those with lower-income backgrounds. Redistributive elements in policy design can be considered to counteract those regressive effects. For regulatory policy, exemptions for lower-income households, for instance, can be considered a redistributive element in policy design, which has been shown to be a feasible option in transportation policy.¹⁰ Even policies that act as positive incentives can raise justice concerns; the design of a subsidy can significantly influence the number of people to whom it is accessible and, ultimately, its effectiveness, due to the high initial capital typically required to access a subsidy.^{11,12} Carbon taxes, acting as a negative incentive, have been shown to be regressive in higher-income countries if no additional mechanisms are in place to counteract their regressive effects.^{13,14} Redistribution through revenue recycling can be used to overcome regressivity,¹⁵ though there is mixed empirical evidence on how effective revenue recycling is in increasing public acceptance of carbon taxes^{16,17,18} and instead broader support for earmarking revenues for green technologies.¹⁹ These distributive questions should be considered in policy design decisions to ensure desirable outcomes, both in terms of social equity and public acceptance.

Distributive justice principles, normative principles to guide our judgment and perception of justice and injustice of the distribution of goods and burdens, can be used to approach these decisions.²⁰ Justice principles have already been used to understand preferred distribution mechanisms in the social welfare context, including pension schemes,²¹ unemployment benefits,²² and healthcare costs.²³ These studies have shown that there are considerable differences in distributive principles between policy contexts, and different people, and in some cases, they have shown a mismatch between implemented policies and distributive preferences. This highlights that it is crucial to understand the public's distributive preferences to inform policy-making effectively, particularly in a context like climate mitigation, where distributive implications are known to be key to policy success. Understanding which distributive justice principles people prefer and how this results in differing policy preferences can help inform the design of more broadly accepted mitigation policies.

The application of distributive justice principles in understanding public acceptance of climate policies is a recognised research gap.²⁴ Numerous empirical and synthesis studies have shown that justice is a key driver of public acceptance,^{3,5,25,26} but it is unclear what values underlie these considerations. The aim of this study was to test whether the particular distributive justice principle an individual prefers influences their decarbonisation policy preferences. Here, we used four distributive justice principles to understand whether the heterogeneity in policy preferences can be explained by differences in people's conceptions of fairness. We explored three policy characteristics – stringency, redistribution, and instrument type – across two distinct decarbonisation policy contexts, phasing out fossil fuels from the heating sector and scaling up renewable energy production. We expect that distinct climate justice orientations, meaning preferences for distributive justice principles, result in differing policy preferences. We expect the majority of people to not have a utilitarian orientation as prior work has shown people to be sensitive to redistributive concerns.^{10,16} We extend previous findings by decomposing the general notion of justice into climate justice orientation based on four justice principles and examining the heterogeneity in policy preferences using these orientations.

We conducted an online survey experiment ($N = 2,230$) with two conjoint experiments focusing on decarbonising the heating sector and scaling up renewable energy production. We chose a representative sample of voters in the country of Switzerland, choosing Switzerland because its practice of direct democracy means that voters are frequently asked to decide and vote on their policy preferences, which increases ecological validity. Additionally, aligning our survey to a planned referendum allowed us to validate the results externally. To understand policy preferences among subgroups with different justice orientations we: (1) measured agreement with four distributive justice principles relevant to the climate mitigation context and having distinct patterns of distribution, (2) identified groups with similar climate justice orientation through latent profile analysis, and (3) examined policy preferences among subgroups with different climate justice orientations using conjoint analysis. We included the following distributive justice principles: equal outcomes as reducing inequalities, limitarianism as limiting excess, sufficientarianism as ensuring access, and utilitarianism as minimising costs. We use the term climate justice orientation to describe individuals' overall pattern of endorsing these principles, capturing how they weigh equality, limitation, sufficiency, and efficiency when distributing climate costs and benefits. We validated our results on policy preferences externally by using the results of the national vote on the Federal Act on a Secure Electricity Supply from Renewable Energy Sources, which took place shortly after our data was collected.²⁷

Justice concerns have been a known key determinant of policy support. We expand on previous findings by decomposing justice perceptions into agreement with four distributive justice principles, showing differences in policy preferences across justice orientations. Even though we show people to have differing policy preferences due to their climate justice orientation, we are able to identify policy packages that are acceptable to all. We show that most people care about redistribution and prefer stringent

regulatory instruments. Policy packages focusing on market-based instruments without strategies to mitigate inequalities are unpopular. We improve the understanding of how justice considerations operate as predictors of policy preferences and show which policy characteristics help to design politically feasible policy packages.

Results

Most people are distribution-sensitive

We identify three climate justice orientations; out of these orientations, the egalitarian and universal groups are dominant. The utilitarian orientation is the least popular, as shown in Figure 1. Climate justice orientation is based on latent profile analysis to identify groups with similar levels of agreement for four distributive justice principles. Each principle implies different constraints on outcomes. These outcomes are constrained to be (1) equal as per the equal outcomes principle, (2) below an upper threshold as per the limitarian principle, (3) above a lower sufficiency threshold following the sufficientarian principle, or (4) not constrained following the utilitarian principle. Most people have a distribution-sensitive climate justice orientation, with the egalitarian or universalist groups making up 90% of the respondents.

