ISSN 1756-7904

DEV INTERNATIONAL DEVELOPMENT University of East Anglia

Working Paper Series

THE ROLE OF PREFERENCES FOR PRO-ENVIRONMENTAL BEHAVIOUR AMONG URBAN MIDDLE CLASS HOUSEHOLDS IN PERU.

Hanna Fuhrmann, Ben D'Exelle, Arjan Verschoor

April 2020

University of East Anglia

Working Paper 56

The School of International Development, University of East Anglia
Norwich, NR4 7TJ, United Kingdom

DEV WORKING PAPER 56

The Role of Preferences for Pro-Environmental Behaviour among Urban Middle Class Households in Peru

Hanna Fuhrmann[a,b], Ben D'Exelle[b], Arjan Verschoor[b]

[a] German Development Institute / Deutsches Institut für Entwicklungspolitik (DIE)

[b] University of East Anglia (UEA)

First published by the School of International Development in April 2020.

This publication may be reproduced by any method without fee for teaching or non-profit purposes, but not for resale. The papers should be cited with due acknowledgment.

This publication may be cited as:

Fuhrmann, H, D'Exelle, B, Verschoor, A, 2020, The Role of Preferences for Pro-Environmental Behaviour among Urban Middle Class Households in Peru., Working Paper 56, DEV Working Paper Series, The School of International Development, University of East Anglia, UK.

ABOUT THE DEV REPORTS AND POLICY PAPERS

These are reports and policy papers that reproduce consultancy, applied research findings and policy work conducted by the School of International Development or International Development UEA (formerly Overseas Development Group). Launched in 2007, they provide an opportunity for staff, associated researchers and fellows to disseminate studies and findings on a wide range of subjects. Recent past work, provided it meets the standards required and has contemporary significance is also welcome.

ABOUT THE SCHOOL OF INTERNATIONAL DEVELOPMENT

The School of International Development (DEV) applies economic, social and natural science disciplines to the study of international development, with special emphasis on social and environmental change and poverty alleviation. DEV has a strong commitment to an interdisciplinary research and teaching approach to Development Studies and the study of poverty. This has been developed over a forty year period, bringing together researchers and students from different disciplines (economists, social scientists, natural resource scientists) into research areas and teaching teams.

THE INTERNATIONAL DEVELOPMENT UEA (FORMERLY OVERSEAS DEVELOPMENT GROUP)

Founded in 1967, International Development UEA is a charitable company wholly owned by the University of East Anglia, which handles the consultancy, research, and training undertaken by the faculty members in DEV and approximately 200 external consultants. Since its foundation it has provided training for professionals from more than 70 countries and completed over 1,000 consultancy and research assignments. International Development UEA provides DEV staff with opportunities to participate in on-going development work, practical and policy related engagement which add a unique and valuable element to the School's teaching programmes.

FOR FURTHER INFORMATION ON DEV AND THE INTERNATIONAL DEVELOPMENT UEA, PLEASE CONTACT:

School of International Development
University of East Anglia, Norwich NR4 7TJ, United Kingdom
Tel: +44 (0)1603 592329
Fax: +44 (0)1603 451999
Email: dev.general@uea.ac.uk
Web: www.uea.ac.uk/dev

Abstract

Pro-environmental behaviour (PEB) is known to reflect people's social preferences, time preferences and risk preferences. Previous research has tended to consider these in isolation, which means they may proxy for omitted ones, leading to biased estimates. Moreover, it has not considered ambiguity preferences, which for some PEBs is conceptually more relevant than risk preferences. Using a survey module from the Global Preference Survey (GPS), we investigate the role of a large range of preferences for PEB in a sample of 900 middle class households in Lima, Peru. The PEBs we consider are habitually saving energy, avoiding the use of plastics, and limiting expenditures on electricity. We find that social preferences matter mainly for saving-energy behaviour; time, risk and ambiguity preferences matter mainly for the consumption of plastics; and time and ambiguity preferences matter for expenditures on electricity. The insight that particular preferences matter for particular PEBs has important policy implications.

Keywords: Risk Preferences, Ambiguity Preferences, Time Preferences, Social Preferences, Pro-Environmental Behaviour

1 Introduction and literature

Individual consumers can help prevent disastrous climate change and environmental pollution by changing their behaviour. Pro-environmental behaviour (PEB) results both from large, occasional decisions such as having solar cells installed and from small, regular ones such as switching off the TV when nobody is actively watching it.

Economists think of behaviour as resulting from people's 'preferences'.[1] Several studies have found individual preferences to be important for PEB. A group of these have found *social preferences* to matter for PEB (Gupta and Ogden, 2009; Volland, 2017; Ziegler, 2018). This is plausible since PEB requires caring about the wellbeing of other people, and a propensity to assume that others, when encouraged to engage in PEB, will do so (Gupta and Ogden, 2009). The social preferences of altruism, trust and reciprocity are therefore expected to be important for PEB.

Other studies looked at the role of *risk preferences*. The benefits of PEB are uncertain, meaning that deciding to engage in PEB carries the risk that the desired outcomes do not come about. In line with that, greater risk aversion has been found to be associated with the undervaluation of PEB (Farsi, 2010; Qiu et al., 2014; Fischbacher et al., 2015), although not universally so (Volland, 2017). Finally, *time preferences* are expected to matter. People who discount the future at a lower rate should value PEB more. This has been empirically confirmed by Qiu et al. (2014), Newell and Siikamäki (2015) and Fuerst and Singh (2018).

In this study, unlike in previous research, we consider the role of social preferences, risk preferences, and time preferences for PEB together, rather than one or some of these in isolation. To this we add ambiguity preferences, which relate to uncertain future outcomes that occur with unknowable probabilities. We explain below why ambiguity preferences are sometimes conceptually more appropriate than risk preferences for PEB. We use survey data for a sample of middle-class households from Lima, the capital of Peru. The social preferences we include are altruism, trust and reciprocity (both positive and negative). With the exception of ambiguity preferences, all preferences are elicited using a survey module from the Global Preference Survey (GPS), introduced by Falk et al. (2016, 2018).

We make the following contributions to the literature on preferences and PEB. First, whereas previous studies consider one or a few preferences in isolation, we include the range of preferences that we think are relevant. As Sutter et al. (2013) point out, omitting relevant preferences can lead to wrongly attributing behavioural effects to the preferences that have been included in the analysis. Whereas we do not claim to be able to identify causal effects of preferences, we avoid in this way potential omitted variable bias. For the same reason, we also

[1] This is empirically confirmed in many domains, including savings behaviour, educational attainment, health-related behaviours such as exercising and smoking, and pro-social behaviour such as donations to charity (Dohmen et al., 2011; Sutter et al., 2013; Falk et al., 2015; 2018).

control in the analysis for variables that are potentially correlated both with PEB and with preferences, such as environmental knowledge, environmental concern, wealth, age, gender and education.

