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Global relationships between time preference and environmental policy performance

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ABSTRACT

How our governments deal with environmental crises can depend on national culture, including time preference (i.e., short- vs. long-term orientation). Here, we follow up on the hypothesis that long-term orientation increases environmental policy performance. To this end, we use three time preference indices (including a newly constructed index with a wide spatial coverage based on Google search data). Our results show that countries with higher long-term orientation have higher environmental policy performance. This relationship is in most cases because of the positive association of long-term orientation and environmental policy performance with economic development and other factors. Only the analysis with increased spatial coverage (especially to African and Asian countries) using Google long-term orientation shows some results indicating positive relationships when considering economic development and other factors. Still, also in this analysis, the positive relationships are largely because of economic development and other factors. Expanding the spatial coverage when measuring time preference might add insights into the time preference-environmental policy performance relationship. Moreover, the results show that researchers need to control for important factors, especially economic development, when analyzing time preference and environmental policy performance or related questions, such as environmental behavior and culture, as these factors can completely, or at least largely, drive the results.

1. Introduction

We currently face major environmental crises, including climate change, biodiversity loss, desertification, soil erosion, and water pollution (Sadoff et al., 2015; IPCC et al., 2018; Keesstra et al., 2018; IPBES, 2019; Borrelli et al., 2020). They are causing substantial risks to the enormous intrinsic and economic worth of nature (Sadoff et al., 2015; Vucetich et al., 2015; Granados Franco et al., 2020; Dasgupta, 2021), which also put them high on the agenda of intergovernmental organizations (e.g., as expressed by sustainable development goals of the United Nations (UN General Assembly, 2015)). Pathways, such as changes in land-use practices, consumption, and reduction of post-harvest waste, exist that can help to combat these crises (e.g., Cerdà et al., 2018, Novara et al., 2021, Pörtner et al., 2021). National cultural traits can influence how the public and their representation (i.e., national governments) demand and implement these pathways and how environmental crises are dealt with (Milfont and Sibley, 2012; Gifford and Nilsson, 2014; Drews, Van den Bergh, 2016; Milfont and Schultz, 2016). Time preference is among these traits (Milfont et al., 2012; Alló and Loureiro, 2014; Milfont and Schultz, 2016; Vastola et al., 2017). Time preference describes whether citizens of a country are rather short- or long-term oriented and influences how they discount future benefits (e.g., Drupp et al., 2018). Therefore, time preference might decisively influence our concern about environmental topics, especially given the long-time horizons of many environmental projects (Milfont and Schultz, 2016). Research suggests that long-term orientation positively relates to an individual and public environmental support and behavior (Franzen and Vogl, 2013; Alló and Loureiro, 2014; Carmi and Arnon, 2014; Tam and Chan, 2017). However, a knowledge gap exists about i) if these relationships also hold for environmental policy performance and ii) if they only exist because of positive correlations of long-term orientation with economic and democratic development (McClanahan and Rankin, 2016 shows this for biodiversity conservation spending).

The hypothesis of long-term orientation increasing environmental policy performance independent of economic and democratic development depends on some premises, most notable: First, the public and their

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representation value environmental benefits, understand (to some degree) and acknowledge the current threats to these values (e.g., Bain et al., 2019) and their ability to mitigate these threats. Second, with more long-term orientation, we value future benefits more. This value increases if the assets do not depreciate due to time itself, such as many natural assets (Drupp et al., 2018; Heal, 2020). Third, given that governments face constraints (e.g., time and budget constraints), environmental policies and investments need to be ranked above other policies and investments that are taken because of our time preference.

Here, we analyze if nations that citizens are more long-term oriented are more likely to show higher levels of environmental policy performance using cross-sectional data. Furthermore, we check if such higher likelihood exists only because of economic and democratic development that simultaneously relates to both variables. To this end, we use for analyzing global environmental policy performance the Environmental Performance Index, which comprehends national policy information (Wendling et al., 2020). We consider the Environmental Performance Index related to environmental overall and specifically to climate and biodiversity. Next, we consider three distinct country-level time preference indices. The main analyses focus on economic time preferences (which is based on representative data; Falk et al., 2018), while additional analyses focus on indices of time-honored traditions versus thrift for the future (Hofstede, 2001) and future focus based on Google searches (based on Preis et al., 2012). These indices will be referred to as economic, thrift, and Google time preference, respectively.

In our main analysis, we analyze the time preference-environmental policy performance relationship with and without controlling for economic and democratic development. We also test explicitly for separate direct associations of time preference and environmental policy performance following Acharya et al. (2016). Finally, we check additionally if the relationships deviate when considering public environmental priority instead of environmental policy performance.