The egalitarian orientation, which makes up 39% of the sample, is characterised by high scores for the equal outcomes, limitarian, and sufficientarian principles, the three distribution-sensitive principles, and moderate scores for the unconstrained outcomes principle. We use the term egalitarian here similar to existing literature to denote high concern for redistribution and social equity.²⁸ The universalist orientation, which constitutes 51% of the sample, shows moderate scores across all four justice principles. Both these groups show overall support for distribution-sensitive principles, indicating that most people care about redistribution. The utilitarian orientation is characterised by low scores for the distribution-sensitive principles and moderate scores for the distribution-blind, unconstrained outcomes principle, showing a polar opposite profile of the egalitarians (see also Supplementary Figure S1). The utilitarian orientation, insensitive to redistribution, is the least popular, with only 10% of the respondents belonging to this group. The unconstrained outcomes principle also receives the lowest overall support (with a mean sum score of 8.5). The other three principles receive higher support (mean sum scores: equal outcomes = 9.7, sufficiency limit = 9.6, and upper limit = 9.2). The three redistributive principles receive consistent scores within each justice orientation.

Climate justice orientation is associated with socio-demographic traits, shown in Table 1. Having a lower income and left-wing political views makes it more likely to be an egalitarian compared to a universalist. Conversely, a higher age, higher income, and conservative political views are associated with a utilitarian justice orientation. Cultural factors may also play a role; for instance, the language and cultural divide between different regions of Switzerland appears to have an effect, with people from the French-speaking part of Switzerland being less likely to have a utilitarian orientation compared to those from the German-speaking region.

Low stringency does not lead to higher policy support

Using data from two conjoint experiments, we find – based on regression estimates of how each policy attribute affects respondents' choices – that people do not prefer packages with low stringency overall; rather, they prefer packages with at least some stringent policy elements, as shown in Figure 2. There are considerable differences among the three justice orientations, with each orientation having a different preferred level of stringency. For renewable energy policy, the egalitarians prefer medium

and high stringency levels to low stringency. For heating sector decarbonisation, the egalitarians prefer medium stringency policy packages. The universalists prefer medium stringency for renewable energy policy packages and low or medium stringency for heating sector decarbonisation. The utilitarians do not show clear preferences for the level of stringency for renewable energy policy, and prefer medium stringency for heating sector decarbonisation.

In both experiments, there is greater support for medium-stringency packages compared to low-stringency packages as seen in Figure 2. This trend is less clear in the heating sector decarbonisation experiment where stringency depended on the level of carbon tax increases, which face opposition regardless of justice orientation (see also Supplementary Figure S4). This explains the higher level agreement of the egalitarians, universalists, and utilitarians on stringency in the heating sector experiment compared to the renewable energy experiment.

On the individual policy level, the overall predicted probabilities for choosing a package that has no regulatory stringent instruments are below 50% in both experiments, showing these options were overall not preferred. The marginal means for no ban on fossil thermal heating and for no obligation of installing rooftop solar panels are 47.8% and 43.5%, respectively (see also Supplementary Figure S4). The one push policy that continued to receive low support is the taxation of thermal fossil fuels. High carbon tax increases are not preferred with marginal means of 42.4% for doubling the current carbon tax, whilst keeping the tax at its current level received high levels of support with marginal means of 55.8%.

Income-based exemptions increase policy acceptability

The acceptability of more stringent measures, like bans and taxes, can be increased considerably by exempting lower-income households (Fig. 3). We assess preferences for exemptions to fossil heating bans and tax increases for lower-income households. These exemptions receive high general support; exempting low-income households from these policies increase acceptability by 5.9% points compared to making no such exemptions, and exempting both low- and middle-income households increase acceptability by 7.2%. The full description of average marginal component effects for all attributes is given in Supplementary Figure S2.

The effect of exemptions differs depending on the justice orientation. Among the egalitarians and universalists, any exemption to lower-income households from fossil heating bans or taxes results in a considerable increase in policy acceptability. These groups oppose stringent bans and tax increases without the exemptions for lower-income households (see also Supplementary Figure S7). For the egalitarians, the positive effect of exemptions on policy acceptability is greater than for universalists. This is consistent with their justice orientations; whilst both groups support redistribution, the support for redistribution is higher among the egalitarians than the universalists (Fig. 1).

Among the utilitarians, however, exemptions to lower-income households did not increase support for stringent packages. This is aligned with their justice orientation, disagreeing with distribution-sensitive principles. The utilitarians did not respond to exemptions, with no effect on acceptability of stringent packages. This group tended to reject exemptions to low-income households only (see also Supplementary Figure S4).

Packaging regulatory and redistributive instruments increases acceptability

The support for a policy package depends on the type of instruments. We see that packages focusing on regulatory and redistributive instruments are highly preferable to packages with a market-based focus, as shown in Figure 4. Market-based packages are overall strongly rejected, with marginal means of 43.5% and 39.1% in the renewable energy and heating sector experiments, respectively. At the same time, regulatory and redistributive packages are preferred, with marginal means of 55.1% and 57.7%.