Second, most research in this field has looked at the role of preferences in PEB that results from major, occasional decisions. However, as mentioned PEB consists of regular behaviour too. To our knowledge, no previous evidence exists on preferences and their importance for regular PEB. We contribute to the literature by considering two types: behaviours that save energy in the household; and behaviours that reduce the amount of plastics consumption. We also consider a measure that results from both regular PEB and occasional PEB, the monthly electricity bill. Volland (2017) uses a similar measure for a sample of households in the UK.

Third, we include ambiguity aversion among the relevant preferences, which is a novel contribution as the studies on PEB that look at the role of attitudes towards uncertainty focus on risk aversion (Farsi, 2010; Qiu et al., 2014; Fischbacher et al., 2015; Volland, 2017). When probabilities of outcomes are known or can be estimated, risk preferences are relevant, when they are unknown, ambiguity preferences are (Elsberg, 1961). In the plausible situation that an individual decision-maker is unable to estimate the probabilities of outcomes of PEB, ambiguity aversion is therefore the relevant concept, which we are able to investigate in this study.[2]

Fourth, by eliciting data on preferences using the Global Preference Survey (GPS) of Falk et al. (2016; 2018), we are employing a validated methodology that allows for simple comparison within and between countries and thereby provides a basis for replication in future research.

Fifth and finally, with the exception of Fuerst and Singh (2018), who conducted their research in India, no evidence exists for the role of preferences in PEB outside a high-income country context. Peru, a middle income country, is a particularly interesting case because of the rapid rise of the middle classes, as a result of sustained economic growth. According to the official news agency of the Peruvian state, Andina, the percentage of people living in middle class households grew from 14.1% of the population in 2004 to 44.7% in 2018, the year of our survey, which amounts to 14.4 million Peruvians (Andina 2019).[3] As their spending increases, so does their potential to do damage to the environment through their consumption behaviour. Evidence on the preferences that correlate with PEB among a group with a large and rapidly growing environmental footprint may help policy makers understand how to encourage PEB more effectively and thereby prevent much damage.

Our findings may be summarised as follows. We find that social preferences matter mainly for saving-energy behaviour; time, risk and ambiguity preferences matter mainly for the

[2] Millner et al. (2013) and Weitzman (2009) theoretically discuss the relevance of ambiguity for climate policies. Yet, to our knowledge no previous study has ever quantified the effect of ambiguity aversion on PEB in a real world setting. Evidence on individual ambiguity preferences and behaviour outside the laboratory is rare in general (see Trautmann and Van de Kuilen, 2014, for a review).

[3] Middle class households are defined by Lima's chamber of commerce as those earning between US$10 and US$50 per day, corrected for purchasing power parity (ibid.).

consumption of plastics; and time and ambiguity preferences matter for expenditures on electricity. The insight that particular preferences matter for particular PEBs has important policy implications, which we spell out in the final section of the paper. The paper proceeds as follows: *Section 2* explains the data collection and measurement of variables. *Section 3* presents empirical findings based on regression analyses. *Section 4* ends with a discussion and conclusion.

2 Data

2.1 Data collection

To elicit information on the variables of interest for our analysis, a household survey was conducted among 900 middle class households in Lima, Peru, in November and December 2018. The data collection was conducted by a local survey firm. To identify middle class households, we first excluded the very poorest and very richest districts by making use of an existing poverty map for Lima (INEI, 2016) as well as the latest national household survey data for Peru (ENAHO, 2017). We next computed the number of households to sample by district through allocating the sample to districts in proportion to the number of middle-income households living in them, using the latest Census (2017) data and the INEI (2016) poverty map. We decided to sample on average five households per block, so divided the number of households to be sampled per district by five in order to determine the number of blocks to sample by district. Blocks were randomly selected.[4]

Within each block, enumerators followed a random walk system and approached every fifth household, thereby sampling approximately five households per block. Enumerators asked eight screening questions before administering the actual questionnaire, in order to ensure that households did indeed belong to the middle class.[5] Enumerators were instructed to always interview the household head (preferably) or their spouse. The surveys were conducted with tablets using the software SurveyCTO. The monitoring function of the software made it possible to follow the data collection process continuously and to ensure direct quality control of the data.

2.2 Measurement of variables

2.2.1 Independent variables: preferences

Data on risk, time and social preferences were collected using questions from the Global Preference Survey (GPS) of Falk et al. (2016; 2018), which has been implemented worldwide, in at least 76 countries. A key advantage of the GPS is that it is experimentally validated, meaning that the survey items included in the GPS were the best predictors for preferences in incentivised

[4] To be precise, we numbered contiguous blocks consecutively on a map, divided the number of district blocks by the number of blocks to be sampled, which gave the number x, and sampled every xth block.

[5] Enumerators observed the appearance of the house, and asked some questions about certain indicative expenditure categories. On the basis of these questions, a score was computed, which if it was in the required range meant enumerators could proceed with the survey. If not, they approached the next house.

choice experiments. By experimentally validating a survey module on preferences and testing it for cultural sensitivities, the authors provide a low-cost measurement tool for use in large and diverse samples, while still retaining key advantages of experimental approaches (Falk et al., 2016). Moreover, the use of a standardized tool for measuring preferences contributes to facilitating comparability across studies. By using questions from the GPS for our research, we thus take advantage of a tool that can easily be applied in almost any country, thereby facilitating international replication and comparison.

For our analysis, risk preferences are elicited using a so-called "staircase" procedure for the subjective valuation of a hypothetical gamble. In particular, respondents choose between this gamble and a certain payment. If they choose the gamble, then the certain payment is increased in the next choice; if they choose the certain payment, then it is reduced. This continues until the certainty equivalent value of the gamble is approximated, i.e. until the decision-maker is almost indifferent between the gamble and the certain payment. Time preferences are measured using a similar staircase procedure for a hypothetical intertemporal choice (between a payment now and a payment in twelve months), and ambiguity preferences (which are not included in the GPS) by using the same staircase procedure as for risk, but replacing the gamble by an ambiguous outcome, i.e. one in which probabilities are not known by the decision-maker.[6]

We elicit social preferences using questions on altruism, trust, and positive and negative reciprocity, which are all measured through respondents rating their willingness to act in certain emblematic situations, or their self-image in terms of certain character traits, on an 11-point Likert-scale from 0 to 10. For example, preferences for negative reciprocity are captured through scores on the following two questions with equal weights.

How willing are you to punish someone who treats **you** *unfairly, even if there may be costs to do so?*

How willing are you to punish someone who treats **others** *unfairly, even if there may be costs to do so?*

All survey questions are shown in abbreviated form in table 1 below and can be found in their original longer version in appendix A1. For the analysis, we use the z-score of each preference measure.

[6] Our method for eliciting ambiguity preferences is inspired by Sutter et al. (2013).

Table 1: Preference measures used in the analysis (own illustration (short form) based on Falk et al., 2016).

