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journal homepage: www.elsevier.com/locate/jceTalking in the present, caring for the future: Language and environment[☆]Astghik Mavisakalyan^{*,a,b}, Yashar Tarverdi^{a,1}, Clas Weber^{c,2}^a Bankwest Curtin Economics Centre, Curtin Business School, Curtin University, Australia^b ARC Centre of Excellence for the Dynamics of Language, Australia^c Department of Philosophy, University of Western Australia, Australia

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ABSTRACT

This paper identifies a new source that explains environmental behaviour: the presence of future tense marking in language. We predict that languages that grammatically mark the future affect speakers' intertemporal preferences and thereby reduce their willingness to address environmental problems. We first show that speakers of languages with future tense marking are less likely to adopt environmentally responsible behaviours and to support policies to prevent environmental damage. We then document that this effect holds across countries: future tense marking is an important determinant of climate change policies and global environmental co-operation. The results suggest that there may be deep and surprising obstacles for attempts to address climate change.

1. Introduction

This paper provides a novel explanation for differences in environmental behaviour within and across countries: future tense marking in language. Language is important for economic outcomes for two reasons. First, language may serve as a marker of underlying *cultural factors*. It has been shown that future tense is associated with speakers' long-term orientation (Galor et al., 2016); long-term orientation in turn is relevant for a range of economic outcomes. Second, language may have a *direct effect* on cognition and behaviour. This effect has been documented in a nascent, but rapidly growing economics literature on the link between linguistic structures and economic outcomes (see Mavisakalyan and Weber, 2017 for a review). Part of this literature builds on the so-called *Linguistic Relativity Hypothesis* to propose that the structure of our language affects our thinking and behaviour.

Speakers of languages that lack future tense marking speak about future events in the present tense, i.e. as if they were present. In contrast, languages with future tense marking require speakers to use a distinct form when talking about the future. This linguistic

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difference seems to affect speakers' intertemporal preferences and induces less future-oriented behaviour (Chen, 2013).³ Consistent with this hypothesis, recent studies have shown that speakers of languages with future tense marking save less and invest less in their health (Chen, 2013; Guin, 2015). At the corporate level, the existing evidence suggests that firms in locations with future tense marking have lower precautionary cash holdings (Chen et al., 2015) and invest less in research and development (Su et al., 2016). That intertemporal preferences potentially mediate the effects of grammatical future tense has been shown experimentally through elicited time preference data by Sutter et al. (2015). Our study contributes to this literature by extending the effects of future tense marking to a new and highly significant area of future oriented-behaviour: environmental action.

The literature has studied several determinants of individual environmental action, highlighting the role of both economic factors and norms (Inglehart, 1995; Gelissen, 2007; Franzen and Meyer, 2010; Bechtel et al., 2016). Existing studies on policies concerning climate change and other environmental problems focus mainly on countries' economic (Damania et al., 2003; Damania and Fredriksson, 2003), institutional (Congleton, 1992; Fredriksson and Neumayer, 2013), historical (Fredriksson and Wollscheid, 2015; Ang and Fredriksson, 2017) and demographic (Tonn et al., 2001; Kahn, 2002) traits. To the best of our knowledge, our study is the first to combine the analysis of the determinants of environmental actions and policies with the study of linguistic structures in economics, and to identify future time reference in language as a significant source of variation in environmental action within and across countries.

We use individual-level data from the World Values Surveys to demonstrate that individual speakers of languages with obligatory future tense marking are less likely to adopt environmentally responsible behaviours compared to observationally identical individuals who speak languages that do not grammatically distinguish between present and future. Moreover, we show that they are also less likely to support policies to prevent environmental damage. We complement the individual-level analysis with an analysis of environmental policy outcomes across countries. The results of this analysis are consistent with those obtained in individual-level comparisons: countries similar in their economic, demographic and institutional characteristics, yet different in their grammatical structure have different climate change policies and global environmental cooperation outcomes. Policies are less stringent in places where the majority language requires future tense marking.

We first provide some background on the connection between culture, language and behaviour and propose mechanisms which mediate the effect of language on climate change action (Section 2). In Section 3 we describe the data used in the study, followed by a discussion of empirical approaches in Section 4. Section 5 presents the results, including various robustness checks. We conclude with a discussion of the implications of our findings in Section 6.

2. Background

2.1. Language, culture and behaviour

The relationship between language, culture, and behaviour is complex. First, many features of language are determined by culture. Culture, in the form of inherited beliefs and values, has in turn important effects on behaviour. Viewed in this way, linguistic structures serve as *indicators* of cultural variables. Second, there is good evidence that language also has a direct influence on cognition and behaviour—the way we speak seems to affect the way we think and act. Finally, there are reciprocal connections between language and culture: language may support the influence and preservation of culture by aiding its propagation and giving it a lasting form; language may further shape culture, as it is the main medium of its transmission (Mavisakalyan and Weber, 2017).

The idea that there's a direct influence of language on cognition and behaviour is at the heart of the *Linguistic Relativity Hypothesis* (LRH). In a nutshell, the LRH states that the structure of one's language has a systematic influence on cognition and behaviour.⁴ Different languages represent the world in different ways by emphasising different aspects of reality. As a result, speakers of a certain language may be more sensitive to various features of the world. For example, Russian has different basic colour terms than English: it has one basic term for light blue and another one for dark blue, but none corresponding to the generic "blue". It thus forces its speakers to distinguish light from dark blue. Experiments show that Russian speakers are better at perceptually discriminating different shades of blue as a consequence (Winawer et al., 2007). For decades, linguists and cognitive scientists have regarded the LRH as misguided. However, starting in the early 1990s, the theory has received a revival, and there is now a substantial and ever-growing body of literature that testifies to its validity (e.g. Levinson, 1996; Boroditsky et al., 2003; Slobin, 2003; Kay and Regier, 2006; Levinson and Wilkins, 2006).

³ The literature has additionally considered the effects of two other linguistic features. Linguistic *gender* systems have been linked with gender inequalities in various contexts including the labour market (Mavisakalyan, 2015; Gay et al., 2017), corporate and political leadership (Santacreu-Vasut et al., 2014; Hicks et al., 2016), household division of labour (Hicks et al., 2015), education (Davis and Reynolds, 2016) and health (Bhalotra et al., 2015). Grammatical rules governing *personal pronouns* (pronoun drop and politeness distinctions) have been linked to various cultural traits across countries, including individualism vs collectivism, social distance, etc. (Kashima and Kashima, 1998; Davis and Abdurazokzoda, 2016). Furthermore, studies have exploited these grammatical features to study the causal relationship between culture and various socio-economic outcomes (Licht et al., 2007; Tabellini, 2008; Davis and Williamson, 2016).

⁴ For an overview on the LRH see Gumperz and Levinson (1996); Lucy (1997); Casasanto (2015). There are different interpretations of the LRH (Scholz et al., 2016). A *strong* interpretation assumes a *strong* effect of language on thought: language *determines* thought; i.e. no thought (of a certain type) without corresponding linguistic structures. A *moderate* interpretation assumes only a *moderate* effect of language on thought: language *influences* thought in systematic and non-trivial ways. The existing evidence on the LRH supports moderate readings of the LRH better than strong ones. Here, we are only assuming a moderate interpretation.

2.2. Future tense, long-term orientation, and temporal displacement

Tense marking is a linguistic feature that seems to affect economic outcomes (Chen, 2013). In particular, the way a language organises reference to the *future* seems to have consequences for a number of future-directed actions, such as saving, exercising, abstaining from smoking, condom use, retirement savings, and long-run health (Chen, 2013). In some languages, e.g. French and English, speakers are required to use a dedicated form when talking about future events. In other languages, e.g. German and Finnish, speakers can talk about the future in the same grammatical form in which they talk about the present.⁵

English: *Tomorrow they will_{auxiliary} drive to Paris.*

French: *Demain ils conduiront à Paris* — (Tomorrow they drive_{future} to Paris).

German: *Morgen fahren sie nach Paris* — (Tomorrow they drive_{present} to Paris).

We follow the terminology and classification of Chen (2013) in referring to languages which require a dedicated marking of the future as *strong-FTR* languages (e.g. English, French) and to languages that do not require to grammatically mark the future as *weak-FTR* languages (e.g. German, Finnish).⁶ The grammatical difference between strong- and weak-FTR is associated with agents' intertemporal preferences and decision making. Our study suggests that this influence includes environmental behaviour.

According to the above, there are two ways to understand the influence of future tense on speakers' intertemporal preferences and behaviour (both are consistent with our findings). Future tense may be a marker for cultural factors, or future tense may directly affect speakers' cognition and behaviour (or both). Both the cultural and the linguistic-cognitive channel of influence rely on the phenomenon of *temporal discounting*. Humans (and other animals) have a well-established tendency to discount future costs and rewards (Ramsey, 1928; Solnick et al., 1980; Kirby and Herrnstein, 1995; Frederick et al., 2002). The further in the future an outcome seems, the more we discount its potential costs or benefits.

The mechanism associated with the cultural channel may proceed via speakers' orientation towards the future. Absence of grammatical future tense in a language seems to indicate increased long-term orientation among its speakers (Galor et al., 2016). Increased long-term orientation can be represented by its effect on agents' *discount rates*. Different agents differ in how strongly the effect of temporal discounting is manifested, as measured by different discount rates. We can thus understand the effect of long-term orientation as a reduction in agents' discount rates. Speakers of strong-FTR language have higher discount rates compared to speakers of weak-FTR languages.