The results show that countries that are more long-term oriented have a higher level of environmental policy performance. However, we observe this relationship because of the positive association of long-term orientation and environmental policy performance with economic and democratic development in most of the analyses. The analysis with increased spatial coverage using Google time preference shows some results indicating a positive long-term orientation-environmental policy performance relationship.

2. Material & methods

2.1. Data

2.1.1. Time preference

Time preference indices encompass information about the central and dominant tendencies in a country while intra-national variation can still exist (Carmi and Arnon, 2014). Moreover, while (individual and national) time preference evolves, today's time preference depends on the initial inherent time preference (Galor and Özak, 2016). Thus, over time time preference can be assumed to be consistently different across space to a certain degree.

In the main analysis, we use the widely used economic time preference measure of the Global Preference Survey (Falk et al., 2018).[1] The Global Preference Survey included 80000 people (representative population samples) in 76 countries and the index used in this study measures time preference concerning immediate and delayed financial rewards of the survey participants (Falk et al., 2018).

Thrift time preference is based on the long-term orientation measure by Hofstede (2001). The index is based mainly on IBM employees and covers 111 countries, of which we use 86 countries in this study (Hofstede, 2001; Falk et al., 2018). Different from economic time preference, thrift time preference focuses on the past and present (tradition and fulfilling social obligations) versus the future (perseverance and thrift) aspect of societies (Hofstede, 2001; Venaik et al., 2013). Therefore, more long-term-oriented people value virtues higher related to the future than the past and present (Hofstede, 2001). This description also shows that the index does not relate directly to an active sense of care for the future but rather to a passive one. We consider the index in the analysis despite recent critics about its validity[2] and representativeness as a proxy of time preference (Falk et al., 2018; Hanushek et al., 2020) because it shows result sensitivity to index choice and it is a commonly used index.

The Google time preference is measured using Google search volume between 2016 and 2018. For constructing Google time preference, we follow Preis et al. (2012) and measure the Google time preference as:

$$\text{Google time } \textit{preference}_{\text{i}} = \sum_{\text{t=1}}^{\text{T}} \frac{\text{SVC}_{\text{it}}/\text{SVP}_{\text{it}}}{\text{T}} - 1 \quad (1)$$

Google time $\textit{preference}_{\text{i}}$ is the Google time preference of country i over time. SVC_{it} and SVP_{it} are the search volumes for the coming and the previous year represented by Arabic numerals, respectively, of country i in year t. T are the number of years. Google search volume was downloaded from Google Trends using the R package 'gtrendsR' (Massicotte and Eddelbuettel, 2019) on March 23, 2020. Google search volume ranges between 0 and 100 (100 indicates the most search inquires during the downloaded period) and the data is normalized and rescaled by Google (Google, 2021). We removed outliers (to avoid specific events influencing the index) when the cook's distance was greater than four times the country's mean (e.g., Cook and Weisberg, 1982). We interpolated Google time preference data using linear interpolation. The compiled data of the Google time preference used in the analysis comprises 112 countries. The period of the Google time preference, i.e., 2016–2018, is selected as Google changed its data-collecting algorithm in 2016 (Google, 2021). Checking for the correlation of Google time preference of the period 2016–2018 and Google time preference of the period 2012–2018, we find an extremely high correlation (Pearson Correlation = 0.97, Spearman Correlation = 0.93). Additionally, Google time preference of single years is overall similar (Fig. S1). The Google time preference focuses on time preference within a short time window compared to the other indices as it measures internet users' behavior of seeking information about the next year, i.e., the future, compared to the last year, i.e., the past (Preis et al., 2012). Using Google search volume data offers great potential but also has some limitations. Limitations are that while Google search volume allows surveying a large share of the population, it is restricted to people that have internet access, seek information online using Google, and use Arabic numerals (e.g., Funk and Rusowsky, 2014, ITU, 2019). Moreover, younger people are generally considered to more frequently use the internet and Google than older people (Beauchesne, 2021; Sentence, 2021; UN, 2021).[3] Thus, the Google time preference likely has a larger weight on lower age classes. These aspects need to be considered when interpreting the results. However, assuming that central and dominant tendencies of time preferences are shared within a country, we still can retrieve cost-efficiently valuable information about each country's time preference, and we still survey a larger number of people with Google search volume data than usually possible with traditional survey methods. Furthermore, the search volume data needs to be used carefully when using a long-time

[1] The economic time preference measure consists of two components i) an intertemporal choice sequence using staircase method and ii) a self-assessment of willingness to wait. The weights of these two components are 0.712 and 0.288, respectively, following Falk et al. (2018).

[2] The validity is questioned because of questions included in the survey to approximate time preference (e.g., 'How proud are you to be a citizen of your country?').

[3] Note that Google does not make their search engine user data publicly available.

horizon as internet users' behavior can change over time (e.g., Correia et al., 2019). However, this should not influence the results given that we compare the search volumes for the coming and the previous year within a given year and we use a short time window (2016–2018).[4] Despite these potential limitations of Google search volume data, the data offers a time- and cost-efficient tool to gather information from a wide spatial and temporal gradient that can complement traditional survey information.