Preference	Question in abbreviated form	Answer Scale
Risk	*(Sequence of five interdependent binary choice questions)* What would you prefer: 50 percent chance of receiving x and 50 percent chance of receiving nothing, or the amount of y as a sure payment?	Five choices between a risky and a certain payment
Ambiguity	*(Sequence of five interdependent binary choice questions)* This bag contains 20 balls, which are all either black or white, but you don't know how many of each there are. What would you prefer: a draw from the bag of 20 balls, where you would get amount x if you drew a white ball, and nothing if you drew a black ball, or the amount of y as a sure payment?	Five choices between an ambiguous and a certain payment
Time	*(Sequence of five interdependent binary choice questions)* Please consider the following: would you rather receive amount x today or amount y in 12 months?	Five choices between a payment now and one in twelve months
Altruism	*(Willingness to act)* How willing are you to give to good causes without expecting anything in return?	11-point Likert-scale from 0 to 10
Negative reciprocity	*(Willingness to act)* 0.5 x How willing are you to punish someone who treats **you** unfairly, even if there may be costs for you? 0.5 x How willing are you to punish someone who treats **others** unfairly, even if there may be costs for you?	11-point Likert-scale from 0 to 10
Positive reciprocity	*(Self-assessment)* When someone does me a favour, I am willing to return it.	11-point Likert-scale from 0 to 10
Trust	*(Self-assessment)* I assume that people have only the best intentions.	11-point Likert-scale from 0 to 10

2.2.2 Dependent variables: Pro-environmental behaviour (PEB)

We capture pro-environmental behaviour (PEB) in a number of different ways (for details see appendix A2). First, we measure the extent to which people engage in *energy saving behaviour*. We do so through constructing an index based on three questions, one focussing on switching off the lights when leaving the room, another on turning off the TV when nobody is actively watching it, and a final one on pro-actively trying to save energy in general. The index constructed is the first component of a Principal Component Analysis (PCA). To verify our assumption that

the first component captures PEB rather than something else, we also use an index based on the simple mean of the three items, as a robustness check.[7]

Second, we capture whether respondents are aiming for *sustainable plastics consumption*. For this purpose, we construct an index based on two questions, one about reusing materials such as plastic bags and another about trying to avoid taking plastic bags in shops. Again, PCA is used to construct our preferred index while an index based on the mean of the items is used as a robustness check.

Third, we measured *monthly spending on electricity*. Contrary to our intentions, this relies mainly on self-reported data. Only a minority of people allowed us to take a picture of their electricity bill (n=33). In those cases, the figure stated on the electricity bill was used for the analysis. In all other cases, people gave their best guess of how much they spent on electricity per month.[8] For the analysis of spending on electricity, we removed outliers: all households that claimed to have no spending on electricity at all (19 cases) and those that reported an electricity spending above 600 Soles per month (10 cases, top 1%), leaving 869 observations for the final variable. For the analysis, the logarithm of this variable was used.

2.2.3 Control variables

Environmental knowledge (EK) and environmental concern (EC) can be expected to matter for PEB and are therefore included as control variables in the analysis (see e.g. Lange et al., 2014, for a discussion on the relevance of environmental attitudes for residential heating expenditures). Moreover, EK and EC may correlate with both PEB and individual preferences, so that not including these variables would bias the estimated effect of preferences on PEB. The same applies to the other control variables, which include a wealth-index (based on a PCA of all assets, and characteristics of the house such as the average number of household members per household room), age, gender and the level of education of the respondent. EK is captured using an additive index based on eight questions eliciting knowledge about the natural environment and humans' influence on it. Our EC index takes the value of the mean of scores on six questions eliciting concern for the environment and for sustainable consumption habits. The questions for EK and EC are based on Thogersen et al. (2010) and Thogersen et al. (2019), and can be found in appendix A3.

[7] All robustness checks and other supplementary analyses are available from the authors on request.
[8] Whether self-reported numbers are sufficiently accurate in this context has been discussed with key informants in Peru and was found to be the case.

3 Empirical Findings

3.1 Descriptive Statistics

Table 2 shows descriptive statistics of the key variables used in the analysis. Respondents are 55% female, and aged between 18 and 75 years, with a mean age of 48 years. Confirming the middle-class nature of our sample, the most frequently occurring levels of education are having completed secondary school (41%) and technical higher education (39%).

For ease of interpreting the regression analyses below, we note here that higher indices of sustainable plastics consumption and saving energy-behaviour indicate a greater degree of PEB, higher monthly electricity spending a lower degree of PEB, and higher EK and EC indices greater environmental knowledge and concern, respectively. The time preference variable being higher indicates greater patience, and the risk preference variable being higher greater willingness to take risk (so lower risk aversion). Likewise, when the ambiguity preference variable is higher, people are willing to put up with a larger amount of ambiguity.

As to the social preferences, negative reciprocity being higher indicates a greater willingness to punish others for behaviour that is perceived to be unfair; altruism higher, a greater willingness to donate to good causes; positive reciprocity higher, a greater willingness to return a favour; and trust higher, a more generous assumption that other people only have the best intentions.

Table 2: Summary statistics of EK and EC, preferences and PEB.

Variable	Obs.	Mean	Std. dev.	Min	Max
Control variables					
Environmental knowledge	898	5.30	1.85	0	8
Environmental concern	898	3.78	0.58	1	5
Preferences					
Altruism	898	4.93	2.44	0	10
Trust	898	3.22	1.86	0	10
Positive reciprocity	898	7.49	2.10	0	10
Negative reciprocity	898	2.67	2.03	0	10
Risk	898	7.29	7.65	1	32
Ambiguity	898	6.72	7.26	1	32
Patience	898	1.96	3.76	1	32
PEB					
Each item individually					
Switching off lights	898	4.48	0.71	1	5
Turning off the TV	887	4.44	0.69	1	5
Trying to save energy in general	898	4.45	0.66	1	5
Reusing plastic materials	898	3.55	1.31	1	5
Avoiding plastic bags in shops	898	2.08	1.09	1	5
Indices (mean)					
Energy saving index (mean)	887	4.45	0.60	1	5
Plastics consumption index (mean)	898	2.81	0.94	1	5
Spending on electricity					
Monthly spending on electricity	869	127.93	80.34	12	556

3.2 Regressions

We analyse the relation of preferences and PEB in a multiple regression model

$$Y_i = ß_0 + ß_1 Altruism_i + ß_2 Trust_i + ß_3 Positive\ reciprocity_i + ß_4 Negative\ reciprocity_i + ß_5 Risk_i + ß_6 Ambiguity_i + ß_7 Time_i + ß_8 EK_i + ß_9 EC_i + ß_{10} X_i + u_i,$$

where Y_i is PEB (i.e. one of energy saving behaviour, sustainable plastics consumption or the log of monthly spending on electricity), X_i indicates all other control variables and u_i is the error term.

We specify five models for each of our three measures of pro-environmental behaviour (energy saving, sustainable plastics consumption, electricity spending), gradually adding regressors to check sensitivity to model specification of coefficients on our key independent variables. In model 1, only social preferences feature; model 2 adds risk and ambiguity preferences; model 3 time

preferences; model 4 environmental knowledge and concern; and model 5 the full range of controls.