The mechanism associated with the linguistic-cognitive channel combines temporal discounting with *temporal displacement*. The idea behind temporal displacement is that using a dedicated grammatical form to talk about future events subjectively projects these events further away from the speaker's *now*—they appear temporally more distant to the agent. The separate grammatical form represents the future as discontinuous with the present. Conversely, speaking about the future in the present tense depicts it as continuous with the present and subjectively locates future outcomes closer to the agent's current temporal perspective. The effect of temporal displacement then combines with that of temporal discounting. In tandem, temporal displacement and temporal discounting affect agents' intertemporal preference structure such that future options appear less rewarding and less costly to speakers of a strong-FTR languages, compared to speakers of weak-FTR languages, since they appear temporally more distant, and are thus more strongly affected by temporal discounting.⁷

To illustrate, imagine two agents A_{weak} and B_{strong} . The only salient difference between A_{weak} and B_{strong} is that A_{weak} is a speaker of a weak-FTR language, presenting the future as if it were present and indicating high long-term orientation, whereas B_{strong} is a speaker of a strong FTR language, projecting the future away from the present and marking low long-term orientation. Assume that A_{weak} is indifferent between a present reward x_1 and an intrinsically more rewarding future option x_2 : $(x_1, t_{now}) = (x_2, t_{later})$. When B_{strong} is presented with the same choice, s/he may well prefer the less rewarding present option. There are two potential explanations. First, the presence of future tense may indicate that B's long-term orientation is low, and thus her discount rate is high: $\delta_A < \delta_B$. Second, assuming that temporal displacement is operative, the later option appears comparatively more distant and therefore less attractive (even assuming identical discount rates). Again, it is possible that both mechanism are jointly operative. Both mechanisms influence B's intertemporal preference structure such that: $(x_1, t_{now}) > (x_2, t_{later})$.

2.3. Intertemporal preferences and environmental action

Pro-environmental actions and policies typically incur present costs for the sake of future rewards. For instance, green products are on average more expensive than conventional products. Buying a green product thus has significant short-term costs, but the expected reward, i.e. avoiding damaging environmental outcomes, is located relatively far in the future. The pay-off structure of such decisions thus makes them amenable to the above described influence of temporal displacement and discounting. Speakers of weak-FTR languages are expected to value the future benefits of pro-environmental actions and policies higher than speakers of strong FTR languages. Given their different preferences, speakers of weak-FTR languages are expected to engage in more pro-environmental

⁵ It is true that German, like English, also has the *potential* to explicitly mark reference to the future, e.g. with the auxiliary “werden”. It is therefore important to stress that the difference between the two groups of languages concerns whether future time reference “is overtly and *obligatorily* marked” (Dahl, 2000, p. 310, our emphasis).

⁶ Chen's (2013) classification is based on that of the European Science Foundation's Typology of Languages in Europe (EUROTYP) project (Dahl, 2000), which undertook a very comprehensive study of the tense and aspect system of the major European languages.

⁷ It is also conceivable that future tense has a direct effect on speakers' discount rates; in that case the cultural and the linguistic-cognitive channel work in equivalent ways. The mechanism proposed here is very similar to one of several proposed in Chen (2013, p. 695).

behaviour than speakers of strong-FTR language. This is indeed what our study finds.

Furthermore, in a standard median voter model, which assumes the presence of electoral motives, political decisions reflect the preferences of the electorate (Downs, 1957). Hence, given the different intertemporal preferences of individual voters, we expect to see better environmental policy and cooperation outcomes in places with weak-FTR languages. The same result is predicted if we alternatively assume a ‘citizen candidates’ model. Politicians who speak weak-FTR languages have either higher long-term orientation and a correspondingly reduced temporal discount rate or a general tendency to perceive future concerns as more pressing (or a combination of both). As a result, they have stronger pro-environmental preferences and are more likely to implement policies consistent with those preferences once elected (Osborne and Slivinski, 1996; Besley and Coate, 1997). Both scenarios are consistent with our findings; distinguishing between them is beyond the scope of our paper.

3. Data

Most of the empirical evidence on the determinants of environmental policies are based on large country-level datasets (e.g., Damania et al., 2003; Fredriksson and Neumayer, 2013; Fredriksson and Wollscheid, 2015; Ang and Fredriksson, 2017). Cross-country data provide a general picture, but they may conceal important behavioural mechanisms underlying aggregate outcomes. Yet, not all questions are amenable to sub-national analysis; understanding the drivers of climate change policies is particularly difficult using micro-level data. With these considerations in mind, the paper combines an individual-level analysis that employs survey data from a large sample of countries to compare pro-environmental behaviours of individuals with aggregate-level data to perform cross-country comparisons of climate change policies.

3.1. Measurement of FTR

Our classification of languages into those which require a dedicated marking of the future, *strong-FTR* languages, and those that do not, *weak-FTR* languages, is based on data from Chen (2013). Chen’s classification rests on whether a language requires an obligatory FTR in ‘prediction-based contexts’ adopted from the European Science Foundation’s Typology of Languages in Europe (EUROTYP) project (Dahl, 2000). To justify this criterion, Dahl (2000) notes that “whether FTR is overtly and obligatorily marked in prediction-based sentences can be used as one of the major criteria for whether it is grammaticalized in language or not” (Dahl, 2000, p. 310). The data itself comes from EUROTYP and, in the case of non-European languages, other established cross-linguistic analyses (e.g., Dahl and Dienes, 1984; Dahl, 1985; Bybee et al., 1994; Nurse, 2008; Cyffer et al., 2009) (see Appendix B in Chen (2013) for further discussion on the coding of languages). Chen (2013) further substantiates the validity of this measure using frequency analysis of future-marking in weather forecast texts retrieved from the web.⁸

3.2. Individual-level data

The data source for individual-level analysis of pro-environmental behaviour is the World Values Surveys, a collection of nationally representative, individual-level surveys conducted in nearly 100 countries (almost 90 percent of the world’s population) containing rich information on a variety of attitudes and preferences, as well as standard socio-economic and demographic characteristics of individuals. Six waves of the survey, with the latest covering the years 2010–2014, have been conducted since its inception in 1981–1984. Cross-country comparability, representativeness, richness and relevance of the data make WVS highly appropriate for the purposes of individual-level analysis in this study.⁹

The language FTR measure is linked to the language spoken at home by the individual. This information has been collected since wave 3 conducted in years 1995–1998. The FTR of the language spoken by individuals is connected to their pro-environmental behaviour, ENVIRONMENTAL ACTION, as captured by affirmative responses to a question on whether in the preceding 12 months, ‘out of concern for the environment’, they have chosen household products that they think are better for the environment. Capturing individuals’ willingness to incur short-term costs for the sake of future rewards, this measure is highly appropriate for understanding individual support for climate change policies adopted at national level. This question was asked in wave 3 of WVS conducted in years 1995–1998. The study therefore is restricted to this wave. As a second dependent variable, we utilise information on the respondents’ support to increase taxes if the extra money is used to prevent environmental damage and their willingness to buy things at 20% higher than usual prices to construct a binary measure of their WILLINGNESS TO PAY FOR POLICIES.

Following Chen (2013), our analysis excludes first-generation immigrants to isolate the effect of differences in language from native-immigrant differences. We drop observations with missing outcome data, arriving at a baseline sample of 34,461 individuals in 35 countries.¹⁰

⁸ The sample of languages from this analysis is too small to be useful for the current study.

⁹ An alternative approach to individual-level analysis of the effect of language structures on economic outcomes of individuals is to study the behaviour of immigrants (e.g., Hicks et al., 2015; Gay et al., 2017) within a single immigrant-hosting country, applying an ‘epidemiological approach’ (see e.g. Gay et al., 2016 for a discussion). We were not able to identify a data source that would contain appropriate information on pro-environmental behaviours and languages spoken by individuals to allow for such study.

¹⁰ The countries in the sample include: Albania, Azerbaijan, Australia, Armenia, Bosnia & Herzegovina, Bulgaria, Belarus, Chile, China, Czech Republic, Estonia, Finland, Georgia, Germany, India, Latvia, Lithuania, Macedonia, Mexico, Montenegro, New Zealand, Nigeria, Peru, Puerto Rico, Romania, Russian Federation, Serbia, Slovak Republic, South Africa, Spain, Sweden, Taiwan, United States, Uruguay, Venezuela.

Table 1
Individual-level descriptive statistics.