The spatial distribution shows that economic long-term orientation was heterogeneous between and within regions but overall higher in Australia, China, Europe, and North America than in other areas (Fig. 1A). Thrift long-term orientation had clusters of higher scores in Europe and Asia (Fig. 1B), and Google long-term orientation in Australia, Europe, North America, and Southern America (Fig. 1C). All three indices of time preference are positively correlated with each other (Table S2).

2.1.2. Environmental policy performance

The Environmental Performance Index quantifies the environmental policy performance of a country, i.e., the index measures the proximity of environmental outcomes to the policy target established at the international and national level as well as by sciences, and it comprises 32 performance indicators on ecosystem vitality and environmental health (Lisciandra and Migliardo, 2017; Wendling et al., 2020). Thus, compared to other indices of environmental policy performance, such as commonly used 'singe-dimension-indicators' (e.g., CO2 emissions per capita), indices counting the number of environmental treaties, or indices only for selected countries (e.g., OECD countries), the Environmental Performance Index provides comprehensive information about environmental policy performance across a wide spectrum of environmental dimensions and space (180 countries) (Lisciandra and Migliardo, 2017; Dahlberg et al., 2018; OECD, 2021). Moreover, it also overcomes shortcomings of its preceding index (i.e., the Environmental Sustainability Index) that was criticized with respect to reliability and capability in measuring environmental policy performance (Lisciandra and Migliardo, 2017). Therefore, and despite relying for some information on imputed values and assignments of weights to compute the overall index (Rogge, 2012; Dahlberg et al., 2018), the Environmental Performance Index provides a reliable, comprehensive, and well-suited index to understand the relationship between time preference and environmental policy performance over a large set of countries and for different environmental dimension.

Out of the Environmental Performance Index, we utilize the overall index and two sub-indices to measure three dimensions of environmental policy performance: environmental policy performance overall, climate policy performance, and biodiversity policy performance. Environmental policy performance overall, climate policy performance, and biodiversity policy performance range in our sample from 25.1 to 82.5, from 12.1 to 95, and from 15.1 to 91.6, respectively.

Environmental policy performance overall and climate policy performance were higher in North America and Europe, and they exhibit a decreasing West-East and North-South gradient (Fig. 1D and E). Biodiversity policy performance was spatially very heterogeneous with clusters of higher scores in Europe, Southern Africa, and the eastern part of South America (Fig. 1F).

2.1.3. Other country information

In our additional analysis of public environmental priority, we use two distinct measures referred to as public environmental priority index 1 and 2. Environmental priority index 1 is based on the World Values Survey Association and the European Values Study between 2017 and 2020 (EVS/WVS, 2020) and environmental priority index 2 on the World Values Survey Association between 2005 and 2009 and between 2010 and 2014 (Inglehart et al., 2014a, 2014b; Text S§1). Additional country information (e.g., about economic and democratic development) used in the analyses is summarized in Table S1. Note that both economic and democratic development often positively relate to institutional development overall (Acemoglu et al., 2005; Kotschy and Sunde, 2017; Lawson et al., 2020).

Finally, the entire sample includes 75 countries for economic time preference, 86 countries for thrift time preference, and 112 countries for Google time preference. The sub-sample that includes those countries with information about all three preference indices consists of 52 countries.

2.2. Empirical framework

We analyze the relationship between time preference and environmental policy performance by using two different bootstrapped linear regression models.[5] Frist, we estimate a model without controls that captures all correlation between environmental policy performance and long-term orientation:

$$y_{ji} = \alpha_0 + \alpha_1 \text{Long} - \text{Term } Orientation_{\gamma i} + e_{1i} \quad (2)$$

y_{ji} is the log of either environmental policy performance overall, climate policy performance, or biodiversity policy performance of country i depending on j. $\text{Long} - \text{Term } Orientation_{\gamma i}$ is the log of either the economic long-term orientation, thrift long-term orientation, or Google long-term orientation of country i depending on γ.

Second, we estimate a model that controls for important economic and democratic development factors:

$$y_{ji} = \beta_0 + \beta_1 \text{Long} - \text{Term } Orientation_{\gamma i} + \beta_2 X_i + e_{2i} \quad (3)$$

X_i is a vector of control variables, including GDP per capita (log-transformed), democracy index (log-transformed), and latitude information (in absolute terms and log-transformed). These control variables capture important national capabilities that enable a country to be more or less engaged in environmental-related topics. For example, wealthier countries are likely to have more funds available to invest in climate-neutral technologies or protect biodiversity. The control variables also include important factors that can alter a nation's time preference (Falk et al., 2015, 2018; Baynham-Herd et al., 2018). Furthermore, we check the influence of in-/exclusion of various control variables (Table S1) on the relationship between time preference and environmental policy performance. The additional public environmental priority analysis follows the same estimation procedure described for environmental policy performance.