Preferences across these policy package types vary based on climate justice orientation. The egalitarians and universalists both oppose packages with a market-based focus and support regulatory and redistributive packages. The utilitarians, on the other hand, are less opposed to market-based packages and in the renewable energy experiment tend to prefer packages with a market-based focus. The utilitarians are more indifferent to package focus compared to egalitarians and universalists. Ultimately, we see that whilst the packages focusing on regulatory and redistributive instruments differ in their level of acceptability across the three justice orientations, these packages are acceptable to all justice orientations, showing potential as politically feasible policies.

Discussion

We show that the large majority of people are distribution-sensitive, with the distribution-insensitive, utilitarian climate justice orientation being the least popular. These differences in distributive preferences are reflected in how people evaluate policies. People who are sensitive to distribution show a clear preference for regulatory and redistributive policies, whilst the utilitarians are indifferent to redistribution. These differences, and the popularity of each climate justice orientation, should be considered in policy design. We identify decarbonisation policy patterns that are acceptable across these different climate justice orientations.

We observe a general preference for stringent measures over policy packages with low stringency. Although general resistance to stringent and coercive policies has been observed previously by several authors,^{29,30,3} we do not observe such an opposition in our results. Instead, our results align with recent studies that have noted high support for stringent policy measures in related sustainability policy contexts.^{31,32} These recent studies have also employed a conjoint methodology, which aims to more closely mimic real-world decision-making, and may help explain the differing results. Alternatively, this could be explained by a temporal shift in public preferences.

We show that support for these stringent measures can be increased by including exemptions for lower-income households. Considering that we know from previous results that the perceived impact of a policy on low-income households is a key predictor of policy support³³ and that exemptions do not erode support,¹⁰ such exemptions are a viable way of increasing support for stringent policies.

Aligned with previous findings,³⁴ we see that regulatory instruments, like obligations or bans, are preferred over market-based instruments, like carbon taxes. Carbon taxes are known to face additional hurdles in design and implementation that go beyond initial policy support,³⁵ suggesting different instruments may be preferred for timely climate mitigation. Though even for carbon taxes, acceptability can be increased considerably by exempting lower-income households. Packaging regulatory and redistributive instruments is acceptable across all climate justice orientations. Our results support previous studies in the field, which have found regulatory policies to be feasible³⁶ and have shown policy packaging to be an effective way to increase public support.^{37,32,38} Furthermore, policy packages that combine stringent measures with redistributive elements can have the additional positive effect of reducing inequalities, as shown in recent modelling studies.^{39,40} We note that these results represent a snapshot of preferences and may not directly translate into political outcomes, which are also shaped by organised interests, political communication, and broader contextual factors.

We identify three distinct justice orientations in the climate mitigation context: the egalitarians, the universalists, and the utilitarians, with the utilitarians forming the smallest subgroup. Compared to the social welfare literature, where support for distributive justice principles has found considerably more extensive use, redistribution-sensitive principles seem to find more widespread support in the decarbonisation context. This is aligned with previous findings in the climate context, which show that principles

representing solidarity and capacity are the most popular.⁴¹ The egalitarian orientation strongly favours redistribution, both in this study and in studies that have utilised latent profile analysis to describe distributive preferences in the social welfare literature, and is associated with lower-income backgrounds and left-leaning political views.²¹ Higher-income background and right-leaning political preferences have also been noted to be strongly predictive of more meritocratic and redistribution-insensitive preferences by previous studies,^{22,21} like we find here. Here, we classified people based on stated income into income categories, though their self-perception of this and hence their interpretation of how they would be affected by redistributive policy elements may have differed from our classification. People with higher income backgrounds have also been observed to perceive the distribution of carbon footprints across income categories as considerably fairer than people with lower income backgrounds,⁴² suggesting an underlying link between income and distributive values as we observe here.

This study has several strengths and limitations. By making use of a conjoint design, we assessed multidimensional preferences and reveal sources of heterogeneity. We conducted data from two independent conjoint experiments to show that the preferences and the heterogeneity in preferences revealed in this study hold in a wider decarbonisation context. Hypothetical survey experiments, as conducted here, have the limitation of including a certain amount of desirability bias and not mimicking real-world behaviour perfectly. We were able to externally validate our results through a referendum, showing that the results presented here can indeed be translated into real-world policy preferences. Policy preferences are known to be driven by other factors beyond justice, like policy effectiveness, which we did not measure here. Any attempt to quantitatively measure distributive justice preferences is heavily dependent on which principles are included and how they are measured. Here we consider four principles, deemed relevant, applicable, and distinct in the climate mitigation context. A known limitation of studying value- or norm-based concepts quantitatively is the representativeness of the survey items to accurately reflect the concepts behind them. Here, the agreement with these principles was measured across three different climate mitigation contexts, such that the score for any given principle was not dependent on a single item. We only looked at basic sociodemographic characteristics to understand who the people in each of the identified justice orientation groups are, without considering other values that may be associated with climate justice orientation.