Variables	Mean (s.d.)		All
	WEAK FTR	STRONG FTR	
STRONG FTR	0	1	0.869 (0.338)
ENVIRONMENTAL ACTION	0.617 (0.486)	0.411 (0.492)	0.438 (0.496)
MALE	0.500 (0.500)	0.477 (0.499)	0.480 (0.500)
AGE	40.840 (14.920)	40.990 (15.980)	40.970 (15.850)
MARRIED	0.721 (0.448)	0.643 (0.479)	0.653 (0.476)
NO CHILDREN	0.252 (0.434)	0.260 (0.439)	0.259 (0.438)
PRIMARY	0.286 (0.452)	0.196 (0.397)	0.208 (0.406)
SECONDARY	0.284 (0.451)	0.307 (0.461)	0.304 (0.460)
TERTIARY	0.430 (0.495)	0.497 (0.500)	0.488 (0.500)
EMPLOYED	0.692 (0.462)	0.514 (0.500)	0.537 (0.499)
INCOME DECILE 1	0.077 (0.268)	0.127 (0.333)	0.121 (0.326)
INCOME DECILE 2	0.105 (0.307)	0.174 (0.379)	0.165 (0.371)
INCOME DECILE 3	0.136 (0.343)	0.151 (0.358)	0.149 (0.356)
INCOME DECILE 4	0.149 (0.356)	0.129 (0.335)	0.132 (0.338)
INCOME DECILE 5	0.169 (0.375)	0.114 (0.317)	0.121 (0.326)
INCOME DECILE 6	0.123 (0.329)	0.084 (0.278)	0.089 (0.285)
INCOME DECILE 7	0.094 (0.292)	0.074 (0.262)	0.077 (0.267)
INCOME DECILE 8	0.063 (0.243)	0.062 (0.240)	0.062 (0.241)
INCOME DECILE 9	0.038 (0.190)	0.046 (0.209)	0.045 (0.207)
INCOME DECILE 10	0.046 (0.208)	0.038 (0.192)	0.039 (0.194)
N	4528	29,933	34,461

Note.— Standard deviations in parentheses. Variables are defined in section 3.2. Source: World Values Survey Wave 3 (1995–1998). The sample is restricted to non-immigrants. Thirty-five countries listed in footnote 10 are included.

Table 1 provides the definitions and descriptive statistics for all variables used in the baseline analysis by language FTR. Eighty-seven percent of individuals in the sample speak a strong FTR language. The incidence of ENVIRONMENTAL ACTION is 62% among speakers of weak FTR languages and 41% among speakers of strong FTR languages suggesting a negative effect of STRONG FTR on pro-environmental action.

The individual-level analysis controls for standard observable demographic and socio-economic characteristics of individuals included in similar studies (e.g., Gelissen, 2007; Franzen and Meyer, 2010; Bechtel et al., 2016). The demographic controls include gender, age and family circumstances. Forty-eight percent of individuals in the sample are male—a gender that has been linked to unecological attitudes (Blocker and Eckberg, 1997; Gelissen, 2007). We control for age, to account for associated differences in environmental preferences. As Farzin and Bond (2006) argue, young people may have larger stakes in environmental quality, and therefore may have stronger demand for stringent environmental policies. On the other hand, older people may feel the environmentally induced health problems more directly, and thus may be more willing to extend support for such policies. Intergenerational environmental altruism and greater access to time and resources to support environmental initiatives may further contribute to higher demand for environmental policies by older people (Farzin and Bond, 2006). Intergenerational altruism is also more likely to be observed among those with families and children—additional characteristics of individuals we control for. The average age in the sample is around 41 years old; sixty-five percent of individuals are married and only 26% of all individuals have no children.

Furthermore, we account for standard socio-economic characteristics of individuals. These include educational attainment

expected to be positively correlated with pro-environmental behaviour (e.g., [Gelissen, 2007](#); [Franzen and Meyer, 2010](#)). Primary and secondary school attainment comprise 21% and 30% of the sample, with the remaining 49% having tertiary education. We further control for individuals' employment status (54% prevalence in the sample) and income, captured in deciles, both expected to result in increased propensity for environmental action (e.g., [Franzen and Meyer, 2010](#); [Bechtel et al., 2016](#)).

We complement the individual-level analysis of pro-environmental behaviour with a cross-country analysis of environmental policies. The data used in this analysis are described next.

3.3. Country-level data

The cross-country analysis is based on data from multiple sources, including [Steves et al. \(2011\)](#); [Keefer \(2012\)](#); [Chen \(2013\)](#); [Marshall et al. \(2016\)](#); [World Bank \(2016\)](#). Together, they result in a sample of 68 countries in the baseline specification.¹¹ [Table 2](#) specifies the sources and presents descriptive statistics for all variables used in the baseline cross-country analysis by weak- and strong-FTR language groups. Following other studies (e.g., [Licht et al., 2007](#); [Santacreu-Vasut et al., 2013](#); [Bhalotra et al., 2015](#)), the FTR marker is assigned to a country's most widely spoken language (based on information collected by [Alesina et al., 2003](#)).¹² 76% of the countries in our baseline sample speak a strong-FTR language, while the remaining 24% are weak-FTR countries.

We analyse the relationship between the FTR system of a country's majority language and its climate change policies as captured by Climate Laws, Institutions and Measures Index (CLIMI) developed by [Steves et al. \(2011\)](#) and used in several published studies (e.g., [Fredriksson and Neumayer, 2013](#); [2016](#)). CLIMI measures countries' climate change mitigation policies with reference to the 2005–2010 annual national communications to the UNFCCC. CLIMI uses 12 components, grouped into four key policy areas, with sub-weights and weights reflecting the contribution of each of the components/areas to climate change mitigation: (i) International cooperation (0.1) [components: Kyoto ratification (0.5), Joint Implementation or Clean Development Mechanism host (0.5)]; (ii) domestic climate framework (0.4) [components: cross-sectoral climate change legislation (0.33), carbon emissions target (0.33), dedicated climate change institution (0.33)]; (iii) significant sectoral fiscal or regulatory measures or targets (0.4) [components: energy supplies/renewables (0.3), transport (0.13), buildings (0.07), agriculture (0.13), forestry (0.17), industry (0.2)]; and (iv) additional cross-sectoral fiscal or regulatory measures (0.1) [components: cross-sectoral policy measures (1)]. CLIMI ranges from 0 and 1, with higher values representing stricter policies.

As a second dependent variable, we use a measure of a country's participation in global collaborative environmental efforts, GLOBAL, that comes from [Esty et al. \(2005\)](#) and has been used in several studies on the subject (e.g., [Fredriksson and Neumayer, 2013](#); [2016](#)). This measure combines information on a country's number of memberships in environmental intergovernmental organizations, its contribution to international and bilateral funding of environmental projects and development aid, and its participation in international environmental agreements. GLOBAL ranges from -1.69 to 1.74 (see [Esty et al., 2005](#) for details).

[Table 2](#) presents the descriptive statistics for the variables employed in the baseline analysis. The average CLIMI score in the entire sample is 0.412.¹³ In the sample of countries with a weak-FTR majority language it is 0.517, while in the sample of countries with a strong-FTR language it is 0.380. This gap of 0.137 points suggests a negative effect of STRONG FTR on CLIMI.

Our analysis of the link between language FTR and climate change policies controls for a range of observable characteristics of countries that have been accounted for in previous studies on determinants of environmental policies. Since CLIMI is derived from information collected over the period 2005–2010, we use explanatory variables averaged over this time period.

Four groups of covariates are included in the baseline models. The first included economic characteristics. We expect the demand for environmental quality to increase with GDP PER CAPITA (measured in log) (e.g., [Fredriksson and Neumayer, 2013](#); [2016](#)). Following these studies, we also control for OPENNESS, defined as imports plus exports divided by GDP. On the one hand, more open countries may cooperate more on environmental problems ([Neumayer, 2002](#)). On the other hand, it is possible that the interests of exporting countries are threatened by environmental agreements. Under such a scenario, higher openness for trade may decrease the willingness to commit to stringent environmental policies. The sectoral structure of an economy may also influence the stringency of its environmental policies. We include manufacturing value added as a percentage of GDP, MANUFACTURING %, to account for this possibility. According to [Cole et al. \(2006\)](#) and [Fredriksson and Vollebergh \(2009\)](#), this measure may capture the lobbying pressures from workers in the manufacturing sector for lower regulations. Alternatively, it may measure the degree to which an economy consists of pollution-intensive manufacturing, positively affecting the regulatory stringency.

The second group of covariates encompasses demographic characteristics of countries. We control for the size of the country, as captured by the log of its population size, POPULATION SIZE (e.g., [Fredriksson and Wollscheid, 2014](#)). Additionally, we control for the share of immigrants in the total population, IMMIGRANT % (averaging at 8.2% in the sample) as a measure of ethnic diversity. Previous research has highlighted the difficulty in agreeing on public goods and policies in diverse societies (e.g., [Easterly and Levine, 1997](#); [Alesina et al., 1999](#)). Accounting for ethnic diversity is particularly important in the present context, given our interest in isolating the

¹¹ The countries in the sample include: Albania, Argentina, Armenia, Australia, Austria, Azerbaijan, Bahrain, Belarus, Belgium, Bolivia, Bosnia & Herzegovina, Brazil, Bulgaria, Canada, Colombia, Congo Republic, Costa Rica, Czech Republic, Denmark, Dominican Republic, Egypt, Estonia, Fiji, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, India, Indonesia, Ireland, Italy, Japan, Jordan, Korea Republic, Kyrgyz Republic, Latvia, Lithuania, Macedonia, Madagascar, Malta, Mauritania, Mexico, Mongolia, Morocco, New Zealand, Niger, Norway, Peru, Poland, Portugal, Romania, Russian Federation, Saudi Arabia, Slovak Republic, Slovenia, South Africa, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States, Uruguay, Venezuela, Vietnam.

¹² To reflect the heterogeneity in multilingual countries, a weighted measure with weights given by the share of the population speaking each language is used in robustness checks (e.g., [Tabellini, 2008](#); [Mavisakalyan, 2015](#)).

¹³ Saudi Arabia has the lowest CLIMI score in the sample at 0.023, while the UK has the highest score at 0.801.

Table 2
Cross-country descriptive statistics.