Furthermore, we estimate the separate direct correlations using bootstrapped sequential g-estimation (Acharya et al., 2016). Direct correlations show whether time preference directly, and separate from economic and democratic development (which are the so-called post-treatment variables and are potential mediators), correlates with environmental policy performance or whether this is because economic and democratic development simultaneously determine time preference and environmental policy performance. The sequential g-estimation estimates this by fixing the post-treatment variables at a particular level (Acharya et al., 2016).

[4] Google was also criticized for only providing relative and not absolute search volume (Correia et al., 2019). However, this should not influence the results giving our use of comparing search volume of coming and the previous year. Yet, the relative information does not allow checking the importance of the search terms in each country.

[5] We draw 1000 bootstrapped samples with replacement for the bootstrapped regressions using the R-package 'rsample' (Kuhn et al., 2020). Each bootstrapped sample has the same number of observations as the initial sample. Next to the bootstrapped linear regressions results, we also report the linear regression results using the same model but without bootstrapping.

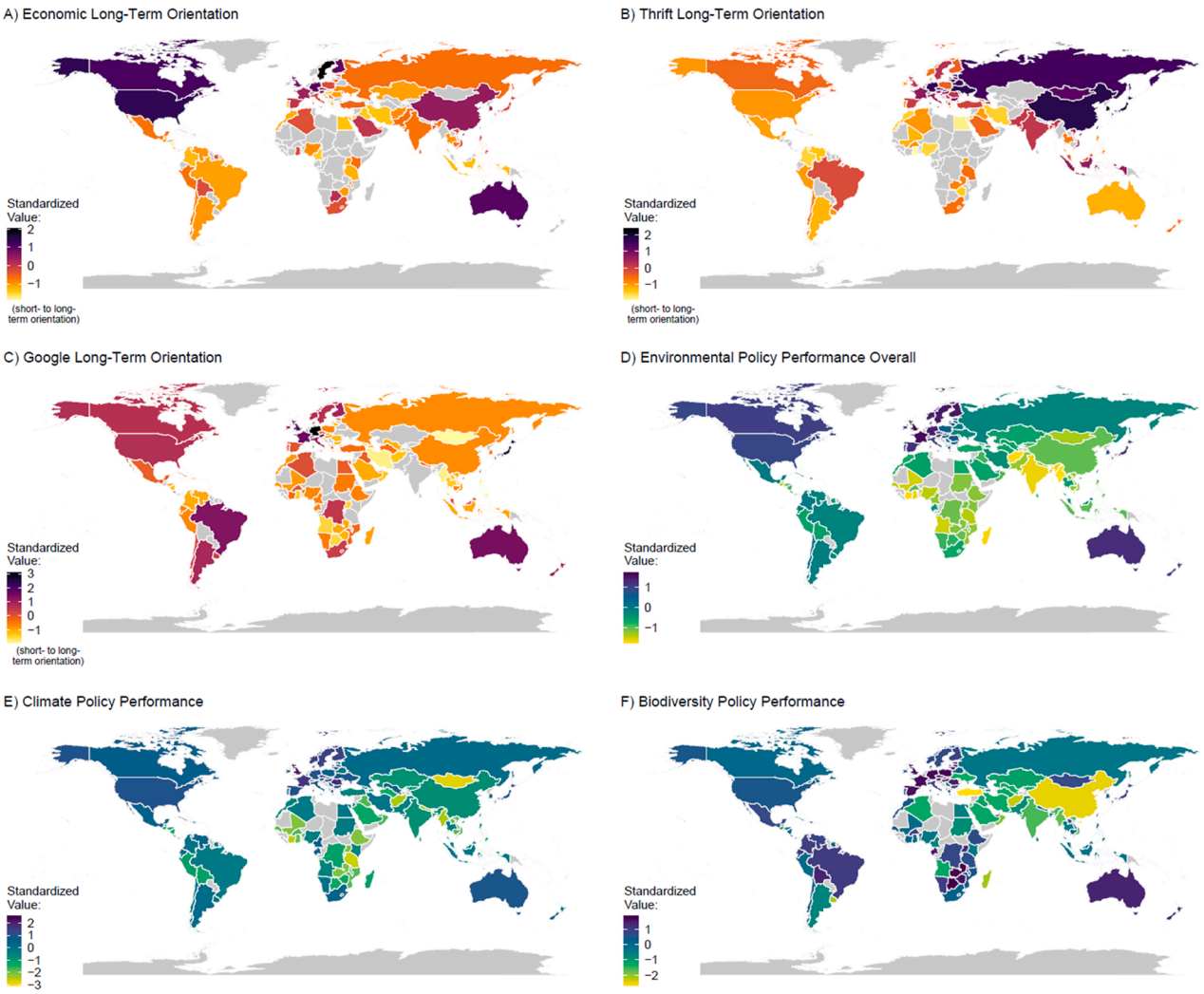

Fig. 1. Spatial distribution of long-term orientation and environmental policy performance. Panel A) economic long-term orientation, B) thrift long-term orientation, C) Google long-term orientation, D) environmental policy performance overall, E) climate policy performance, and F) biodiversity policy performance. For better visual comparison, we standardized all indices. Thus, each index has a mean of zero and a standard deviation of one. Note that time preference is represented as long-term orientation, thus, ranges from short- (low) to long-term orientation (high). National indices are only shown when information about time preference and environmental policy performance is available.

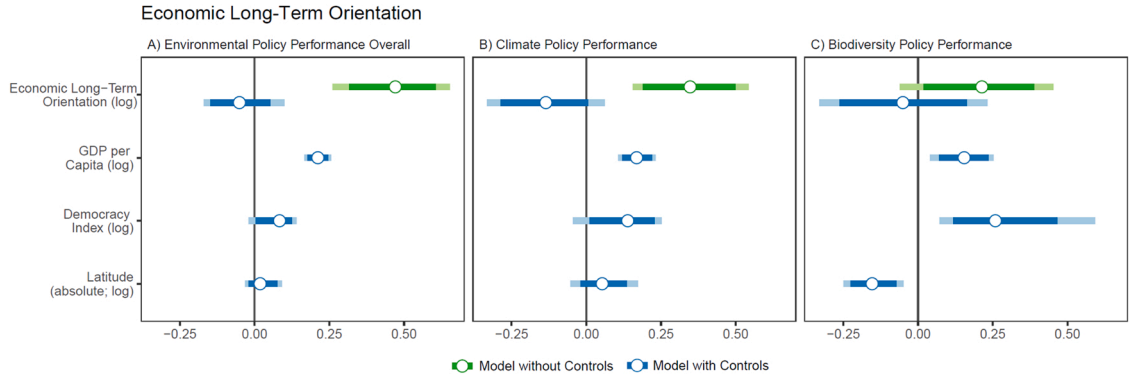

Fig. 2. : Relationship of economic long-term orientation with environmental policy performance. Panel A), B), and C) show the relationship of economic long-term orientation with environmental policy performance overall, climate policy performance, and biodiversity policy performance, respectively. The results are based on bootstrapped regressions (Table S4). The cycles are point estimates and the bars show the 95% and 99% confidence intervals. Note that time preference is represented as long-term orientation, thus, ranges from short- (low) to long-term orientation (high). Control variables in the model are GDP per capita (Constant 2010 US$; log), democracy index (1 to +21; log), and latitude (absolute degrees; log; see Table S1). For different model specifications and a sub-sample analysis, see Fig. S2. For the not bootstrapped regression results, which are similar, see Table S5.

