Personality and Stated Choices

Christopher Boyce (University of Stirling)
Mikołaj Czajkowski (University of Warsaw)
Nick Hanley (University of St Andrews)

In a recent paper, Boyce, Wood and Ferguson (2016) make the following comment:

"It is clear that the use of cognitive psychology (an area of psychology concerned with how people process information in *general*), has helped improve the predictive power of economic models creating the hugely influential field of behavioural economics. However, although behavioural economics has helped us understand how people react *on average*, there is often substantial variation in individual reactions. The use of personality psychology .. has the potential to instigate a second wave of behavioural economics to predict individual-specific reactions to economic circumstance."

Our approach

- In this paper, we explore (for the first time?) the extent to which variations in **personality** can explain preference heterogeneity and the variation in Willingness to Pay for an environmental good.
- Use the "Five Factor Model" (McCrae and Costa, 2008), whereby each individual can be characterized by differences across five key dimensions: Agreeableness, Conscientiousness, Extraversion, Neuroticism, and Openness to Experiences
- We ask people a standard set of questions which score people on these 5 personality traits
- Do this in 3 separate stated preference **choice experiments**
- So, for each person in each sample, we know (i) how they respond to stated preference choices for an environmental good (ii) their personality type.

Choice experiments?

- A stated preference method, although can also be applied using revealed preference data
- Describe good / policy options in terms of their attributes and the levels these take. One attribute is typically a price.
- Generate alternative choices which are made up of these attributes/levels combinations
- Choices which individuals make reveal their trade-off rates (MRS)
- Can also estimate WTP for a change in any attribute
- Analysed using Random Utility Theory (McFadden; Manski) and discrete choice models.

Table 1: summary of choice experiment design in the three data sets.

	Attribute 1	Attribute 2	Attribute 3	Attribute 4	Attribute 5
Latvia (source: Pakalniete *et al.* (2017))	Areas experiencing losses of native species (over large areas; over small areas; no-where)	Summer water quality for swimming (bad, moderate, good)	New alien (invasive) species establishing populations (often; rarely; almost never)		Cost to individuals: rise in taxes.
Estonia 1 (source: Tuhkanen *et al.* (2016))	Oil spills at sea: frequency (rarely, sometimes, often, very often)	Oil spills at sea: chance of the oil reaching the shoreline (25%, 50%, 75%, 99%)	Invasive Species (one new species every 50 years; every 15-20 years; every year)	Water quality for recreation, in terms of clarity of sea and algae washed up on beaches (good, moderate, poor)	Cost to individuals: rise in taxes.
Estonia 2 (source: Karlõševa *et al.* (2016))	Location of development: at Apollo Shoals; at Western Shoals.	Type of development: None; new wind farm; new eco wind farm; marine protected area; none			Cost to individuals: rise in taxes.

1B: Estonia 1 study

Problem		Alternative A	Alternative B	No additional actions
Large-scale oil pollution	Cases of Large-scale pollution of marine waters	rarely	often	very often
	Probability that pollution reaches the shore	low	very high	very high
Water quality for recreation		poor	moderate	poor
Introduction of new non-indigenous species		often	in exceptional cases	often
Annual cost to your household (EUR)		10	20	0

○ Alternative A

○ Alternative B

○ No additional actions

(Note: Each respondent received 12 such cards. Translation from original in Estonian and Russian)

1C: Estonia (2) study

	Status Quo	**Alternative A**	**Alternative B**
Apollo shoal	No change	ECO-Windfarm	Marine Protected Area
Western shoals	No change	Wind Farm	No change
Cost to your household (EUR per year)	0	10	5
YOUR CHOICE	□	□	□

(Note: Each respondent received 12 such cards. Translation from original in Estonian and Russian)

The Latvian choice experiment
(Note: Each respondent received 12 such cards. Translation from original in Latvian and Russian)

	Program A	Program B	No additional actions
Reduced number of native species	No such areas	(on) Small areas	(on) Large areas
Water quality for recreation in coastal areas	Bad	Good	Bad
New harmful alien species establishing	Rarely	In exceptional cases	Often
Your yearly payment	5 LVL	2 LVL	0 LVL
Your choice:	○	○	○

COMMON TO ALL:

- Status quo (SQ) choice option with no environmental improvement
- Cost of each improvement option

UNIQUE TO EACH:

- Environmental choice attributes

➔ We thus model the effects of personality trait on SQ and cost for all three data sets; but only look at effects on environmental attributes for one (Latvia).

- Next, we reviewed the psychological literature on personality to see what predictions we could make about the effects of these 5 personality traits on preferences towards cost, the status quo, and improvements to environmental attributes.

Table 2: summary of predictions from psychology literature on expected effects of personality traits on preferences towards status quo option, cost and environmental attributes.