Future work could expand on this work in numerous ways. Many more principles could be considered, particularly when these principles emerge as relevant from conversations with the public or policymakers. We find that within each orientation support for redistributive principles is similar, suggesting people might care about redistribution but not necessarily about its exact mechanism, though this should be corroborated in future studies. As the utilitarian orientation stands out for its distinct policy preferences, it would be valuable to investigate additional values utilitarianism is associated with, like fatalism or climate scepticism, to understand how this orientation relates to societal discourses. Expanding this work to cover multiple nations with differing cultural and historical backgrounds, as well as considering additional value-based drivers for distributive preferences, might deepen our understanding of what justice means to people in the decarbonisation context. It could be valuable to study the three policy dimensions investigated here, stringency, redistribution, and instrument type, in further cultural and policy contexts. Additional redistributive elements, like revenue recycling, could be included using conjoint designs to better understand the effect of redistribution on policy preferences. Additional drivers of policy preferences, like effectiveness, trust, or self-interest, could be studied alongside climate justice orientation to gain further insight into the mechanisms of preference development. Like most studies in the field, this study gave a snapshot into the public's policy preferences. Given the several contradictions between different studies, it would be valuable to conduct a longitudinal study to understand the stability and development of policy preferences over time.

We observe general support for stringent regulatory policies among the Swiss population, suggesting

there might be latent majority support for climate action as long as these policies are packaged in a desirable way. The incorporation of redistributive elements in policy design can be used to increase policy acceptability, even for policies that have traditionally been perceived to face opposition by the public. Regulatory, distribution-sensitive policy packages are highly acceptable, whilst those that focus on market-based instruments and are distribution-blind are rejected by the public.

Justice has been known to be a key driver of policy acceptance, though how it operates in driving acceptance has been less clear. We provide further evidence supporting these findings, showing that distributive elements affect policy preferences both as value-based drivers of policy preferences as well as specific policy design attributes. Packaging stringent regulatory measures with distribution-sensitive design elements, like exemptions, is a possible solution to implement feasible, socially sensitive, and effective decarbonisation policies aligned with mitigation targets.

Methods

Sample

We fielded an original survey instrument in May 2024 ($N = 2,230$), using the online ISO 20252-certified panel provider Bilendi. The survey was developed in English and then translated into German, French, and Italian. Respondents provided informed consent before data collection, participated voluntarily in the survey, and received reimbursement for participation. The survey comprised three original sections: distributive justice orientation, a conjoint experiment on decarbonising the heating sector, and a conjoint experiment on scaling up renewable energy production.

We implemented a non-probability quota-based sample that is nationally representative on gender, age, and language region in Switzerland (German-speaking: $n = 1,511$; French-speaking: $n = 611$; Italian-speaking: $n = 97$; Romansh-speaking: $n = 11$). The distribution of the quota variables is nationally representative, with all quota categories falling within 3% of the national statistics. The participants were randomly selected to either take part in the heating sector decarbonisation experiment ($n = 1,098$) or the renewable energy scale-up experiment ($n = 1,116$).

Measuring climate justice orientation

To describe the climate justice orientation of respondents, we made use of distributive justice principles. Since the relevance of specific distributive justice principles is context-specific and no validated scales to measure agreement with justice principles in the climate mitigation context have been developed, we designed an original instrument. Based on the literature, we included the following four distributive justice principles: utilitarianism, equal outcomes, sufficientarianism, and limitarianism. We took utilitarianism to focus on maximising well-being, or minimising costs, as one of the dominant normative concepts guiding societal action.^{43,44,45,46} Out of these four principles, this is the only distribution-insensitive principle, meaning it is blind to relative or absolute inequalities between people, hence we refer to it as having unconstrained outcomes. The equal outcomes principle, also referred to as the egalitarian principle, was operationalised as reducing inequalities between different income groups and is an obvious choice to challenge distribution insensitive, utilitarian thinking.^{20,47} The sufficientarian principle was included as ensuring access to either policy benefits or basic goods and is considered a principle relevant to the climate mitigation context due to its focus on those who do not have enough.^{48,46} We operationalised limitarianism as limiting excess and consider this principle highly relevant to the climate mitigation context due to the huge existing inequalities in emissions attribution as well as the potential to cover policy costs.^{45,49} Previous work has also measured several distributive justice principles and

noted that there are clear groupings of principles, which carry similar meaning to people, for instance, there is a clear similarity between the sufficientarian (everyone must be granted some minimum standard) and Rawlsian difference (an action must benefit the least advantaged) principles.⁴¹ Here, we chose four principles that imply distinct patterns of policy costs and benefits, which is critical to assessing them precisely in a survey.