3.2.1 Energy saving behaviour

Table 3 shows the regression results for energy saving behaviour. All social preferences are statistically significant predictors for energy saving behaviour, also after adding all relevant control variables (model 5). The sign of the coefficients (positive for altruism, trust and positive reciprocity, negative for negative reciprocity) confirms the hypothesis that more pro-social individuals tend to display higher levels of energy saving behaviour. The size of the coefficients is not very sensitive to adding control variables. Because all variables have been z-standardised, the regression coefficients are directly comparable.

Table 3: OLS Regression analysis of energy saving behaviour.

VARIABLES	(1)	(2)	(3)	(4)	(5)
Altruism	0.197***	0.204***	0.201***	0.234***	0.218***
	(0.0563)	(0.0570)	(0.0574)	(0.0588)	(0.0585)
Trust	0.139***	0.131**	0.130**	0.119**	0.110**
	(0.0535)	(0.0544)	(0.0544)	(0.0545)	(0.0539)
Positive reciprocity	0.223***	0.222***	0.221***	0.218***	0.228***
	(0.0553)	(0.0556)	(0.0557)	(0.0576)	(0.0577)
Negative reciprocity	-0.229***	-0.238***	-0.238***	-0.223***	-0.176***
	(0.0545)	(0.0559)	(0.0559)	(0.0570)	(0.0576)
Risk		-0.00632	-0.00869	-0.0288	-0.0237
		(0.0876)	(0.0878)	(0.0881)	(0.0868)
Ambiguity		0.0482	0.0463	0.0624	0.0530
		(0.0877)	(0.0878)	(0.0879)	(0.0868)
Patience			0.0229	0.0309	0.0438
			(0.0513)	(0.0516)	(0.0510)
EK				-0.0823	-0.0580
				(0.0506)	(0.0542)
EC				-0.0883*	-0.0559
				(0.0520)	(0.0519)
Female					0.189*
					(0.0996)
Age					0.0172***
					(0.00332)
Wealth index					-0.0734
					(0.0566)
Education					0.0634
					(0.0552)
Constant	-0.00427	-0.00440	-0.00427	-0.00540	-0.927***
	(0.0482)	(0.0482)	(0.0483)	(0.0481)	(0.176)
Observations	887	887	887	887	887
R-squared	0.088	0.089	0.089	0.096	0.126

Standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

By contrast, we do not find significant results for risk, ambiguity and time preferences. Surprisingly, neither EK nor EC is a significant predictor for energy saving behaviour in our analysis. We do find a positive coefficient for age, indicating that older people engage more in energy saving behaviour. Finally, women are more likely than men to engage in such behaviour.

Table 4: OLS Regression analysis of sustainable plastics consumption.

VARIABLES	(1)	(2)	(3)	(4)	(5)
Altruism	0.162***	0.113***	0.0977**	0.0343	0.0283
	(0.0413)	(0.0395)	(0.0396)	(0.0398)	(0.0400)
Trust	-0.151***	-0.0847**	-0.0864**	-0.0697*	-0.0627*
	(0.0396)	(0.0379)	(0.0378)	(0.0370)	(0.0370)
Positive reciprocity	0.132***	0.118***	0.113***	0.144***	0.129***
	(0.0405)	(0.0385)	(0.0383)	(0.0389)	(0.0393)
Negative reciprocity	-0.0899**	0.00116	0.00140	-0.0407	-0.0264
	(0.0405)	(0.0392)	(0.0390)	(0.0389)	(0.0397)
Risk		-0.196***	-0.207***	-0.177***	-0.180***
		(0.0618)	(0.0616)	(0.0604)	(0.0601)
Ambiguity		-0.197***	-0.206***	-0.229***	-0.227***
		(0.0618)	(0.0616)	(0.0603)	(0.0601)
Patience			0.106***	0.0829**	0.0942***
			(0.0347)	(0.0341)	(0.0342)
EK				0.0804**	0.0627*
				(0.0346)	(0.0375)
EC				0.217***	0.215***
				(0.0355)	(0.0358)
Female					0.181***
					(0.0686)
Age					0.00167
					(0.00228)
Wealth index					0.0523
					(0.0386)
Education					0.0668*
					(0.0381)
Constant	-0.00313	-0.00265	-0.00273	-0.00186	-0.182
	(0.0358)	(0.0338)	(0.0337)	(0.0329)	(0.121)
Observations	898	898	898	898	898
R-squared	0.055	0.161	0.169	0.210	0.222

Standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

3.2.2 Sustainable plastics consumption

Looking at the regression results for sustainable plastics consumption in table 4, we find that all social preferences are statistically significant predictors in model 1, but most of these effects are not robust, since they largely diminish after all other preferences measures and relevant control variables have been added. In model 5, the coefficients of altruism and negative reciprocity are statistically insignificant, trust retains only marginal significance, and the only social preferences variable that remains a statistically significant positive predictor is positive reciprocity.

By contrast, risk and ambiguity tolerance are both negatively related to sustainable plastics consumption, also after adding all relevant control variables. This means that more risk and ambiguity tolerant people are less likely to engage in this particular PEB, which we reflect upon in the discussion. The results for time preferences confirm the hypothesis that more patient individuals show higher levels of sustainable plastics consumption.

Table 4 also illustrates the importance of considering all relevant preferences. For instance, when risk and ambiguity aversion are not controlled for, negative reciprocity is statistically significant, but it loses significance when these variables are added. This suggests that the significance of the coefficient of negative reciprocity in the incomplete models is spurious.

Finally, we find evidence that higher levels of EK and EC lead to more sustainable plastics consumption, as predicted, and that women and more educated people engage in this PEB more.

Table 5: OLS Regression analysis of monthly spending on electricity (log).

VARIABLES	(1)	(2)	(3)	(4)	(5)
Altruism	0.0154	0.0289	0.0394*	0.0265	0.0405*
	(0.0227)	(0.0228)	(0.0228)	(0.0233)	(0.0214)
Trust	0.0414*	0.0255	0.0271	0.0333	0.0230
	(0.0219)	(0.0220)	(0.0219)	(0.0219)	(0.0200)
Positive reciprocity	0.0297	0.0276	0.0308	0.0222	-0.0262
	(0.0223)	(0.0222)	(0.0221)	(0.0229)	(0.0211)
Negative reciprocity	0.0227	0.00560	0.00469	0.00507	0.0572***
	(0.0224)	(0.0228)	(0.0227)	(0.0232)	(0.0216)
Risk		-0.0343	-0.0276	-0.0172	-0.0223
		(0.0352)	(0.0350)	(0.0350)	(0.0318)
Ambiguity		0.111***	0.117***	0.108***	0.0902***
		(0.0351)	(0.0349)	(0.0349)	(0.0317)
Patience			-0.0691***	-0.0684***	-0.0408**
			(0.0194)	(0.0195)	(0.0179)
EK				0.0594***	-0.0120
				(0.0200)	(0.0198)
EC				0.0121	0.0161
				(0.0208)	(0.0191)
Female					-0.00604
					(0.0362)
Age					0.00490***
					(0.00122)
Wealth index					0.259***
					(0.0206)
Education					-0.0198
					(0.0204)
Constant	4.690***	4.689***	4.690***	4.690***	4.453***
	(0.0194)	(0.0192)	(0.0191)	(0.0190)	(0.0645)
Observations	869	869	869	869	869
R-squared	0.015	0.035	0.049	0.059	0.230

Standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

3.3.3 Monthly spending on electricity

Table 5 shows the regression results for the logarithm of monthly spending on electricity. No clear picture emerges for the relevance of social preferences. The only social preference that is statistically significant at better than marginal level in the complete model specification is negative reciprocity. Its coefficient is positive, which means that people who say they are more prepared to punish others for behaviour they think is unfair also spend more on electricity. It is not a robust result, since the coefficient on negative reciprocity is only significant in model 5. Altruism is marginally significant in model 3 and model 5, but nowhere else. No social preference is thus robustly statistically significant.

Ambiguity aversion is positively related with spending on electricity, which we reflect on in the next section, and patience is negatively related with such spending, meaning that more patient individuals have lower spending on electricity per month, which is as expected.

Age and wealth clearly matter, with richer and older people spending more on electricity. There is a much larger jump in R-squared between models 4 and 5 in table 5 than there is in tables 3 and 4. This suggests that, relative to preferences, the socio-economic control variables are more important for electricity spending than for the other two PEBs. Combined with the absence of significant coefficients on most preferences, it is hard to avoid the conclusion that preferences do not matter very much for spending on electricity, in this sample.

4 Discussion & Conclusion

In this study, we contribute to the literature that relates PEB to individual preferences. We elicit a full range of individual preferences (risk, ambiguity, time and social) instead of focussing on just one preference in isolation, to make sure preferences do not proxy for omitted ones. We link data on individual preferences to two dependent variables that have not been considered before in this literature (habitual energy-saving behaviour and sustainable plastics consumption) and thereby expand the evidence base on the importance of preferences for PEB that takes place regularly (e.g. switching off lights), as opposed to occasional behaviour (e.g. buying an energy-efficient refrigerator). Unlike previous studies, we consider the role of ambiguity preferences in predicting PEB, which is arguably conceptually more relevant than risk preferences. The reason for this is that the probability of future benefits of PEB is not typically known or easy to estimate.

For eliciting preferences, we make use of a state-of-the-art validated survey measure that allows for international comparability and replication (Falk et al., 2016, 2018). By focussing on households in Peru, we shed light on preference heterogeneity and its importance for PEB outside the context of high-income countries, which is rare in the literature (Fuerst and Singh, 2018, for India is an exception). We focus on middle class households, which is a group that is on the rise in low and middle-income countries experiencing long-term economic growth, and the determinants of whose PEB is important to understand for helping ensure that the development of these countries is sustainable. Due to having a rich data set, we are able to control for individual characteristics such as environmental knowledge and concern, wealth, and education that are potentially correlated both with PEB and with preferences. This reduces the risk of omitted variable bias.

We find that social preferences are strongly correlated with saving-energy behaviour (switching off unnecessary lights etc.), but hardly with sustainable plastics consumption and with the monthly electricity bill. This demonstrates that preferences that matter for one type of PEB do not necessarily matter for another. For instance, our finding that a trusting propensity matters for saving-energy behaviour confirms previous studies on the link between trust and PEB (Gupta

and Ogden, 2009; Volland, 2017; Ziegler, 2018), whereas our finding that, if anything, trusting other people more predicts lower sustainable plastics consumption is at odds with that literature.

The willingness to take risk and experience ambiguity are both negatively related with sustainable plastics consumption, which is the same as saying that both risk and ambiguity aversion are positively related with it. In other words, when people are less tolerant of risk and ambiguity, they engage more in avoiding wasteful plastic use. This is at odds with most previous literature that relates PEB and risk aversion (Farsi, 2010; Qui et al., 2014; Fischbacher et al., 2015). In that literature, the rationale given for such a link is that the benefits of PEB are uncertain, which more risk tolerant people mind less, as a result of which they engage more in such PEB. However, it is worth pointing out that it is not just the benefits of PEB that are uncertain: the costs of not engaging in PEB are uncertain too. A risk or ambiguity averse person may thus avoid the use of plastics since the environmental damage that may result from using plastics is uncertain. Given that the smaller, regular PEBs to avoid plastics that we investigate in our study require less uncertain investment than the PEBs in the studies mentioned above (e.g. purchase of an energy-efficient appliance), the uncertainties about potential damage from not engaging in the behaviour seem to outweigh the uncertain benefits from engaging in it in this case.

Our findings for risk aversion and sustainable plastics consumption are comparable to what Volland (2017) finds for spending on energy. He finds for a UK sample that higher risk tolerance is associated with greater such spending (and therefore risk aversion with less of such spending). In other words, both in his case and in our case, risk aversion and PEB are positively associated. However, unlike Volland, we find no link between risk tolerance and the monthly electricity bill. Instead, we do find that the willingness to experience ambiguity is positively related with such spending. Perhaps ambiguity averse people mind the financial uncertainty more that results from profligate spending. It shows in any case the importance of including ambiguity aversion in the analysis of PEB, and not just risk aversion alone.

We find no link between risk and ambiguity aversion and habitual energy-saving behaviour. One possible interpretation is that, in the case of this PEB, the uncertain benefits of engaging in this PEB and the uncertain costs of not engaging in it are not considered to be sufficiently sizeable to be much of a worry.

More patience is positively related with sustainable plastics consumption, negatively related with the monthly electricity bill, and not significantly related with habitual energy-saving behaviour. Previous studies have found patience to be positively related with PEB (Fischbacher et al., 2015; Newell and Siikamäki, 2015; Fuerst and Singh, 2018; Ziegler, 2018). Our findings on plastics avoidance and electricity expenditures are consistent with that. The reason offered in these studies is that more patient people discount the future at a lower rate, and therefore value PEB, whose benefits are in the future, more highly. In line with that, we do not find a positive relationship between patience and PEB that also has immediate benefits (people saving money through energy-efficient behaviour) but only between patience and PEB with predominately future benefits (avoiding plastic waste).

We see three main messages emerging from this study. First, it matters to control for all relevant preferences when explaining PEB. Examples abound, in the analyses above, of the statistical significance of coefficients on preferences disappearing as we gradually add more preferences as independent variables. This means that studies that do not control for all relevant preferences may draw the wrong conclusion about which ones matter for PEB.

Second, different preferences matter for different PEBs. For habitual energy-saving behaviour, which brings only tiny benefits to the individual actor and requires a strong sense of a shared responsibility for the well-being of future generations, we found social preferences mainly to matter. For sustainable plastics consumption, we found that patience and risk and ambiguity tolerance matter: people who discount the future at a lower rate and mind more the uncertain damage of not engaging in the behaviour are more likely to engage in this particular PEB. For spending on electricity, which unlike the other two PEBs brings large benefits to the actor, patience and ambiguity aversion matter.