3. Results

3.1. Economic time preference

We find that environmental policy performance economic positively correlated with economic long-term orientation in a model without control variables (Fig. 2A). However, this positive relationship vanished when we control for national economic and democratic development. This vanishing of the relationship was independent of sample selection (i.e., country selection) and control variable selection (i.e., in-/exclusion of control variables; Fig. S2). Moreover, national wealth (i.e., GDP per Capita) strongly correlated with environmental policy performance.

Climate policy performance positively correlated with economic long-term orientation in a model without but not in a model with control variables (Fig. 2B). This observation was independent of sample selection and control variable selection (Fig. S2). Moreover, wealthier countries showed considerably higher climate policy performance, and countries that were more democratized (i.e., higher democratization index) had, in tendency, a higher level of climate policy performance.

Biodiversity policy performance correlated positively with economic long-term orientation but only in the model without control variables (Fig. 2C). This pattern is independent of control variable selection but depends on the sample selection, as the sub-sample analysis shows no correlation in the model without control variables (Fig. S3). Countries with higher biodiversity policy performance were also, on average, wealthier and more democratized. The correlation between biodiversity policy performance and democratization was higher than between biodiversity policy performance and wealth. This is different from the correlations of environmental policy performance overall and climate policy performance with democratization and wealth.

Furthermore, we find no direct relationship of economic long-term orientation with any level of environmental policy performance separate from economic and democratic development (*sensu* Acharya et al., 2016) (Fig. S3).

The relationship of long-term orientation with the public priority of environmental topics shows the same pattern as with environmental policy performance. Hence, economic long-term orientation generally correlated positively with public environmental priority in the models without but not in the models with control variables. Public environmental priority was also higher in wealthier countries while countries' democratic development did not explain public environmental priority (Table S3).