Variables	Source	Mean (s.d.)		
		WEAK FTR	STRONG FTR	All
STRONG FTR	Chen (2013)	0	1	0.765 (0.427)
CLIMI	Steves et al. (2011)	0.517 (0.253)	0.380 (0.205)	0.412 (0.223)
GDP PER CAPITA	World Bank (2016)	9.968 (1.109)	9.619 (0.854)	9.701 (0.923)
OPENNESS	World Bank (2016)	0.943 (0.312)	0.842 (0.439)	0.865 (0.413)
MANUFACTURING %	World Bank (2016)	16.048 (6.157)	15.651 (5.050)	15.744 (5.285)
POPULATION SIZE	World Bank (2016)	15.857 (1.761)	16.534 (1.561)	16.375 (1.623)
IMMIGRANT %	World Bank (2016)	8.647 (7.143)	8.048 (10.167)	8.189 (9.496)
POPULATION AGE 65+ %	World Bank (2016)	12.793 (6.524)	10.594 (5.112)	11.111 (5.505)
DEMOCRACY	Marshall et al. (2016)	0.750 (0.447)	0.692 (0.466)	0.706 (0.459)
OTHER REGIME	Marshall et al. (2016)	0.250 (0.447)	0.308 (0.466)	0.294 (0.459)
LEFT GOVERNMENT	Keefer (2012)	0.375 (0.500)	0.250 (0.437)	0.279 (0.452)
CONTINENT AFRICA	World Bank (2016)	0.125 (0.342)	0.096 (0.298)	0.103 (0.306)
CONTINENT ASIA	World Bank (2016)	0.188 (0.403)	0.212 (0.412)	0.206 (0.407)
CONTINENT EUROPE	World Bank (2016)	0.625 (0.500)	0.423 (0.499)	0.471 (0.503)
CONTINENT NORTH AMERICA	World Bank (2016)	0.000 (0.000)	0.096 (0.298)	0.074 (0.263)
CONTINENT OCEANIA	World Bank (2016)	0.063 (0.250)	0.038 (0.194)	0.044 (0.207)
CONTINENT SOUTH AMERICA	World Bank (2016)	0.000 (0.000)	0.135 (0.345)	0.103 (0.306)
N		16	52	68

Note.— Standard deviations in parentheses. Variables are defined in section 3.3. The countries in the sample are listed in footnote 11.

effect of language from other confounders; including the immigrant share of the population therefore seems appropriate. Furthermore, the share of the population of 65 or more years of age, POPULATION AGE 65+ % (averaging at 11.1% in the sample) is included as an additional demographic control for reasons discussed above. In particular, it has been suggested that intergenerational environmental altruism, linked with older age, may contribute to pro-environmental behaviour (Farzin and Bond, 2006).

The third group of covariates comprises measures for institutions. We control for countries' political regime based on polity score measure available from the Polity IV data set (Marshall et al., 2016). The polity score captures the regime authority spectrum on a 21-point scale ranging from -10 (hereditary monarchy) to +10 (consolidated democracy), and is converted into two regime categories to distinguish between democracies (+6 to +10), 71% in the sample, and other regime types (Marshall et al., 2016). A strand of literature shows that democracies are more conducive to enactment of environmental regulations compared to autocracies (e.g., Murdoch and Sandler, 1997; Farzin and Bond, 2006). As an additional control, we include an indicator for LEFT GOVERNMENT, with its prevalence being 27.9% in the sample, based on information on the political orientation of the national leader's party available from Keefer (2012).¹⁴ An implication that follows from a number of studies is that left-wing parties are more pro-environmental than their right-wing counterparts (e.g., Neumayer, 2003; 2004).

Finally, dummies for continents are included throughout the analysis. Forty-seven percent of the countries in the sample are based on the European continent, followed by 21% country representation from Asia. Africa and South America contribute each 10.3% of the countries in the sample, while North American countries comprise 7%. The smallest share of countries in the sample, 4.4%, is in Oceania.

¹⁴ According to the source for this data, the parties have been classified as left if their names reveal them to be communist, socialist, or social democratic or if the sources label them as left-wing (Beck et al., 2001).

4. Empirical approach

Our empirical analysis proceeds in several steps. We start with an analysis of individual-level determinants of pro-environmental behaviour. We then complement the individual-level analysis with an analysis of environmental policies across countries and establish a baseline effect of language FTR on policies across countries. We extend this analysis, by including additional variables that could be correlated with hitherto unexplained parts of climate change policies. Clearly, this approach cannot fully account for all confounding influences. We therefore adopt two strategies to directly address the problem of endogeneity. First, we use an instrumental variable, a source of exogenous variation in language FTR, and estimate a 2SLS model. Second, we also assess the extent of bias following the partial identification approach proposed by Oster (2016). The description of these steps follows.

4.1. Individual-level model

To establish the effect of STRONG FTR at the individual level, we estimate variants of a model of propensity for ENVIRONMENTAL ACTION, EA_{jl}^* for an individual j in country l of the following form:

$$EA_{jl}^* = K_{jl}\gamma + \zeta StrongFTR_{jl} + \omega_{jl} \text{ for all } j = 1, \dots, M; l = 1, \dots, P \tag{1}$$

where $StrongFTR_{jl}$ is the indicator of a strong FTR language, K_{jl} is a vector of controls for gender, age, family status, education, employment and income characteristics and ω_{jl} is a disturbance term. Observed environmental action EA_{jl} is assumed to relate to latent propensity through the criterion $EA_{jl} = 1(EA_{jl}^* \geq 0)$, which under an assumption of normality for ω_{jl} gives rise to the standard probit model of the form:

$$Pr(EA_{jl} = 1 | K_{jl}, StrongFTR_{jl}) = \Phi(K_{jl}\gamma + \zeta StrongFTR_{jl}) \tag{2}$$

with marginal effects of STRONG FTR derived from the estimated model thus:

$$\frac{\partial Pr(EA_{jl} = 1 | K_{jl}, StrongFTR_{jl})}{\partial StrongFTR_{jl}} = \zeta \phi(K_{jl}\gamma + \zeta StrongFTR_{jl}) \tag{3}$$

Marginal effects such as those described in (3) can be evaluated either at the sample means or for specified values of each explanatory variable.

The identical model is estimated for WILLINGNESS TO PAY FOR POLICIES as dependent variable.

4.2. Cross-country model

To establish the baseline relationship between language FTR and climate change policy of country i , we estimate variants of the following model using ordinary least squares (OLS):

$$CLIMI_i = X_i\alpha + \beta StrongFTR_i + \varepsilon_i \text{ for all } i = 1, \dots, N \tag{4}$$

where $StrongFTR_i$ is an indicator of strong-FTR language spoken in the country, X_i is a vector of controls for economic, demographic, institutional and geographic characteristics of countries defined in Section 3.3, and ε_i is a disturbance term.

Estimating the effect of language FTR on climate change policies requires that it is exogenously determined and uncorrelated with the error term in (4). However, this is unlikely to hold due to unobserved heterogeneity: both linguistic features and environmental policy outcomes may be the product of deeper, unobserved factors.¹⁵

Existing attempts to isolate the effect of linguistic measures on various economic outcomes have taken into account the historical and geographic relatedness of languages (e.g., Chen et al., 2015; Mavisakalyan, 2015; Roberts et al., 2015). We follow these approaches as a first step to mitigate the influence of unobserved heterogeneity, and include proxies for such relatedness. We sequentially introduce these proxies into the estimations of Eq. (4). The aim is to reveal the extent to which the estimated effect of STRONG FTR ON CLIMI captures the correlation between STRONG FTR and these variables that have been omitted from Eq. (4), by comparing the estimated parameters from baseline and comprehensive specifications.

Despite our efforts to control for relevant observable variables, we cannot rule out that some omitted variable is correlated with both STRONG FTR and CLIMI. A conventional approach to deal with this possibility is to use an instrumental variable. Galor et al. (2016) argue that pre-industrial geographical features that resulted in high returns to agricultural investments are at the root of cross-language variations in the presence of future tense. Building on this observation, we use CROP YIELD (pre-1500CE), sourced from Galor and Özak (2016), as an instrument for STRONG FTR and estimate Eq. (4) using 2SLS where STRONG FTR is treated as endogenous and modeled as:

$$StrongFTR_i = \tau X_i + \psi CropYield_i + \iota_i \text{ for all } i = 1, \dots, N \tag{5}$$

To evaluate how concerned we should be about omitted variables, we also exploit an approach proposed by Oster (2016), which

¹⁵ We largely exclude the possibility of reverse causality. Tabellini (2008) points out: ‘As a classic example of network externalities, language evolves slowly over time. Linguistic innovations are costly because until they are widely adopted communications is more difficult.’ (p. 273). In support of this, Roberts et al. (2015) show that future-time reference variable, in particular, is very stable over time.

builds on the work of [Altonji et al. \(2005\)](#) to use the amount of selection on the observables as a guide to the amount of selection on the unobservables. To that end, we evaluate the bias-adjusted coefficient derived by [Oster \(2016\)](#):

$$\beta^* \approx \tilde{\beta} - \delta [\hat{\beta} - \tilde{\beta}] \frac{R_{\max} - \tilde{R}}{\tilde{R} - \hat{R}} \quad (6)$$

where $\hat{\beta}$ and \hat{R} are the coefficient and R-squared from a parsimonious model including `STRONG_FTR` but no other controls, and $\tilde{\beta}$ and \tilde{R} are the coefficient and R-squared from a regression with `STRONG_FTR` and a set of other controls. δ denotes the relative importance of observable relative to unobservable variables in generating bias while R_{\max} is the R-squared from a hypothetical regression of `CLIMI` on all observable and unobservable variables.