Third, pro-environmental policy can make use of evidence that particular preferences matter for particular PEBs. To promote daily energy-saving habits, policy messages could emphasise that this PEB is an opportunity to care for and take responsibility for future generations. To promote the sustainable use of plastics, the consequences of not doing so could be vividly shown to people, so that the dreadful future that would result from excessive use feels real. And to promote energy efficiency that results in a lower monthly electricity bill, simple worked examples on financial savings ("you could save X %") in addition to appeals on future benefits may work.

Acknowledgements

We would like to thank Babette Never and Sascha Kuhn from DIE (German Development Institute) for their support in the construction of the survey modules. We would further like to thank Sebastian Schneider (MPI) and Thomas Dohmen (IZA) for their helpful comments on the design of the study. The paper also benefited from comments on preliminary findings from the participants of the 2019 M-BEES/M-BEPS and 2019 IAREP-SABE conferences. We are grateful to the German Federal Ministry of Education and Research (BMBF) for funding the study.

References

Andina (2019). 'Peru's middle class grew 4.5% to 14.4 million in 2018,' Andina, 15 May [Online]. Available at https://andina.pe/ingles/noticia-perus-middle-class-grew-45-to-144-million-in-2018-751540.aspx [Accessed 12 March 2020].

Carattini, S., Baranzini, A. and Roca, J. (2015). Unconventional Determinants of Greenhouse Gas Emissions: The Role of Trust. Environmental Policy and Governance, 23 (4), 243-257.

Census (2017). Censos Nacionales 2017: XII de Población, VII de Vivienda y III de Comunidades Indígenas. Instituto Nacional de Estadística e Informática.

Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J. and Wagner, G. (2011). Individual Risk Attitudes: Measurement, Determinants and Behavioral Consequences. Journal of the European Economic Association, 9 (3), 522-550.

Ellsberg, D. (1961). Risk, Ambiguity, and the Savage Axioms. Quarterly Journal of Economics, 75 (4), 643-69.

ENAHO (2017). Perú – Encuesta Nacional de Hogares sobre Condiciones de Vida y Pobreza 2017. Instituto Nacional de Estadística e Informática.

Falk, A., Becker, A., Dohmen, T., Enke, B., Huffman, D. and Sunde, U. (2015). The Nature and Predictive Power of Preferences: Global Evidence. IZA Discussion Paper No. 9504.

Falk, A., Becker, A., Dohmen, T., Huffman, D. and Sunde, U. (2016). The Preference Survey Module: A Validated Instrument for Measuring. IZA Discussion Paper No. 9674.

Falk, A., Becker, A., Dohmen, T., Enke, B., Huffman, D., and Sunde, U. (2018). Global evidence on economic preferences. Quarterly Journal of Economics, 133 (4), 1645-1692.

Farsi, M. (2010). Risk aversion and willingness to pay for energy efficient systems in rental apartments. Energy Policy, 38 (6), 3078-3088.

Fischbacher, U., Schudy, S. and Teyssier, S. (2015). Heterogeneous Preferences and Investments in Energy Saving Measures. Munich Discussion Paper No. 2015-11.

Fuerst, F. and Singh, R. (2018). How present bias forestalls energy efficiency upgrades: A study of household appliance purchases in India. Journal of Cleaner Production, 186, 558-569.

Gupta, S. and Ogden, D. T. (2009). To buy or not to buy? A social dilemma perspective on green buying. Journal of Consumer Marketing, 26 (6), 376-391.

INEI (2016). Instituto Nacional de Estadística e Informática – Planos Estratificados de Lima Metropolitana a Nivel de Manzana 2016.

Millner, A., Dietz, S. and Heal, G. (2013). Scientific Ambiguity and Climate Policy. Environmental and Resource Economics, 55 (1), 21-46.

Newell, R. G. and Siikamäki, J. (2015). Individual Time Preferences and Energy Efficiency. American Economic Review: Papers & Proceedings, 105 (5), 196-200.

Ostrom, E. (2009). A Polycentric Approach for Coping With Climate Change. Policy Research Working Paper 5095, The World Bank.

Qiu, Y., Colson, G. and Grebitus, C. (2014). Risk preferences and purchase of energy-efficient technologies in the residential sector. Ecological Economics, 107, 216-229.

Sutter, M., Kocher, M. G., Glätzle-Rützler, D. and Trautmann, S. T. (2013). Impatience and Uncertainty: Experimental Decisions Predict Adolescents' Field Behavior. American Economic Review, 103 (1), 510-531.

Thogersen, J., Haugaard, P. and Olesen, A. (2010). Consumer responses to ecolabels. European Journal of Marketing, 44, 1787-1810.

Thogersen, J., Pedersen, S. and Aschemann-Witzel, J. (2019). The impact of organic certification and country of origin on consumer food choice in developed and emerging economies. Food Quality and Preference, 72, 10-30.

Trautmann, S. T. and Van de Kuilen, G. (2014). Ambiguity Attitudes. In: Keren, G. and Wu, G. (eds), The Wiley Blackwell Handbook of Judgment and Decision Making, First Edition, 89-116.

Volland, B. (2017). The role of risk and trust attitudes in explaining residential energy demand: Evidence from the United Kingdom. Ecological Economics, 132, 14-30.

Ziegler (2018). Heterogeneous preferences and the individual change to alternative electricity contracts. MAGKS Papers on Economics No. 27-2018, Philipps-University Marburg.

Appendix

A.1 Measures for preferences

The questions for risk, time and social preferences are taken from the GPS of Falk et al. (2016; 2018). All questions are available for download online and can be found in various languages, which are also adjusted for local currencies: https://www.briq-institute.org/global-preferences/home. For the data collection, we used the Peruvian (Spanish) version of the GPS (using Peruvian Soles as currency). Here, we present the English wording as it is illustrated in Falk et al. (2016), listing only the questions that we use for our analysis.

Social preferences

We now ask for your willingness to act in a certain way in different areas. Please indicate your answer on a scale from 0 to 10, where 0 means you are "completely unwilling to do so" and a 10 means you are "very willing to do so". You can also use any numbers between 0 and 10 to indicate where you fall on the scale, like 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.

Negative reciprocity

- *How willing are you to punish someone who treats **you** unfairly, even if there may be costs to do so?*
- *How willing are you to punish someone who treats **others** unfairly, even if there may be costs to do so?*

  Completely unwilling to do so 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10 very willing to do so

Altruism

- *How willing are you to give to good causes without expecting anything in return?*

  Completely unwilling to do so 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10 very willing to do so

How well do the following statements describe you as a person? Please indicate your answer on a scale from 0 to 10. A 0 means "does not describe me at all" and a 10 means "describes me perfectly". You can also use any numbers between 0 and 10 to indicate where you fall on the scale, like 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.