Like the validated Basic Social Justice Orientation scale used in social justice literature,⁵⁰ our instrument measured agreement with each principle using a Likert scale. We used 6-point Likert scales throughout the survey as these have been shown suitable for assessing both the direction and magnitude of preferences, with 0 corresponding to Completely disagree and 5 corresponding to Completely agree. We included several statements for each distributive justice principle, as it is difficult to grasp latent concepts, like we were measuring here, with only a single statement.^{21,51} We therefore evaluated agreement with each principle three times, using three sets of four items, and taking the sum score for each principle, resulting in a score from 0-15 for each principle. Each set covered a different climate mitigation context: what makes the energy transition just (general conceptualisation), what is a just carbon tax design (distribution of policy costs), and what is a just design for a subsidy (distribution of policy benefits). The instrument to measure climate justice orientation is given in full in Supplementary Table S1. We checked the internal consistency of the items measuring each principle, calculating intraclass correlation coefficients, and saw good consistency across the different sets (Supplementary Table S2). To avoid priming participants to think about the questions in a specific framework, we did not mention the terms justice or fairness in the survey information.

Experimental design

We developed the conjoint experiments in three phases, including a review of current and planned Swiss decarbonisation policies at various levels of government, consultation with academic experts, and interviews with members of the Swiss public. The investigated policies were relevant to the Swiss political discussions at the federal and cantonal levels, with the ambition of the policy combinations in our experiment going beyond what was under discussion.

To assess preferences for mitigation climate policies, we embedded two conjoint experiments, addressing different parts of the energy transition. Participants were randomly selected to take part in one of these two experiments, using simple randomisation. We implemented a conjoint design as it has been shown to reduce social desirability bias and mimic real-world decision-making compared to more traditional surveying methods. Each participant was tasked with assessing two policy packages by choosing their preferred package and rating the packages using Likert scales. For rating the packages in the conjoint experiment, 0 corresponded to *Completely oppose* and 5 to *Completely support*.

The attributes for the experiment on heating sector decarbonisation included (1) phase-out year of fossil thermal fuels, (2) percentage of tax increase on fossil thermal fuels, (3) ban on fossil boilers, (4) support instrument for heat pump acquisition, (5) building standards on energy efficiency, (6) exemptions for lower-income households to ban and tax. The experiment on generation infrastructure contained the following attributes: (1) target electricity mix, (2) the percentage of net imports in the energy mix, (3) obligation for rooftop solar panels, (4) exceptions to biodiversity protection for generation infrastructure, (5) cantonal distribution of renewable electricity production. In both experiments, we pooled policy packages based on their constituent policies along three dimensions: stringency, instrument type, and redistributive elements. We considered policy packages to have low stringency when they contained no push policies, meaning no obligations, bans, or taxes and rather focused on incentives, like subsidies or targets. Conversely, policy packages were considered to have high stringency when strict bans or obligations, or high tax increases were in place. We distinguished between packages with regulatory

and market-based instruments. Regulatory instruments were obligations, bans, standards, and targets, whilst market-based instruments included pricing. Furthermore, we also considered packages to have a market-based focus, i.e. following the utilitarian principle, when they were blind to distribution, either in terms distributions between people or between people and nature.

The full attribute tables, together with the definitions along the stringency, instrument type, and redistributive elements axes, for the two experiments are given in Supplementary Tables S3 and S4. The full survey instrument is given in Supplementary Document S2.

Both experiments used a fully randomised design. The heating sector decarbonisation experiment thus resulted in 2160 possible policy packages that could be presented to respondents, and the renewable energy experiment in 1800 possible policy packages. Each participant evaluated two randomly generated policy packages side-by-side eight times. The first and last tasks contained the same packages with swapped sides to correct for the measurement error associated with conjoint experiments.⁵² With eight choice and rating tasks, we have in total 17,568 observations for the heating sector for both the choice and rating outcome variables, and 17,856 observations for the renewable energy experiment.

We did not randomise the order of the attributes between participants as the attributes in both experiments followed a logical order, with target-setting towards the top and distributive elements towards the bottom. Studies have shown no effect arising from the order of the attribute levels.⁵³

Analytical methods

Climate justice orientation

Climate justice orientation is a latent concept, particularly when considering that people might agree with multiple distributive justice principles at the same time. To describe the heterogeneity in how people rate these principles and to identify groups with similar climate justice orientations, we used latent profile analysis. This method is suitable here as we are interested in identifying qualitatively different groups of people considering multiple indicators. Latent profile analysis has recently been used to describe the heterogeneity in related contexts, including policy preferences⁵⁴ and normative concepts.²¹ All Likert scales were coded as an ordinal scale from 0 to 5, with 0 corresponding to *Completely disagree* and 5 to *Completely agree* in all questions outside of the conjoint experiment.

We ran a maximum likelihood estimation, assuming normal distributions for the distributive justice principle scores, no covariates, and equal variance between profiles, using the *mclust* package for estimation and the *tidyLPA* package for data structuring.^{55,56} No covariates were assumed to ensure that solution selection is independent from possible associations with sociodemographic variables that can confound the LPA results. We ran the estimation for models with one to eight groups. Model selection was based on three factors; (1) first, we considered model fit statistics that indicate the data is well-represented by the identified latent profiles, (2) based on the fit statistics, models with three and four profiles were considered as possible solutions and evaluated with regards to their theoretical interpretability and entropy estimates, while (3) ensuring group sizes do not become less than 5%.^{57,58} To quantify model fit, we considered five information criteria: the Bayesian information criterion, Akaike information criterion, sample size adjusted Bayesian information criterion, approximate weight of evidence criterion, and the integrated completed criterion. These criteria summarise model fit, how well the number of groups explains the heterogeneity in the data, and model complexity, meaning how many different groups it takes to describe the data. The Supplementary Figure S5 shows these criteria for the eight models that were considered.