Since δ and R_{\max} are not known, [Oster \(2016\)](#) proposes a bounding approach: the estimated effect of `STRONG_FTR` should range from $\tilde{\beta}$ to β^* estimated under an assumption of $\delta = 1$, i.e. observables and unobservables have the same explanatory power in `CLIMI`, and given values of $R_{\max} \in [\tilde{R}, 1]$. We take two approaches to specifying plausible values for R_{\max} . First, we assume $R_{\max} = 0.90$ which is sensible for a cross sectional sample that potentially has considerable noise in the outcome variable. Second, we follow [Oster \(2016\)](#) in setting $R_{\max} = \min\{1.3\tilde{R}, 1\}$.¹⁶ Estimated coefficients can be considered as robust, if the identified set $[\tilde{\beta}, \beta^*]$ excludes zero. Furthermore, following [Oster \(2016\)](#), we calculate the value of δ that would be needed to explain away the entire causal effect of `STRONG_FTR` on `CLIMI`. Values of $\delta > 1$ suggest that the results are robust, i.e. the unobservables would have to be more important than the observables in explaining `CLIMI`.

5. Results

5.1. Individual-level results

First, we explore the consequences of speaking a `STRONG_FTR` language at the individual level. We estimate probit models of the effect of `STRONG_FTR` on the probability of taking an `ENVIRONMENTAL_ACTION` given in [Eq. \(2\)](#). We present the results of this analysis in [Table 3](#). For ease of interpretation the marginal effects, such as those described in [Eq. \(3\)](#), are reported.

Starting with a parsimonious specification reported in column (1), we estimate a significant negative effect of `STRONG_FTR` language spoken at home by an individual on the probability of acting pro-environmentally. This is consistent with the descriptive statistics reported in [Table 1](#). In column (2) we control for standard demographic and socio-economic characteristics of individuals. We estimate a negative significant marginal effect on `STRONG_FTR`, although its magnitude is smaller. Additionally, we find that males are less likely to act pro-environmentally; this is in line with other studies (e.g., [Blocker and Eckberg, 1997](#); [Gelissen, 2007](#)). Conversely, age is positively correlated with the probability of taking `ENVIRONMENTAL_ACTION`. We find that the probability of acting pro-environmentally is higher for individuals who don't have children, potentially due to additional financial constraints faced by these individuals, although this result is not robust to inclusion of additional controls in subsequent models. Socio-economic characteristics are important determinants of `ENVIRONMENTAL_ACTION`. In particular, similar to others (e.g., [Gelissen, 2007](#); [Franzen and Meyer, 2010](#)), we find a positive link between educational attainment and the probability of acting pro-environmentally. In column (3) we repeat this regression and also include dummies for countries in the sample. The estimated marginal effect on `STRONG_FTR`, while of considerably smaller magnitude, remains significant. Moving from a `WEAK_FTR` to a `STRONG_FTR` language leads to an 8.9 percentage point decrease in the probability of taking an `ENVIRONMENTAL_ACTION` (this implies that the `ENVIRONMENTAL_ACTION` is 20% lower). This is a sizeable effect. It is larger, for example, than that of moving from tertiary to secondary level of education, or from male to female gender identity.

In columns (4)–(6) we expand the list of control variables in an effort to mitigate the possibility of omitted variable bias in the estimates of `STRONG_FTR`. First, we control for `TRUST`, a dummy that takes 1 if the respondent believes that most people can be trusted and 0 otherwise. This is a potentially important determinant of individuals' willingness to engage in action in support of a collective need. Indeed, we estimate a positive significant marginal effect on `TRUST`. However, the estimate on `STRONG_FTR` is largely unaffected by the inclusion of this variable (column (4)). In column (5) we report the results of the regression that includes two further controls. The first is a dummy for `LEFT_VIEWS`, calculated based on the individual's self-positioning on a political scale. The second is `IDEALIST`, a dummy that takes 1 if the respondent has the view that less emphasis on money and material possessions in the future would be a good thing and 0 otherwise. As expected, we find that both `LEFT_VIEWS` and `IDEALIST` are positively correlated with the probability of taking an `ENVIRONMENTAL_ACTION`; the estimated negative marginal effect on `STRONG_FTR` remains significant. The next group of additional predictors for `ENVIRONMENTAL_ACTION` includes three variables. We control for individuals who are `OPTIMIST`, defined as a dummy to indicate the belief that humanity has a bright future and 0 otherwise. In addition, we include a dummy for `HIGH_LOCUS_OF_CONTROL`, characterised by an individual's assessment of the degree of free choice and control over their life. Our last variable is a dummy for `EXISTENTIALIST`, for those who often or sometimes think about meaning and purpose of life in contrast to those who do so rarely or never. We estimate strong positive marginal effects on `HIGH_LOCUS_OF_CONTROL` and `EXISTENTIALIST`. The marginal effect on `OPTIMIST`, however, is indistinguishable from 0. This regression also confirms the negative significant effect of `STRONG_FTR` on the probability of acting pro-environmentally. In the final column, we introduce controls for the nine language families covering the languages in the sample. [Roberts et al. \(2015\)](#) highlight the significance of controlling for language families in studying the economic effects of linguistic structures. The estimate on `STRONG_FTR` remains robust to the inclusion of these controls.

¹⁶ [Oster \(2016\)](#) tests the robustness of treatment parameters from randomized control studies published in reputable economics journals from 2008–2013 and finds that using $R_{\max} = 1.3\tilde{R}$ reproduces 90% of randomized results.

Table 3
Individual regressions with baseline and additional controls — Probit marginal effects.

Control variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
STRONG FTR	-0.206** (0.0927)	-0.197** (0.089)	-0.089*** (0.027)	-0.086*** (0.029)	-0.083** (0.032)	-0.082** (0.034)	-0.139*** (0.030)
MALE		-0.086*** (0.014)	-0.074*** (0.007)	-0.075*** (0.007)	-0.075*** (0.008)	-0.074*** (0.007)	-0.074*** (0.007)
AGE		0.005* (0.003)	0.007*** (0.001)	0.007*** (0.001)	0.007*** (0.001)	0.007*** (0.001)	0.007*** (0.001)
MARRIED		0.008 (0.012)	0.024*** (0.007)	0.028*** (0.008)	0.028*** (0.008)	0.029*** (0.008)	0.027*** (0.008)
NO CHILDREN		0.036*** (0.011)	0.016** (0.007)	0.014* (0.007)	0.014* (0.007)	0.005 (0.008)	0.004 (0.008)
PRIMARY		-0.118** (0.046)	-0.140*** (0.012)	-0.141*** (0.012)	-0.140*** (0.012)	-0.134*** (0.012)	-0.128*** (0.010)
SECONDARY		-0.040 (0.025)	-0.059*** (0.009)	-0.058*** (0.009)	-0.057*** (0.009)	-0.052*** (0.009)	-0.050*** (0.009)
EMPLOYED		0.079 (0.048)	0.024*** (0.006)	0.021*** (0.006)	0.021*** (0.006)	0.017*** (0.006)	0.019*** (0.006)
TRUST				0.031*** (0.010)	0.030*** (0.010)	0.035*** (0.010)	0.036*** (0.010)
LEFT VIEWS					0.027** (0.012)	0.027** (0.013)	0.031*** (0.012)
IDEALIST					0.022* (0.012)	0.021* (0.012)	0.018* (0.011)
OPTIMIST						0.000 (0.012)	0.005 (0.010)
HIGH LOCUS OF CONTROL						0.049*** (0.013)	0.047*** (0.012)
EXISTENTIALIST						0.093*** (0.009)	0.092*** (0.009)
Income deciles	No	Yes	Yes	Yes	Yes	Yes	Yes
Countries	No	No	Yes	Yes	Yes	Yes	Yes
Language families	No	No	No	No	No	No	Yes
Pseudo R ²	0.014	0.046	0.178	0.177	0.178	0.180	0.183
N	34,461	34,461	34,461	33,087	33,087	33,087	33,083

Note.— Dependent variable is ENVIRONMENTAL ACTION. *Denotes significance at 10 percent; **at 5 percent; ***at 1 percent levels.

Next, we ask whether STRONG FTR also affects preference for pro-environmental policies by estimating a version of Eq. (2) where WILLINGNESS TO PAY FOR POLICIES is used as the dependent variable instead. The results of this analysis are reported in Table 4. Indeed, the negative significant effect of STRONG FTR extends to individuals' pro-environmental policy preferences. Estimation results from the most extensive specification reported in column (7) suggest marginal effects of 10.1 percentage points. This implies that the WILLINGNESS TO PAY FOR POLICIES is 24% lower for speakers of STRONG FTR languages. This is an economically highly significant effect.

The estimated marginal effects on other variables are broadly similar to those obtained from the regressions of ENVIRONMENTAL ACTION with one notable exception: while we established a positive significant correlation between the respondent's age and their probability of taking an ENVIRONMENTAL ACTION, the relationship between age and WILLINGNESS TO PAY FOR POLICIES is negative. As discussed earlier, young people may have larger stakes in environmental quality, and therefore may have stronger demand for pro-environmental policies (Farzin and Bond, 2006). At the same time, older people may feel the environmentally induced health problems more directly, and thus may be more willing to take an ENVIRONMENTAL ACTION; they may also have greater access to time and resources to support environmental initiatives (Farzin and Bond, 2006).