3.2. Thrift and Google time preference

For the relationship of thrift long-term orientation with environmental policy performance overall and climate policy performance, we find the same relationships as for economic long-term orientation. Hence, a positive relationship of thrift long-term orientation with environmental policy performance overall and climate policy performance when neglecting economic and democratic development and no relationship when we consider these developments (Figs. 3 and S4). Whereas, we observe no relationship at all between thrift long-term orientation and biodiversity policy performance. For all levels of environmental policy performance, we find no direct associations separate from economic and democratic development (*sensu* Acharya et al., 2016) (Fig. S3).

Using Google long-term orientation (which measure is available for considerably more countries; $N = 112$), we observe that countries, which are more long-term oriented have higher environmental policy performance overall – also after controlling for economic and democratic development (Figs. 3 and S5). We also observe these relationships when testing for direct correlations (*sensu* Acharya et al., 2016) (Fig. S3). When we use a sub-sample ($N = 52$), we only observe this relationship for the model without but not for the models with control variables. For climate policy performance and biodiversity policy performance, we find a positive relationship of Google long-term orientation for the model without control variables and some specification models with control variables (Fig. 3, Fig. S5). This is the same when testing for separate direct correlations (*sensu* Acharya et al., 2016) (Fig. S3). The sub-sample analysis shows the same results as the other time preference indices, i.e., only a positive relationship between long-term orientation and environmental policy performance in the model without control variables.

The countries included in the Google time preference analysis compared to the sub-sample analysis are mostly located in Africa and Asia and are less wealthy, less democratized, closer to the equator, have lower education levels, and a lower share of internet users (Figs. S6 and S7, Table S6). Moreover, when comparing countries of the Google time preference analysis and the economic time preference analysis, we observe again more countries in Africa and Asia in the Google time preference analysis. However, the countries of the two analyses are fairly similar in terms of distribution of the variable values, such as wealth, share of internet users, or latitude (Fig. S8).

4. Discussion

Hypotheses suggest that long-term orientation increases environmental policy performance. Here, we study this relationship between time preference (i.e., short- vs. long-term orientation) and environmental policy performance. We find that countries with higher long-term orientation show higher environmental policy performances. However, this observation is dominantly linked to economic and democratic development factors that simultaneously influence time preference and environmental policy performance. These economic and democratic development factors are also often positively to other aspects of institutional development (Acemoglu et al., 2005; Kotschy and Sunde, 2017; Lawson et al., 2020). The simultaneous influence of economic and democratic development factors is in line with findings for governmental biodiversity conservation spending (McClanahan and Rankin, 2016), which are based only on thrift time preference. Indeed, in most cases, the environmental policy performance-long-term orientation relationship seems to be constrained by the national economic development and its positive relationship to long-term orientation. While the economic and democratic development factors play a dominant role in the time preference-environmental policy performance relationship, we cannot definitively reject our hypotheses about any positive relationship between long-term orientation and environmental policy performance. This is because the additional analysis with Google time preference still shows some positive associations between long-term orientation and environmental policy performance when controlling for economic and democratic development. While Google time preference measures different aspects compared to economic time preference, i.e., it focuses on information seeking for the next vs. the last year compared to financial patience, it also includes more countries, especially in Africa and Asia, and likely has a higher representation of younger generations. Thus, it would be worthwhile to include more African and Asian countries when collecting survey data in the future to understand if the controlled relationship between time preference and environmental policy performance depends on the index used or relationships are only present when considering countries in certain regions. Moreover, considering that younger generations are more severely affected by some environmental crises over their lifetime than older generations, such as climate change (Thiery et al., 2021), younger generations that are more long-term oriented, and their governments, might be more concerned about future environmental consequences. Thus, future research should also consider intergenerational differences when studying time preferences and environmental actions. Despite these considerations, what our results clearly show is that the relationship between long-term orientation and environmental policy performance largely, or even completely, depends on wealth and other factors, which need to be considered consequently in future research.