Considering all these factors, we chose the model with three profiles as the solution for further analysis. The three-profile solution showed a good fit based on the information criteria, had a high entropy, its smallest group size was above 5% (BIC = 41,030; AIC = 40,930; entropy = 0.785, proportion of smallest

group = 9.8%), and results in three qualitatively distinct justice orientations. A comparison of these factors for these models is given in Supplementary Table S5. We also ran all subsequent analyses with the four-profile solution; the results did not differ significantly, as illustrated by Supplementary Figures S6 and S7. To better understand the composition of the identified profiles, we performed multinomial logistic regression between the profiles and sociodemographic variables, using a multivariate model.

Decarbonisation policy preferences

We derived the causal effects of the policies following the standard conjoint analysis method, regressing the choice and rating outcome variable on each of the policy attributes⁵⁹ based on 35,680 observations from the two experiments. We used the choice outcome variable throughout for reporting results. As this study focused on subgroup analysis, i.e. differences in policy preferences between the identified justice orientations, we calculated marginal means to communicate absolute preferences.⁶⁰ These are predicted probabilities, showing the likelihood of a policy package being chosen, given that a specific policy characteristic is part of the package. We calculated these predicted probabilities for different stringency levels and packages, focusing on different policy instruments. We use average marginal component effects to communicate preferences relative to a base-level category. We calculated these relative preferences to understand the effect of exemptions for lower-income households compared to no exemptions.

As a robustness check of the outcome measure, we calculated average marginal component effects using both the choice and rating outcomes. To account for measurement error within participants, we apply the intrarepsondent reliability calculation by utilising the data from the first and eighth tasks in the conjoint experiments.⁵² We filtered out respondents based on two criteria: (1) we only included responses whose duration fell within the threshold of 45% of the median duration (median duration – 10min 25s), and (2) we excluded responses that answered identically to twelve consecutive Likert-scale questions in the climate justice orientation section (straightlining).

We calculated average marginal component effects using both forced choice and rating data for the two conjoint experiments to test the internal consistency of the policy preference results.^{53,61} We saw near-identical patterns of policy preferences using both outcome variables, given in Supplementary Figures S2 and S3. As a robustness check for the policy preferences, we ran another analysis excluding responses where the choice and rating outcomes were not aligned. We dropped observations where the participants rated the chosen policy package lower than the non-chosen one (5.3% of all observations in the heating sector decarbonisation and 5.1% in the renewable energy experiment). The results did not significantly change, as shown in Supplementary Figure S8.

For external validation, we identified policy packages most similar to the Swiss Federal Act on a Secure Electricity Supply from Renewable Energy Sources, with the referendum taking place on the 9th of June, 2024 – shortly after we fielded our survey. The act passed the referendum, with a 68.7% majority.²⁷ We estimated marginal means for policy packages resembling this act in our renewable energy scale-up experiment and calculated the percentage of observations where these packages were voted favourably with a rating of Somewhat support or above. These measures showed overall support for policy packages most similar to the Swiss renewable energy act, aligned with the results of the referendum. These results are shown in full in Supplementary Table S6.

We ran two robustness checks to understand the presence of sampling biases. Firstly, we restricted the sample to only German- and French-speaking regions to test whether the smallest, Italian, subsample has a substantial effect on the results. Secondly, we restricted the sample to exclude lower education levels as this group was under-represented. No substantial differences were found compared to running these analyses with the full sample, as shown in Supplementary Figures S9 and S10.

Data availability

Data supporting the findings of this study are openly available at the following URL/DOI: 10.5281/zenodo.15425204.⁶²

Code availability

The code used to generate the results of this study is openly accessible at the following URL/DOI: 10.5281/zenodo.15425149.⁶³

Inclusion & ethics

The recruitment, data collection and storage, and the survey instrument used in this study were approved by the ETH Zurich Ethics Commission prior to any involvement of human participants (project EK-2024-N-137).

Competing interests

The authors declare no competing interests.

Author contributions

Kristiina Joon: Conceptualisation, Investigation, Data curation, Formal analysis, Visualisation, Writing—Original draft. **Angie Celis:** Conceptualisation, Investigation. **Rira Seo:** Conceptualisation, Investigation. **Susanne Hanger-Kopp:** Conceptualisation, Writing—review & editing. **Anthony Patt:** Funding acquisition, Supervision, Writing—review & editing. **Tim Tröndle:** Conceptualisation, Supervision, Writing—review & editing.