Positive reciprocity

- *When someone does me a favour, I am willing to return it.*

  Does not describe me at all 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10 describes me perfectly

Trust

- *I assume that people have only the best intentions.*

Does not describe me at all 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10 describes me perfectly

Risk and ambiguity preferences

Risk

- *Please imagine the following situation: You can choose between a sure payment of a particular amount of money, or a draw, where you would have an equal chance of getting amount x or getting nothing. We will present to you five different situations. The draw with the 50/50 chance of receiving amount x or receiving nothing is the same in all situations. The sure payment is different in every situation.*

  What would you prefer: a draw with a 50 percent chance of receiving amount x, and the same 50 percent chance of receiving nothing, or the amount of y as a sure payment?

  [If the participant preferred the gamble, then the sure payment was increased, if they preferred the sure payment, then the sure payment was reduced; and they were asked the question again. This continued until the certainty equivalent value of the gamble was closely approximated (see figure A1 for the steps that were taken).]

Ambiguity

- *Please imagine the following situation: You can choose between a sure payment of a particular amount of money, or a draw from a bag of 20 balls, where some are white and some are black. You don't know how many balls are black and how many balls are white. If you draw a white ball, you get amount x, if you draw a black ball, you get nothing. We will present to you five different situations. The draw from the bag with black and white balls is the same in all situations. The sure payment is different in every situation.*

  What would you prefer: a draw from the bag of 20 balls, where you would get amount x if you drew a white ball, and nothing if you drew a black ball, or the amount of y as a sure payment?

  [The certainty equivalent value of the draw was approximated using the same staircase procedure as the one for risk (figure A1).]

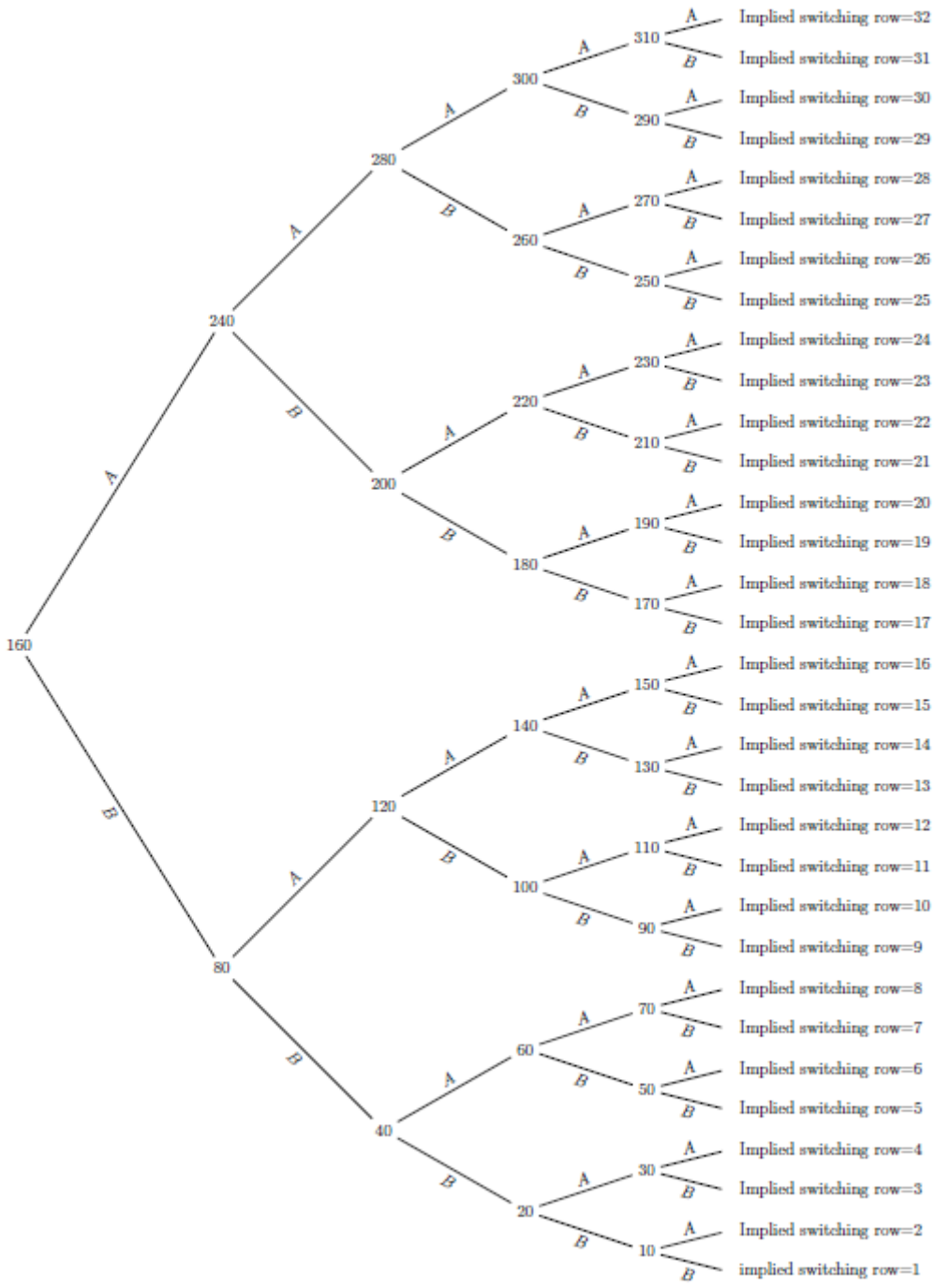

Figure A1: Tree for the staircase risk task (numbers = sure payment, A = choice of lottery, B = choice of sure payment); taken from Falk et al. (2016). The lottery considered here is a 50/50 chance of 300.

Time preferences

- *Suppose you were given the choice between receiving a payment today or a payment in 12 months. We will now present to you 5 situations. The payment today is the same in each of these situations. The payment in 12 months is different in every situation. For each of these situations we would like to know which you would choose. Please assume there is no inflation, i.e. future prices are the same as today's prices.*

  Please consider the following: would you rather receive amount x today or amount y in 12 months?

  [The participant then chose five times between amount x, which was kept constant, and a payment in twelve months, which was increased compared to the previous choice if the future payment had been chosen and reduced if the payment today had been chosen (see figure A2).]