Overall, the findings so far suggest that languages with STRONG FTR lead their speakers to act less pro-environmentally and to extend lower support for pro-environmental policies. In discussing the potential mechanisms of STRONG FTR above, we mentioned two possibilities: a cultural channel and a linguistic-cognitive channel. To explore the extent to which language is simply serving as a marker for the cultural trait of long term orientation, we control for such proxy generated based on the responses to questions on the degree to which thrift and savings money is an important value to teach children.

Including this measure has no effect on our estimates of STRONG FTR.¹⁷ This result is very similar to that obtained by Chen (2013), who found that the language future tense effects (in the context of savings behaviour) operate through a channel which is entirely independent of cultural attitudes as captured through the same proxy we use here. There are two ways to interpret this result: either our results support a scenario where FTR operates through the linguistic-cognitive channel; or the proxy we use to capture the respondents' long-term orientation is far from perfect in the context of our study. Strictly distinguishing across various channels underlying our results is a largely infeasible task given the constraints around empirical design and data.

¹⁷ We also directly regressed the cultural trait of long term orientation on STRONG FTR and other controls. We obtained insignificant estimates on STRONG FTR throughout. The results of these analyses are available on request.

Table 4
Individual regressions with baseline and additional controls using an alternative dependent variable — Probit marginal effects.

Control variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
STRONG FTR	-0.093** (0.043)	-0.094** (0.043)	-0.097* (0.056)	-0.097* (0.052)	-0.094* (0.055)	-0.067* (0.060)	-0.101* (0.061)
MALE		-0.020*** (0.007)	-0.027*** (0.007)	-0.025*** (0.007)	-0.025*** (0.007)	-0.018** (0.007)	-0.017** (0.007)
AGE		-0.002 (0.001)	-0.003*** (0.001)	-0.004*** (0.001)	-0.004*** (0.001)	-0.004*** (0.001)	-0.004*** (0.001)
MARRIED		0.028*** (0.008)	0.015** (0.006)	0.017*** (0.006)	0.017*** (0.006)	0.014* (0.007)	0.014* (0.007)
NO CHILDREN		0.022*** (0.008)	0.020** (0.008)	0.017** (0.008)	0.017** (0.008)	0.009 (0.009)	0.008 (0.009)
PRIMARY		-0.048* (0.029)	-0.083*** (0.012)	-0.082*** (0.013)	-0.081*** (0.013)	-0.066*** (0.014)	-0.066*** (0.014)
SECONDARY		-0.033* (0.019)	-0.024** (0.010)	-0.021** (0.010)	-0.020** (0.011)	-0.011 (0.012)	-0.011 (0.012)
EMPLOYED		-0.022 (0.019)	0.006 (0.007)	0.004 (0.007)	0.004 (0.007)	0.006 (0.007)	0.006 (0.007)
TRUST				0.035*** (0.011)	0.033*** (0.011)	0.028** (0.012)	0.029** (0.012)
LEFT VIEWS					0.004 (0.010)	-0.005 (0.011)	-0.005 (0.011)
IDEALIST					0.036*** (0.009)	0.035*** (0.009)	0.035*** (0.009)
OPTIMIST						0.023** (0.010)	0.024** (0.010)
HIGH LOCUS OF CONTROL						0.039*** (0.010)	0.038*** (0.010)
EXISTENTIALIST						0.092*** (0.015)	0.092*** (0.015)
Income deciles	No	Yes	Yes	Yes	Yes	Yes	Yes
Countries	No	No	Yes	Yes	Yes	Yes	Yes
Language families	No	No	No	No	No	No	Yes
Pseudo R ²	0.002	0.009	0.044	0.045	0.046	0.049	0.050
N	38,449	38,449	38,449	38,449	37,047	30,851	30,847

Note.— Dependent variable is WILLINGNESS TO PAY FOR POLICIES. *Denotes significance at 10 percent; **at 5 percent; ***at 1 percent levels.

5.2. Cross-country results

5.2.1. Baseline results

We established that support for pro-environmental policies is less prevalent among the individuals speakers of STRONG FTR languages. Do we then observe less stringent environmental policies in places where STRONG FTR language are spoken? This could happen either because the political decisions reflect the preferences of the electorate (Downs, 1957) or if politicians who speak strong-FTR languages have weaker pro-environmental preferences and implement policies consistent with those preferences (Osborne and Slivinski, 1996; Besley and Coate, 1997) or both. The rest of the paper is dedicated to exploring the link between language FTR and environmental policies across countries.

The OLS estimates of the effect of STRONG FTR on our baseline measure of climate change policies, CLIMI, based on Eq. (4) are presented in Table 5. The specification reported in column (1) excludes other controls. Consistent with the descriptive statistics reported in Table 2, the estimates identify a negative relationship between STRONG FTR and CLIMI.

Next, we examine the relationship between STRONG FTR and CLIMI, controlling for economic characteristics of countries (column (2)). The magnitude of the effect of STRONG FTR is smaller, but preserves its significance. As expected, GDP PER CAPITA is positively correlated with CLIMI. Conversely, OPENNESS is negatively correlated with CLIMI, possibly reflecting the lack of willingness to commit to stringent environmental policies by exporting countries whose interests may be threatened by such policies. This variable, however, loses its significance once other characteristics of countries are controlled for in columns (3)–(6). Meanwhile, we estimate a significant positive coefficient on MANUFACTURING %, a variable that potentially captures the pollution-intensity of economies.

We further control for demographic characteristics of countries. The results reported in column (3) demonstrate that the significance of the estimated coefficient on STRONG FTR is robust to inclusion of these controls, although its magnitude is smaller. In the spirit of previous findings on the link between ethnic diversity and public policies (e.g., Easterly and Levine, 1997; Alesina et al., 1999), we show that the share of a country's immigrant population is negatively related to the stringency of its climate change policies. This potentially reflects the difficulties in agreeing on public policies in diverse communities. This effect does not persist, however, once additional controls are included in estimations reported in columns (4)–(6). We also find that the share of a country's elderly population, defined as those aged 65 and above, is positively correlated to the stringency of climate change policies although this effect is not robust to controlling for continents in column (5).

In column (4), we control for institutional characteristics of countries. The estimated coefficient on STRONG FTR is hardly affected.

Table 5
Baseline cross-country regressions — OLS coefficients.

Control variables	All (1)	All (2)	All (3)	All (4)	All (5)	No outliers (6)
STRONG FTR	−0.146** (0.068)	−0.095** (0.038)	−0.078** (0.034)	−0.081** (0.032)	−0.061* (0.033)	−0.097*** (0.035)
GDP PER CAPITA		0.133*** (0.025)	0.109*** (0.031)	0.077*** (0.029)	0.087*** (0.029)	0.068** (0.027)
OPENNESS		−0.086* (0.043)	−0.057 (0.059)	−0.005 (0.058)	−0.045 (0.070)	−0.046 (0.066)
MANUFACTURING %		0.012*** (0.004)	0.009** (0.004)	0.006* (0.004)	0.008** (0.004)	0.009** (0.004)
POPULATION SIZE			0.003 (0.016)	0.003 (0.017)	−0.001 (0.020)	0.001 (0.020)
IMMIGRANT %			−0.005** (0.002)	−0.003 (0.002)	−0.002 (0.002)	−0.002 (0.002)
POPULATION AGE 65+ %			0.013*** (0.005)	0.009** (0.004)	0.003 (0.006)	0.003 (0.006)
DEMOCRACY				0.182*** (0.048)	0.210*** (0.053)	0.218*** (0.052)
LEFT GOVERNMENT				0.004 (0.044)	0.020 (0.048)	0.014 (0.049)
Constant	0.517*** (0.062)	−0.917*** (0.218)	−0.837** (0.384)	−0.633* (0.375)	−0.575 (0.395)	−0.413 (0.382)
Continents	No	No	No	No	Yes	Yes
R ²	0.075	0.530	0.643	0.724	0.749	0.755
N	70	68	68	68	68	64

Note.— Dependent variable is CLIMI. Columns (1)–(5) report the results based on the full sample. Column (6) reports the results in a sample where outliers are removed; these are identified by predicting DFbetas for STRONG FTR from the full sample regression and then dropping those observations for which $|DFbeta| > 2/\sqrt{N}$. Columns (5) and (6) include continent dummies. *Denotes significance at 10 percent; **at 5 percent; ***at 1 percent levels.

We find that the stringency of climate change policies is higher in democracies, consistent with other findings in the literature (e.g., Murdoch and Sandler, 1997; Farzin and Bond, 2006). The estimated coefficient on LEFT GOVERNMENT, while positive, is insignificant.

Finally, in column (5) we control for economic, demographic and institutional characteristics of countries, and also include dummies for continents. The significant negative effect of STRONG FTR on CLIMI persists: we estimate that CLIMI is 0.06 points lower in countries with a STRONG FTR, relative to a WEAK FTR majority language. This is equivalent to a 15% decrease in CLIMI, implying, for example, that if Greece were to switch from a strong- to a weak-FTR language, the stringency of their climate change policies would be at the level of those observed in Sweden (our estimates are reasonably precise relative to the difference in actual stringency of climate change policies between the two countries).