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Figures with captions

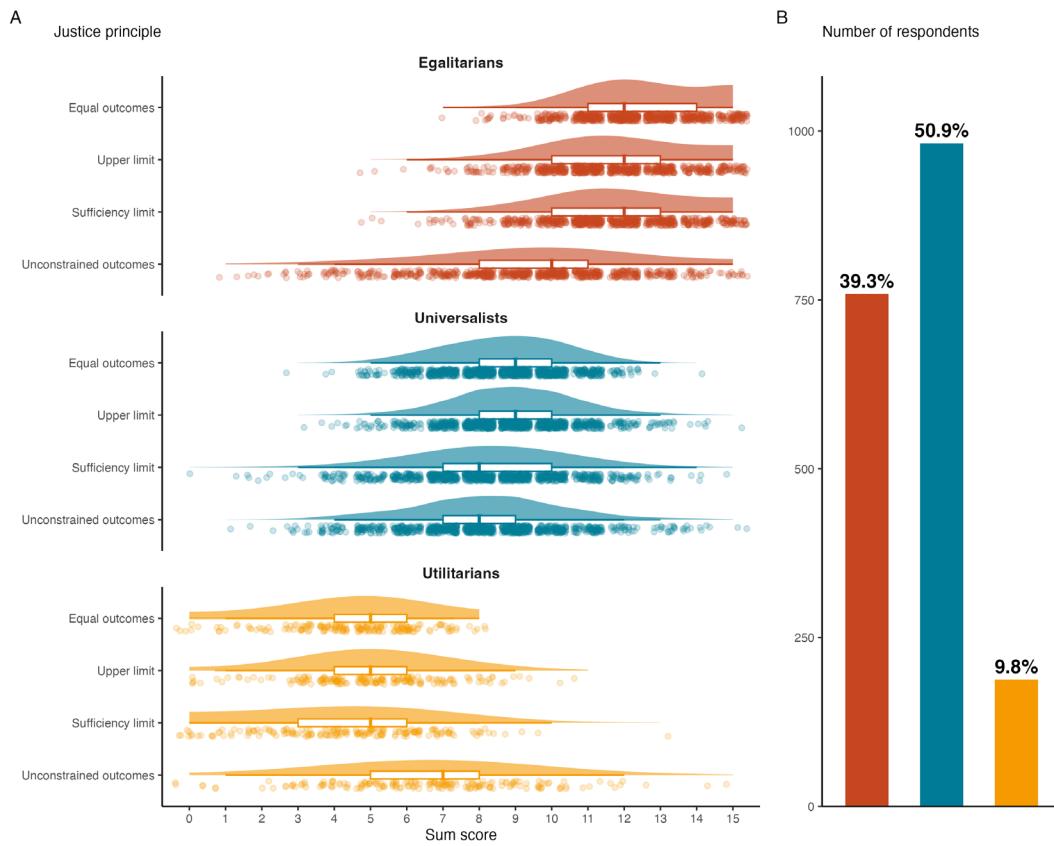


Figure 1: Most people are distribution-sensitive, with the utilitarians forming the smallest group. Panel A: The egalitarian, universalist, and utilitarian orientations are shown with bounded distribution and raw data of sum scores for the assessed justice principles. The box plots show the first, second, and third quartiles. Distributive justice principles are operationalised as different constraints on outcomes, either equal, with an upper limit (limitarianism), sufficiency limit (sufficientarianism), or unconstrained (utilitarianism). Panel B: The distribution of respondents across the three orientations: egalitarians (red), universalists (blue), and utilitarians (yellow).

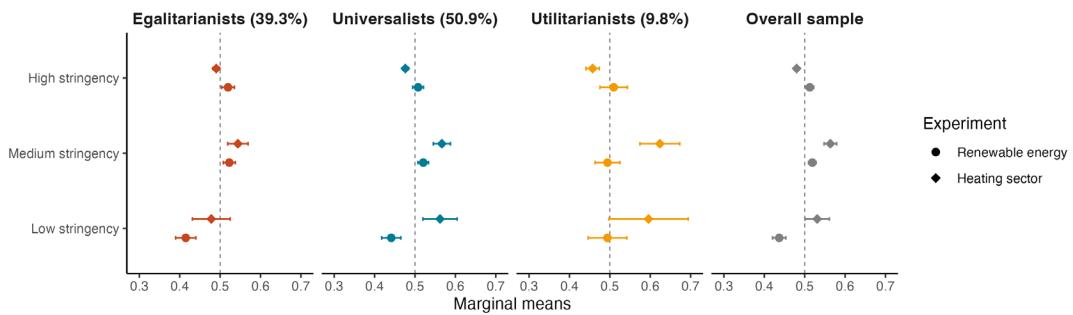


Figure 2: Low stringency does not lead to higher policy support. The marginal means for policy packages with different levels of stringency across the two conjoint experiments for egalitarians (red), universalists (blue), utilitarians (yellow), and the overall sample (grey). Error bars represent 95% confidence intervals.