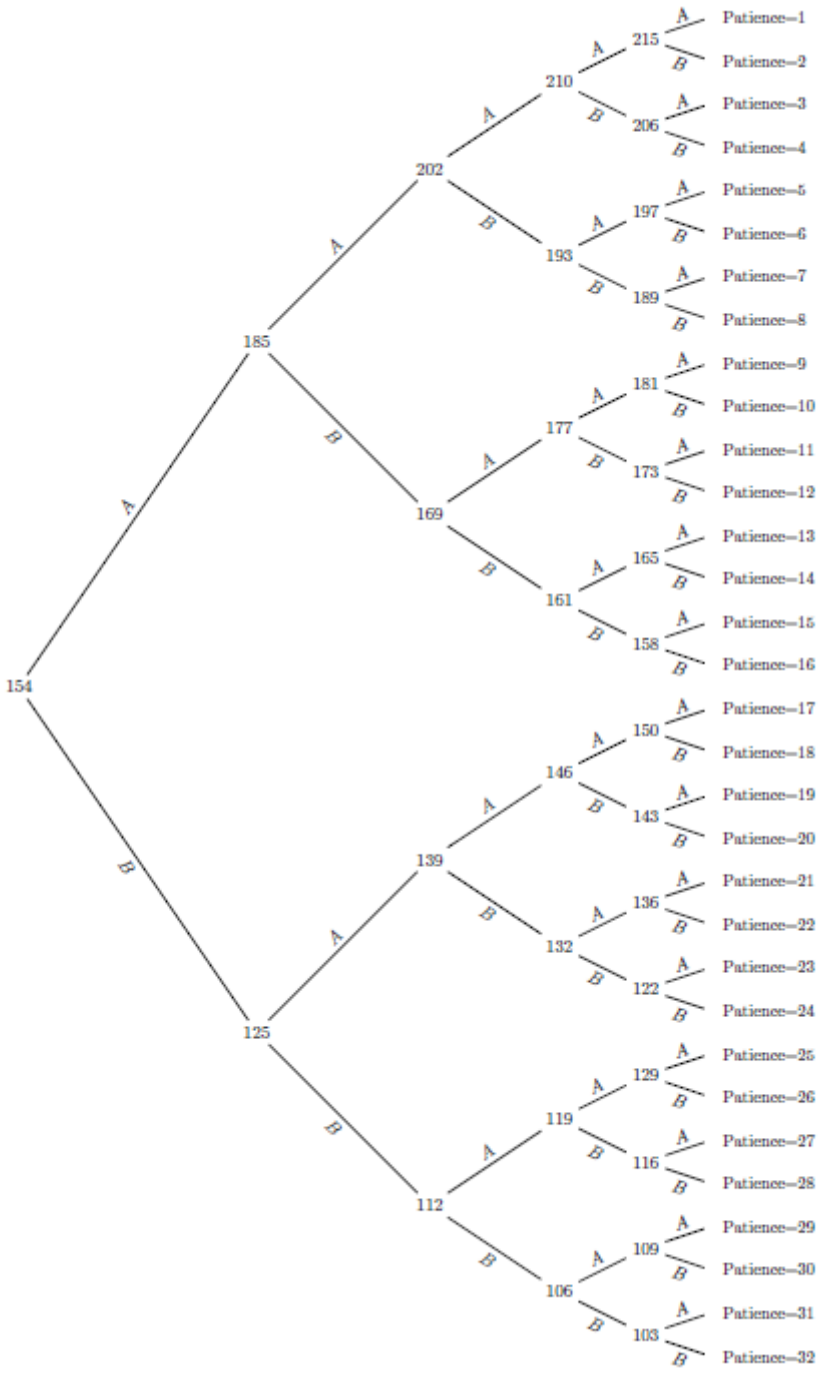

Figure A2: Tree for the staircase time task (numbers = payment in 12 months, A = choice of amount 100 today, B = choice of amount y in 12 months); taken from Falk et al. (2016). The first intertemporal choice considered is 100 today or 154 in 12 months.

A.2 Measures for Pro-Environmental Behaviour

The indices for energy saving behaviour and sustainable plastics consumption are built based on different usage behaviour questions, which are all measured on a 5-point Likert-Scale.

Energy saving behaviour

- *Do you usually switch off the lights when you leave the room?*
- *Do you usually turn off the TV if nobody is watching actively?*
- *Do you actively try to save energy in your household?*

no, nearly never (1) – yes, rarely (2) – yes, sometimes (3) – yes, often (4) – yes, nearly always (5)

Sustainable plastics consumption

- *Do you usually reuse materials such as plastic bags?*
- *Do you usually avoid taking plastic bags in shops (e.g. supermarkets)?*

no, nearly never (1) – yes, rarely (2) – yes, sometimes (3) – yes, often (4) – yes, nearly always (5)

Spending on electricity

For spending on electricity, enumerators either copied the number from the electricity bill (when participants allowed us to take a photo), or people were asked the following question.

- *Please give us your best guess how much you spent on electricity in the last month. (in Soles)*

A.3 Measures for control variables

The question for EK and EC are based on Thogersen et al. (2010) and Thogersen et al. (2019).

Environmental knowledge

The measure for EK is built using an additive index based on eight questions eliciting knowledge on different environmental dimensions. Each correct answer is counted as one, wrong answers or indifference are counted as 0.

Of the following statements, which one capture your understanding of energy saving and sustainable consumption? If you think a statement is correct, please say "yes"; if you think a statement is false, please say "no".

- *I know a lot about the topic of global climate change.*
- *I know quite a lot about the different possibilities how to save energy in my household.*
- *Compared with others, I have a good understanding of the impact of transport on air pollution.*
- *You can save energy when you set your air con 2 degrees warmer.*
- *Using a lot of energy has a negative impact on the environment.*
- *You can save energy and money in the long run when you buy a new fridge with an energy efficient technology.*
- *Whether I leave the light on the whole day or turn it off when I leave the room does matter for my energy consumption.*
- *Using public transport instead of a private car is better for the environment.*

  yes – no – don't know

Environmental concern

The measure for EC is built using a mean index based on six questions eliciting concern for the environment and for sustainable consumption habits, which are all measured on a 5-point Likert-Scale.

How much do you agree or disagree with the following statements?

- *It is important to me that the products that I use do not harm the environment.*
- *I consider the potential environmental impact of my actions when making many of my decisions.*
- *My purchase habits are affected by my concern for our environment.*
- *I am concerned about wasting the resources of our planet.*
- *I would describe myself as environmentally responsible.*
- *I am willing to restrict myself in order to take actions that are more environmentally friendly.*

strongly disagree (1) – disagree (2) – neither agree nor disagree (3) – agree (4) – strongly agree (5)

Wealth index

The wealth index is built based on the following items using PCA:

- Dummy variables for a number of household assets (0 or 1): fridge, freezer, radio, fan, rice cooker, microwave, washing machine, smartphone, laptop, desktop computer, stereo, water heater, car, motorbike, bicycle

- Number of household members per household rooms
- Characteristics of the house (low (-1), medium (0), high (1)): size, material, quality, water supply
- Highest level of education of the household head (low (-1), medium (0), high (1))

Level of education

The level of education of the respondent is measured based on the following question, with answer options coded from 1 to 7:

- *What is your highest certificate of education?*
  - *No education certificate or pre-school (1)*
  - *Primary school / Elementary school (2)*
  - *Secondary school / High school (3)*
  - *Technical higher education (4)*
  - *Bachelor's degree (5)*
  - *Master's degree (6)*
  - *PhD / Doctorate (7)*