In column (6), we evaluate the sensitivity of this finding to the potential presence of influential observations calculated based on DFbetas for STRONG FTR from baseline regression in column (5). We drop those observations for which $|DFbeta| > 2/\sqrt{N}$ (Belsley et al., 1980). The estimated coefficient on STRONG FTR is more significant in this sample, both in statistical and economic terms.

5.2.2. Robustness checks

We have established a statistically significant negative relationship between STRONG FTR and CLIMI. An important question is whether language simply acts as a marker of unobserved characteristics, or whether language itself has a direct causal effect (Mavisakalyan and Weber, 2017). In Table 6, we explore this issue by including several additional controls (to allow for comparisons, column (1) repeats the estimate from baseline specification in column (5) of Table 5).

First, we run a placebo regression with a different linguistic feature which is irrelevant to the outcome of our study, as an additional control (e.g., Mavisakalyan, 2015). The feature we control for is LANGUAGE GENDER, a measure of grammatical gender intensity in a language that comes from Gay et al. (2017) (the study provides the details on how this measure is constructed). Reassuringly, the results presented in column (2) show that this linguistic feature is unrelated to CLIMI, while the estimated significant negative effect on STRONG FTR persists.

Existing attempts to isolate the economic effect of linguistic measures have considered the relevance of historic origins of countries. These may potentially confound the estimated effect of STRONG FTR, as they may influence linguistic and cultural evolution, while also being relevant for policy outcomes either through affecting these directly or through other channels. To mitigate the effect of associated bias, we introduce controls for the nine language families covering the languages in the sample. The estimate on STRONG FTR is robust to the inclusion of these controls (which in turn are jointly significant) (column 3).

Another possibility to consider is that linguistic features of countries are spatially correlated, i.e. that there is a concentration of linguistic features in certain areas. The estimated effect on STRONG FTR may then be due to correlated geographic and climatic factors. To address this concern, our baseline list of controls includes continent fixed effects. In column (4) we additionally control for countries' LANDLOCKED status, their LATITUDE and the total rents they derive from natural resources as a share of GDP—features that have been linked to countries' economic development (e.g., Hall and Jones, 1999); they have also been used in previous attempts to isolate

Table 6
Cross-country regressions with additional controls— OLS coefficients.

Control variables	(1)	(2)	(3)	(4)	(5)
STRONG FTR	−0.061* (0.033)	−0.076** (0.033)	−0.091* (0.048)	−0.096** (0.045)	−0.113** (0.056)
LANGUAGE GENDER		0.022 (0.014)	0.033 (0.026)	0.036 (0.025)	0.031 (0.026)
LANDLOCKED				−0.007 (0.051)	0.007 (0.060)
LATITUDE				−0.017 (0.196)	−0.004 (0.217)
RESOURCES RENTS %				−0.005*** (0.002)	−0.004** (0.002)
COMMON LAW					0.052 (0.118)
FRENCH CIVIL LAW					0.060 (0.064)
Constant	−0.575 (0.395)	−0.654 (0.417)	−0.684 (0.419)	−0.408 (0.400)	−0.360 (0.511)
Language families	No	No	Yes	Yes	Yes
Baseline controls	Yes	Yes	Yes	Yes	Yes
R ²	0.749	0.760	0.813	0.846	0.851
N	68	68	65	64	64

Note.— Dependent variable is CLIMI. *Denotes significance at 10 percent; **at 5 percent; ***at 1 percent levels.

the effect of linguistic measures on various outcomes (e.g., Mavisakalyan, 2015). Our estimates on LANDLOCKED and LATITUDE are insignificant, while RESOURCES RENTS % is negatively significantly correlated with CLIMI. The significant negative effect of STRONG FTR is robust to this addition to the list of controls.

Finally, we control for the institutional relatedness of countries in the sample by introducing controls for the origins of their legal systems. These have been included in other attempts to mitigate the effect of unobserved heterogeneity in studying the effect of linguistic measures on economic outcomes (e.g., Chen et al., 2015; Roberts et al., 2015). Furthermore, there is evidence to suggest that they might affect climate change policies (Fredriksson and Wollscheid, 2015). Most sources distinguish between two main secular legal traditions: common law and civil law, and several subtraditions—French, German, Socialist, and Scandinavian—within civil law (Porta et al., 1998; La Porta et al., 2008). French civil law and common law are the most common internationally, and dummies for these legal systems are included in the regressions reported in column (5). The estimated coefficients on these dummies are insignificant, while the effect of STRONG FTR is significant and sizeable.¹⁸

As another robustness check of the cross-country results we explore whether the results are sensitive to how STRONG FTR is assigned. In the baseline models, STRONG FTR is assigned to a country's majority language. This potentially conceals the differences across linguistically distinct groups in diverse societies. To address this issue, we introduce a refinement: we replace the STRONG FTR dummy with a continuous variable, STRONG FTR %, measuring the total population share speaking a STRONG FTR language. Data on FTR for some of the minority languages is missing. Similar to the approach in Mavisakalyan (2015), we restrict the sample to countries where information on language FTR is available for at least 80% of the population, and additionally control for the share of the population with unknown language FTR.

The results are reported in Table 7. For ease of comparisons, column (1) reports the results with our baseline measure of STRONG FTR (this corresponds to the estimates from the model with the comprehensive list of controls presented in column (5) of Table 6). The results of the regression of CLIMI on our alternative measure of language FTR and comprehensive list of controls are presented in column (2). The estimated coefficient on STRONG FTR % is negative and significant, albeit small in magnitude, while that on UNKNOWN FTR % is insignificant.

5.2.3. Addressing endogeneity

The above shows that the effect of STRONG FTR persists, even when proxies for unobserved heterogeneity are included. Still, unobserved heterogeneity can never be completely excluded. The standard approach to address the problem of omitted variable bias is to use an instrumental variable. This is what we pursue here: building on the findings by Galor et al. (2016); Galor and Özak (2016), we exploit CROP YIELD as an instrument for STRONG FTR in estimating its effect on CLIMI.

The results of this exercise are summarised in Table 8. To allow for comparisons, the corresponding OLS estimates are reported in columns (1) and (3) (these are identical to those reported in column (5) of Table 5 and column (5) of Table 6). The estimates from the

¹⁸ Davis and Williamson (2016) propose an *Interdependent Institutions Hypothesis*, according to which there is an interaction between formal and informal institutions and the effect of culture (i.e. informal institutions) may depend on the formal institutional context. Certain legal and political frameworks are more permeable for cultural influences, or may even amplify these, e.g. “democracy and the common law tradition magnify the [cultural] influence of individualism” (Davis and Williamson, 2016, p. 1056). We explored whether this possibility holds in our context by including interaction terms of STRONG FTR and DEMOCRACY and STRONG FTR and legal origin dummies in estimations. These were insignificant throughout.

Table 7
Cross-country regressions using an alternative independent variable — OLS coefficients.

Control variables	(1)	(2)
STRONG FTR	−0.113** (0.056)	
STRONG FTR %		−0.001* (0.001)
UNKNOWN FTR %		0.006 (0.004)
Constant	−0.360 (0.511)	−0.303 (0.669)
Baseline controls	Yes	Yes
Additional controls	Yes	Yes
R ²	0.851	0.853
N	64	58

Note.—Dependent variable is CLIMI. STRONG FTR % is the share of population speaking a STRONG FTR language. UNKNOWN FTR % is the share of population speaking a language with missing FTR data. The regression in column (2) is restricted to countries with UNKNOWN FTR % ≤ 20. *Denotes significance at 10 percent; **at 5 percent; ***at 1 percent levels.

Table 8
Cross-country 2SLS regressions.

Control variables	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)
STRONG FTR	−0.061* (0.033)	−0.188* (0.108)	−0.113** (0.056)	−0.244*** (0.088)
GDP PER CAPITA	0.087*** (0.029)	0.069** (0.028)	0.119*** (0.042)	0.087** (0.036)
OPENNESS	−0.045 (0.070)	−0.030 (0.059)	−0.028 (0.078)	−0.058 (0.062)
MANUFACTURING %	0.008** (0.004)	0.007 (0.004)	0.005 (0.006)	0.007 (0.005)
POPULATION SIZE	−0.001 (0.020)	0.010 (0.020)	−0.013 (0.022)	−0.016 (0.017)
IMMIGRANT %	−0.002 (0.002)	−0.002 (0.002)	−0.002 (0.003)	−0.004 (0.003)
POPULATION AGE 65 + %	0.003 (0.006)	0.003 (0.005)	−0.005 (0.008)	−0.002 (0.007)
DEMOCRACY	0.210*** (0.053)	0.199*** (0.048)	0.233*** (0.055)	0.223*** (0.041)
LEFT GOVERNMENT	0.020 (0.048)	0.006 (0.047)	0.037 (0.062)	0.021 (0.048)
LANGUAGE GENDER			0.031 (0.026)	0.032 (0.021)
LANDLOCKED			0.007 (0.060)	0.014 (0.050)
LATITUDE			−0.004 (0.217)	−0.051 (0.155)
RESOURCES RENTS %			−0.004** (0.002)	−0.004*** (0.001)
COMMON LAW			0.052 (0.118)	0.151 (0.098)
FRENCH CIVIL LAW			0.060 (0.064)	0.097* (0.050)
Constant	−0.575 (0.395)	−0.512 (0.344)	−0.360 (0.511)	−0.249 (0.394)
Continents	Yes	Yes	Yes	Yes
Language families	No	No	Yes	Yes
R ²	0.749	0.699	0.851	0.830
N	68	68	64	64
Kleibergen and Paap (2006) F statistics †		9.53		10.02

Note.—Dependent variable is CLIMI. *Denotes significance at 10 percent; **at 5 percent; ***at 1 percent levels. † The H_0 is that the first stage regression is weakly identified.