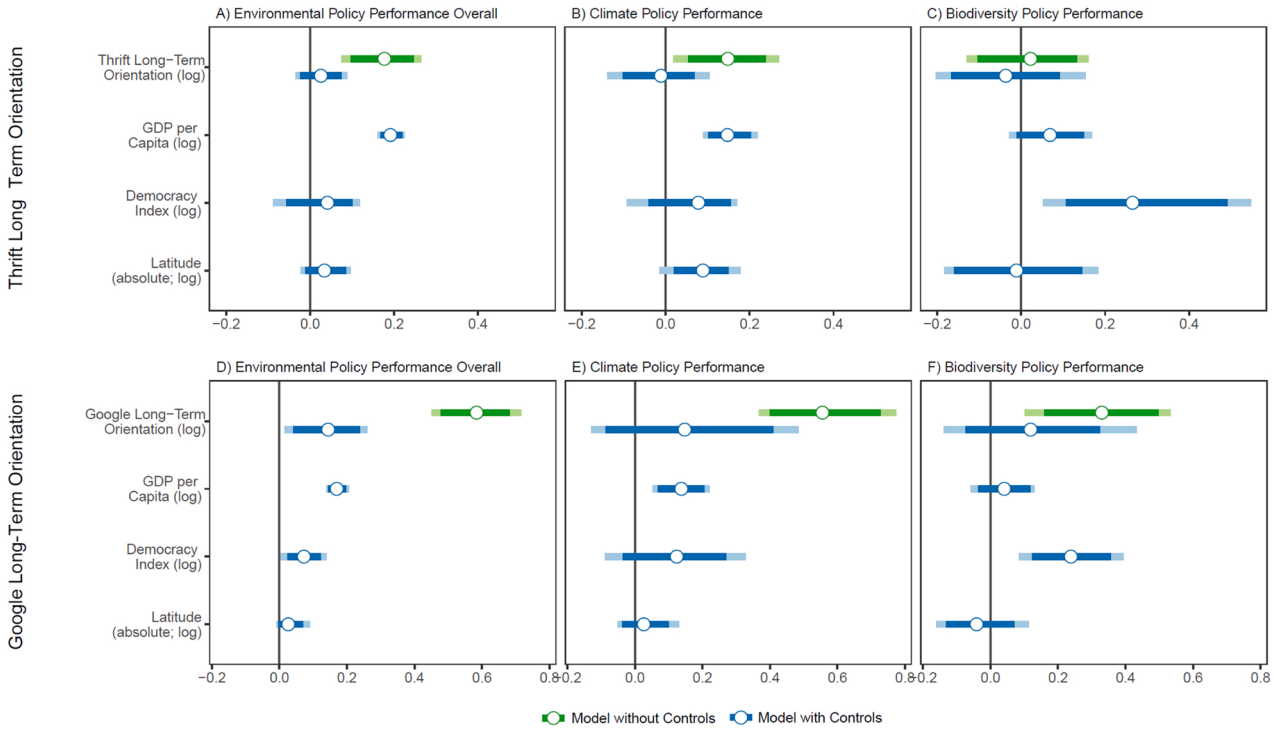

Fig. 3. Relationship of thrift and Google long-term orientation with environmental policy performance. Panel A), B), and C) show the relationship of thrift long-term orientation with environmental policy performance overall, climate policy performance, and biodiversity policy performance, respectively. Panel D), E), and F) show the relationship of Google long-term orientation with environmental policy performance overall, climate policy performance, and biodiversity policy performance, respectively. The cycles are point estimates and the bars show the 95% and 99% confidence intervals. The results are based on bootstrapped regressions (Table S7 and S8). Note that time preference is represented as long-term orientation, thus, ranges from short- (low) to long-term orientation (high). Control variables in the model are GDP per capita (Constant 2010 US$; log), democracy index (1 to +21; log), and latitude (absolute degrees; log; see Table S1). For different model specifications and for a sub-sample analysis, see Fig. S4 and S5.[61]

Previous studies show often positive associations between long-term orientation and individual and public environmental support and behavior, however, often without controlling for potential confounding factors, such as wealth (e.g., Joireman et al., 2001, Franzen and Vogl, 2013, Alló and Loureiro, 2014, Carmi and Arnon, 2014, Tam and Chan, 2017). In our study, we did not observe a positive correlation between long-term orientation and public environmental priority when controlling economic and democratic factors. Which is in line with findings by Lades et al. (2021) who studied pro-environmental behavior on the individual level and controlled for several factors, such as income. The patterns we find for public environmental priority were similar to the patterns observed for environmental policy performance, which might indicate similar rationales and dependencies between time preferences and environmental actions at the private and governmental level. Moreover, the results of public environmental priority, especially the importance of economic development, might imply that the relationship of time preference and public environmental priority does not exceed what is possible because of the economic and institutional endowment. However, the importance of time preference in this context might increase when a more heterogeneous set of countries, with respect to wealth, education, and other factors, are considered than in the current analysis (N = 51 and 48). Furthermore, our results show that it is crucial to account for economic development and test for separate direct relationships (*sensu* Acharya et al., 2016). This importance also applies when comparing other relationships between countries as well as individuals, such as the relationship between willingness to pay for environmental goods and time preferences (or other cultural traits).