Households exempted from tax and ban

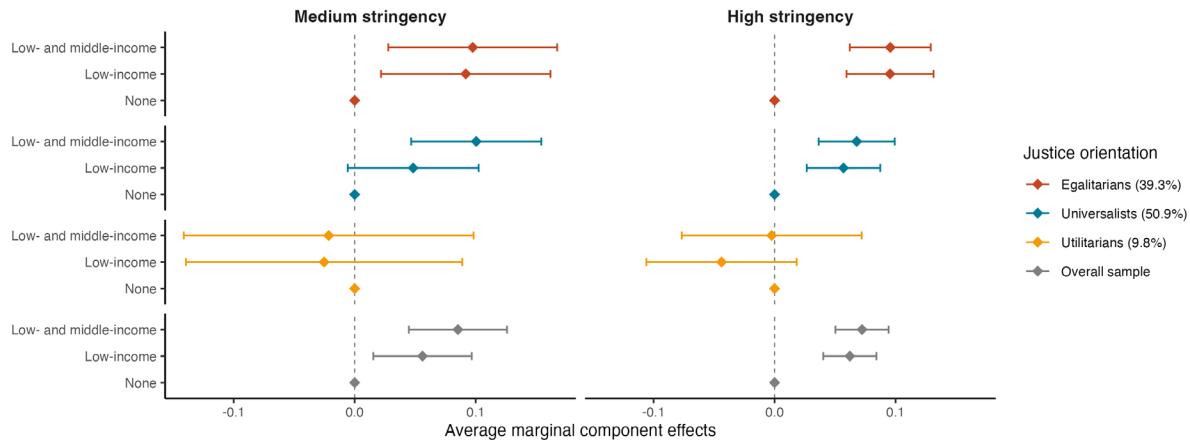


Figure 3: Income-based exemptions increase the acceptability of more stringent policy packages. The average marginal component effects for exempting lower-income households from fossil boiler bans and carbon taxes are shown across the three justice orientations and for the overall sample, using no exemptions as the baseline. Error bars represent 95% confidence intervals.

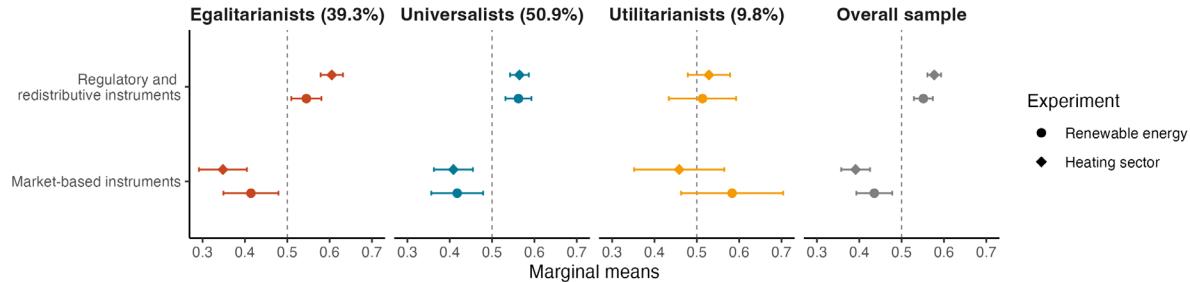


Figure 4: Packages focusing on regulatory and redistributive instruments are acceptable across all climate justice orientations, with high overall acceptability. The graph shows marginal means for policy packages with different instrument types across the two conjoint experiments for egalitarians (red), universalists (blue), utilitarianists (yellow), and the overall sample (grey). Error bars represent 95% confidence intervals.

Tables

Table 1: Climate justice orientation is associated with political orientation and income

Variable	Category	Egalitarians		Utilitarians	
		OR [95% CI]	p	OR [95% CI]	p
Gender	Female*				
	Male	1.2 [0.915, 1.57]	0.189	1.1 [0.719, 1.81]	0.603
Age	18–39*				
	40–64	1.5 [1.08, 2.11]	0.017	1.5 [0.874, 2.73]	0.135
	65+	1.7 [1.17, 2.39]	0.005	2.1 [1.13, 4.01]	0.019
Income	Low*				
	Mid	0.67 [0.499, 0.900]	0.008	1.7 [0.948, 2.89]	0.077
	High	0.68 [0.416, 1.10]	0.115	3.1 [1.44, 6.63]	0.004
Education	Below secondary*				
	Secondary	1.3 [0.821, 1.92]	0.294	0.92 [0.453, 1.86]	0.809
	Tertiary	1.3 [0.817, 1.98]	0.288	1.1 [0.548, 2.36]	0.731
Politics	Left*				
	Liberal	0.57 [0.410, 0.794]	<0.001	0.86 [0.391, 1.91]	0.718
	Conservative	0.35 [0.258, 0.476]	<0.001	2.8 [1.48, 5.25]	0.002
Region	German*				
	French	1.1 [0.791, 1.41]	0.712	0.6 [0.350, 1.04]	0.067
	Italian	1.7 [0.869, 3.48]	0.118	1.6 [0.599, 4.49]	0.336

Odds ratios (OR) for demographic variables based on multinomial logistic regression with corresponding p-values, based on a multivariate model. The values indicate how many times more likely participants are to be an egalitarian or a utilitarian compared to a universalist. An odds ratio of 1 means no difference compared to the base level. 95% confidence intervals (CI) are shown in brackets. * indicates a base-level category.