Table 9
Test of omitted variable bias - Cross-country results.

Specification	$\delta_{R_{\max}=0.90}$ (1)	$[\tilde{\beta}, \beta^*_{(R_{\max}=0.90, \delta=1)}]$ (2)	$\delta_{R_{\max}=\min\{1.3\tilde{R}, 1\}}$ (3)	$[\tilde{\beta}, \beta^*_{(R_{\max}=\min\{1.3\tilde{R}, 1\}, \delta=1)}]$ (4)
BASELINE CONTROL	2.689	[-0.060, -0.040]	1.728	[-0.060, -0.027]
COMPREHENSIVE CONTROLS	3.119	[-0.112, -2.106]	1.300	[-0.111, -1.674]

Note.— δ indicates the value of proportional selection of unobservables to observables assuming the maximum value of theoretical R^2 is R_{\max} . The coefficient bounds are calculated assuming the unobservables are as important as the observables in explaining the outcome variable (i.e. $\delta = 1$).

2nd stage of the 2SLS models with baseline as well as with comprehensive lists of controls confirm the negative significant effect of STRONG FTR. Moreover, the magnitudes of the estimated effects are larger. In defence of our identification strategy, the statistics for the weak identification test (Kleibergen and Paap, 2006 F statistics) provides no evidence that the instrument we use is weak or irrelevant.

As an additional approach to address the potential problem of endogeneity of STRONG FTR, we apply the partial identification approach proposed by Oster (2016). The results of this test are presented in Table 9.

In columns (2) and (4) we report the coefficient bounds $[\tilde{\beta}, \beta^*]$ for models with baseline and comprehensive lists of controls (reported in column (5) of Table 5 and column (5) of Table 6 respectively). The first bound $\tilde{\beta}$ comes from the specifications controlling for all baseline/comprehensive observables. The second bound β^* is evaluated using Eq. (6) by setting $\delta = 1$ and applying two assumptions on the value of R_{\max} . First, we assume $R_{\max} = 0.90$. i.e. that the measurement error in CLIMI accounts for 10% of the variation therein (column (2)). Second, we apply the rule of thumb proposed by Oster (2016) in setting R_{\max} equal to the minimum of one or to the R-squared from the regression controlling for all observables multiplied by a factor of 1.3 (column (4)). Furthermore, in columns (1) and (3) we report the corresponding estimates of δ that would be needed to explain away the entire causal effect of STRONG FTR ON CLIMI.

None of the estimated bounds include 0. This suggests that at least part of the estimated effect on STRONG FTR is likely to be causal. Moreover, in all cases $\delta > 1$, i.e. the unobservables would have to be more important than the observables in explaining CLIMI. This provides further assurance that the results are robust to omitted variables.

5.2.4. Implications for international environmental cooperation

Our baseline dependent variable, CLIMI, measures climate change mitigation policies adopted by countries in four key policy areas including (i) international cooperation; (ii) domestic climate framework; (iii) significant sectoral fiscal or regulatory measures or targets; and (iv) additional cross-sectoral fiscal or regulatory measures (Steves et al., 2011). While we have established that STRONG FTR affects CLIMI, so far the analysis does not tell us whether and to what extent this effect applies to individual policy areas.

Here we focus on the link between STRONG FTR and global environmental cooperation, as captured by GLOBAL, given its particularly significant role in climate change mitigation efforts. Moreover, future tense might influence international cooperation through an additional channel.¹⁹

Avoiding global warming and maintaining atmospheric temperatures at current levels is a public good. As is well-known, public goods lead to social dilemmas. Individual actors have an interest both in the goods production and in avoiding the costs of its production. As public goods are non-excludable, narrow self-interest dictates to free-ride. If most defect from shouldering the burden of the goods production, it won't be produced and everyone is worse off. Applied to our case, every nation has an interest in both maintaining current temperature levels and also in avoiding the costs of doing so; but if most nations act in their narrow self-interest, catastrophic climate change seems inevitable.

Empirically, the actual rate of cooperation in such situations is much higher than a game-theoretic model based on narrow self-interest predicts. There are several psychological factors which increase actors' willingness to cooperate. The two most important ones are social value orientation (Messick and McClintock, 1968; Van Lange, 1999) and trust (Dawes, 1980; Yamagishi, 2011). However, there is an additional factor which has recently received attention: orientation towards the future: "A [...] trait relevant to cooperation in social dilemmas is the consideration of future consequences (CFC), defined as 'the extent to which people consider the potential distant outcomes of their current behaviours and the extent to which they are influenced by these potential outcomes' (Strathman et al., 1994; Joireman et al., 2012, p. 743)." (Van Lange et al., 2014, p. 64); see also (Parks, 2015). Further, theoretical models suggest that in repeated prisoner dilemma games (i.e. situations that reflect the incentive structure of public goods dilemmas), anticipatory strategies that predict the future rate of other players' cooperative behaviour are more successful and realistic than strategies based on subjective utility calculations and backward looking learning mechanisms (Lalev and Grinberg, 2006). So, both empirical and theoretical considerations suggest that future orientation increases cooperation.

As the absence of future tense is associated with increased future orientation, we expect that countries with weak-FTR languages, and thus higher orientation towards the future, should be more willing to cooperate on climate change and adopt policy measure that are conducive to combating climate change, even if these policies hurt their short-term interest. This is indeed what we find. In the parsimonious specification reported in column (1) of Table 10 we report a highly significant negative coefficient on STRONG FTR. This

¹⁹ We are thankful to an anonymous referee for raising this point.

Table 10
Cross country regressions using an alternative dependent variable.

Control variables	OLS		2SLS
	(1)	(2)	(3)
STRONG FTR	−0.628*** (0.176)	−0.679*** (0.172)	−0.736* (0.418)
GDP PER CAPITA		0.058 (0.122)	0.053 (0.119)
OPENNESS		0.087 (0.206)	0.091 (0.189)
MANUFACTURING %		0.004 (0.016)	0.003 (0.016)
POPULATION SIZE		0.174*** (0.042)	0.176*** (0.041)
IMMIGRANT %		0.002 (0.011)	0.002 (0.011)
POPULATION AGE 65 + %		0.038* (0.019)	0.038** (0.018)
DEMOCRACY		0.117 (0.163)	0.110 (0.158)
LEFT GOVERNMENT		−0.071 (0.152)	−0.076 (0.140)
Constant	0.704*** (0.161)	−3.007** (1.157)	−2.951*** (1.140)
Continents	No	Yes	Yes
R ²	0.135	0.468	0.467
N	93	85	85
$\delta_{R_{\max} = \min\{1.3\tilde{R}, 1\}}$		2.742	
Kleibergen and Paap (2006) F statistics †			10.798

Note.—Dependent variable is GLOBAL. *Denotes significance at 10 percent; **at 5 percent; ***at 1 percent levels. δ indicates the value of proportional selection of unobservables to observables assuming the maximum value of theoretical R^2 is R_{\max} . The coefficient bounds are calculated assuming the unobservables are as important as the observables in explaining the outcome variable (i.e. $\delta = 1$). † The H_0 is that the first stage equation is weakly identified.

result is remarkably robust to including the entire list of baseline controls in column (2). We also address the endogeneity of STRONG FTR using CROP YIELD as an instrument. Column (3) reports the results of the second stage regression where the estimated coefficient on STRONG FTR remains robust and significant. Applying the partial identification approach proposed by Oster (2016) yields similar results: we find $\delta > 1$, i.e. the unobservables would have to be more important than the observables in explaining GLOBAL.

6. Conclusion

Our findings support the idea that future tense marking in language affects speakers' future-oriented behaviour. The evidence presented here indicates that this effect includes pro-environmental action: at the individual level, speakers of weak-FTR languages are more willing to engage in costly pro-environmental actions and to support pro-environmental policies; at the country level, nations with weak-FTR language, i.e. that speak about the future as it were present, have more stringent environmental policies.

We have proposed that there are two possible channels for this influence: a cultural channel via speakers' long-term orientation or a linguistic-cognitive channel via speakers' perception of temporal distance. Both affect agents' intertemporal preference structure such that weak-FTR speakers discount future costs and rewards less than do strong-FTR speakers. Individuals that speak about the future in the present tense care more about it. There is reason to believe that future tense marking does indeed causally influence pro-environmental behaviour and policies. First, we show that the effect persists after controlling for geographic and historical relatedness of languages. Second, applying full and partial identification approaches also yields support for a causal effect.

Our results have potential implications for policy making. They show that pro-environmental governments or lobby groups face particular obstacles in countries with strong-FTR languages. It seems unrealistic to expect countries to engage in linguistic reforms with the aim of turning strong-FTR languages into weak-FTR ones, at least in the short term. But there are other possible consequences. One may, for instance, conclude that environmental campaigns in strong-FTR countries should especially aim to counterbalance the effect of FTR and portray the risks of climate change as real and urgent. Further, international organisations may decide that investing in environmental projects in weak-FTR countries (that are otherwise equal) has a better payoff, as their citizens will be more receptive for environmental concerns.

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