We use three distinct indices to measure time preference. Independently, we observe similar patterns in the relationships of time preference and environmental policy performance. However, the indices measure different aspects. Economic time preference measures immediate and delayed financial rewards using a representative sample (Falk et al., 2018), whereas thrift time preference measure past (tradition and fulfilling social obligations) versus future (perseverance and thrift) and Google time preference measures seeking for information about the next year compared to the last year. We use thrift time preference as it is commonly used to represent time preference, although it does not file under what we usually imagine under time preference, and its validity is questioned (Venaik et al., 2013; Hanushek et al., 2020). Moreover, Google time preference provides cost-efficient information on time preference for a considerably larger number of countries (112 instead of 76 for economic time preference). The index still has some limitations, such as that it is only based on the population share that uses Google. Moreover, the index might be more representative of younger than of older generations. Researchers should explain the use of a specific time preference index (especially concerning the hypothesis tested) and perhaps use multiple indices, considering the indices' interpretation and shortcomings.

Next, to the in this study explored indices of time preference also alternative measures exist that could proxy people's orientation towards the future compared to the present, such as long-term investments compared to present consumption, research and development spending as a share of the GDP as well as linguistic features that influences people's long-term oriented behavior (see, e.g., Chen 2013 and Galor et al., 2020). Investigating these measures with respect to environmental policy performance and public environmental interest offers interesting future research avenues.

5. Conclusion

The reasons why our findings, both for the policy and public level, are not in line with the proposed hypothesis might be a psychological

distance to environmental crises as well as a lack of awareness and emotions about the values of nature (to oneself and the economic system) and the current endangerment of nature. Increasing environmental education (for all generations), tailoring education, and creating a more direct relation to nature can increase the public's priority, thus, policy actions (Carmi et al., 2015; Ardoin et al., 2020; Whitburn et al., 2020; Dasgupta, 2021). Next to this, reducing the psychological distance to the environmental crises by communicating about their impacts today and in the future, the concrete and palpable nature of those events, and the effectiveness of policies can be important to increase policy support (Singh et al., 2017, Sparkman et al., 2021). Along the same lines, deliberating, i.e., the process of mutual discussion and argumentation, about environmental issues and their future implications, can make people more sensitive to future environmental benefits (or costs if actions are not taken) (MacKenzie and Caluwaerts 2021). These future benefits (or costs) will be more important today for more long-term-oriented people.

Knowledge, communication, and education about the enormous environmental intrinsic and economic value, its endangerment, as well as building policy capacity (Weidner and Jänicke, 2002; Vucetich et al., 2015; Granados Franco et al., 2020; Dasgupta, 2021) might change how we rank environmental policies compared to other policies and implement environmental policies. In turn, long-term orientation would enhance public priority and policy action for environmental problems. For example, higher prioritization of the future combined with higher sensitivity to climate change impacts can influence the carbon costs (e.g., Nordhaus 2017), hence, how we tax carbon today. In the context of the study, we also need to consider a) potential differences and time-lags between public priorities and governmental action (Olper and Swinnen, 2013; Rome, 2013; Anderson et al., 2017; Schaub et al., 2020) and b) that governments are often concerned about their re-election, which creates a conflict between present costs and interest and future benefits (see, e.g., Vachon and Menz 2006, Blignaut and Aronson 2008, Rueff et al., 2015, Handgraaf et al., 2017). Highlighting future consequences and making them accessible to people can reduce this conflict.

CRediT authorship contribution statement

Sergei Schaub conceived the idea, prepared and analyzed the data, and wrote the manuscript.

Code availability statement

The R-code for the reproduction of this study (data preparation and analysis) is available online on Github (https://github.com/sescha ub/eep_tp).

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability Statement

All data for reproduction of this study is freely online accessible. The processed data that support the findings of this study are openly available at the ETH Research Collection (Schaub, 2021; https://doi.org/10.3929/ethz-b-000515870). Please, when using the data refer to the original data sources (see Material & method section). Note that some data is automatically downloaded using the R code and that the random sample Google provides (used for Google time preference) can change between downloads.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.envsci.2021.11.017.

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[6] Additional surveys exist that measured variables relating to time preferences, e.g., World Value Survey (Haerpfer et al., 2020) and GLOBE project (House et al., 2004). The World Value Survey (2017–2020) measured desired traits children should learn at home (i.e., 1 = if thrift saving money and things is an important quality and 0 = otherwise) but does not reference this trait compared to other traits or short-term orientation. The GLOBE project measured, amongst others, societal practices related to future orientation in 2004. The sample of the GLOBE project is non-random, the survey method differs between countries, and the survey focuses on managers. Thus, the features of both datasets raise questions about the validity and fit as a proxy for time preference for our study. Therefore, we base our study on economic, thrift, and Google time preference. It shall be noted that we also conducted analyses using the World Value Survey and GLOBE project time preference proxies (Table S9). For the World Value Survey proxy for time preference, we find no relationship of long-term orientation with environmental policy performance. Differently to this, we find a similar association of environmental policy performance overall with GLOBE project long-term orientation proxy as for economic long-term orientation. However, the relationships of climate and biodiversity policy performance with economic and GLOBE project long-term orientation differed.

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