Personality trait	Expected effect on status quo (SQ)	Expected effect on preferences towards cost	Expected effects on preferences for environmental gains
Neuroticism	Individuals high in neuroticism likely to have stronger preferences for maintaining SQ	No prediction	No prediction
Conscientiousness	More conscientious individuals likely to have stronger preferences for maintaining SQ	More likely to avoid costly options, so expect higher sensitivity to price.	Stronger preferences for environmental improvements
Openness	Individuals scoring high on openness to experience likely to have weaker preferences for SQ	Less likely to avoid costly options, so expect lower price sensitivity.	Stronger preferences for environmental improvements
Agreeableness	No prediction	No prediction	Stronger preferences for environmental improvements
Extraversion	No prediction	No prediction	No prediction

Study design and implementation

- D-efficient choice Bayesian experimental design using pilot data
- For both Estonia studies, implemented using web-based surveys only
- For Latvia, combination of web-based and in-person

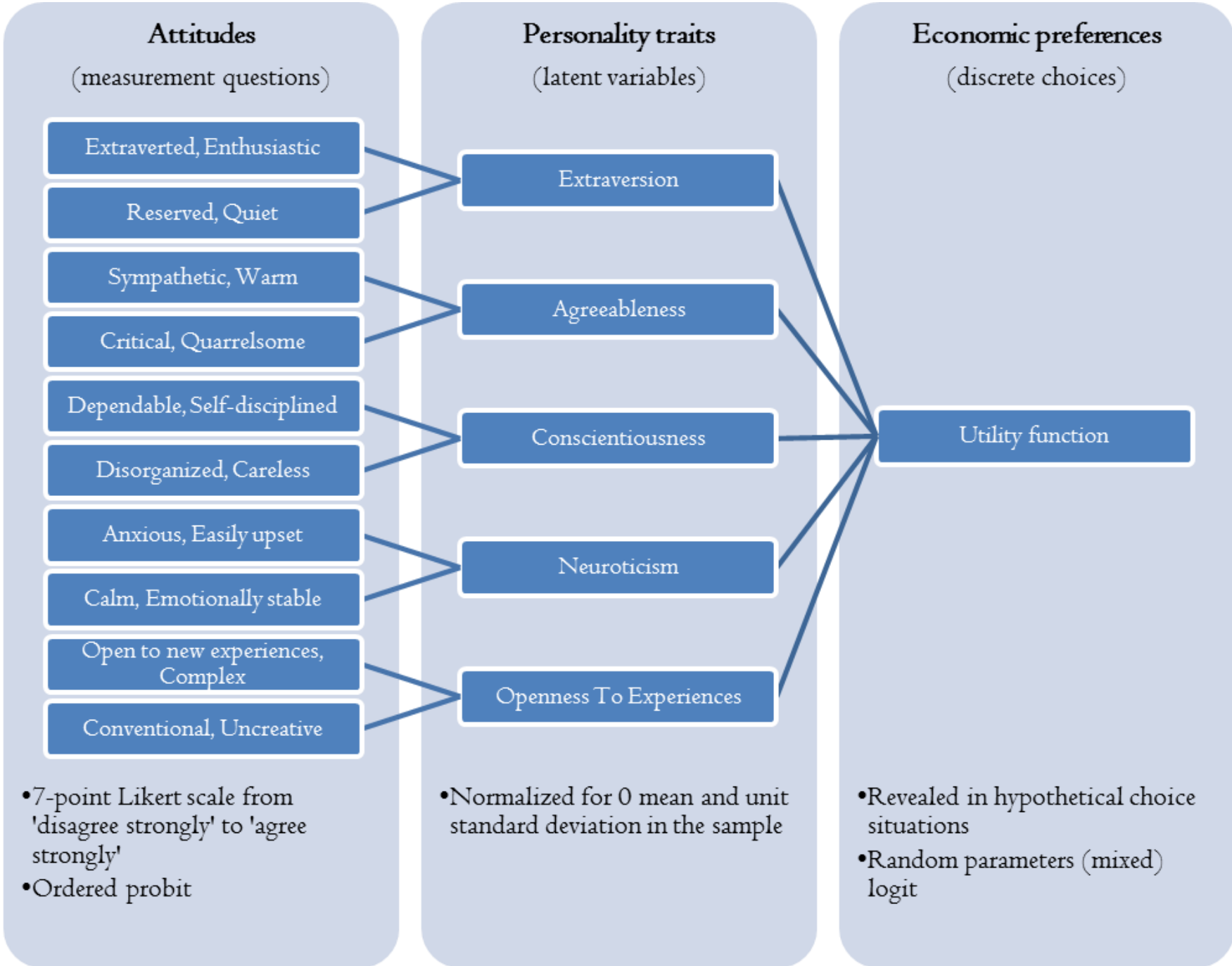
- Sample sizes: Latvia 1247. Estonia 1: 550 Estonia 2: 800.

40. To what extent do you agree or disagree the given statements applied to yourself? Please mark, on your opinion, for each pair of traits in the table the most corresponding to you option. Please mark the extent to which each pair of traits applies to you, even if one characteristic applies more strongly than the other.

I see myself as …	Disagree fully	Disagree moderately	Disagree a little	Neither agree nor disagree	Agree a little	Agree moderately	Agree fully
1. extraverted, enthusiastic	1	2	3	4	5	6	7
2. critical, quarrelsome	1	2	3	4	5	6	7
3. dependable, self-disciplined	1	2	3	4	5	6	7
4. anxious, easily upset	1	2	3	4	5	6	7
5. open to new experiences, complex	1	2	3	4	5	6	7
6. reserved, quiet	1	2	3	4	5	6	7
7. sympathetic, warm	1	2	3	4	5	6	7
8. disorganized, careless	1	2	3	4	5	6	7
9. calm, emotionally stable	1	2	3	4	5	6	7
10. conventional, uncreative	1	2	3	4	5	6	7

Modelling approach

- Hybrid mixed logit choice model
- assume that each respondent's personality can be described using five personality traits: Extraversion, Agreeableness, Conscientiousness, Neuroticism and Openness-to-Experiences.
- These traits are not directly observed – they are being modelled as latent (unobserved) variables.
- However, they can be indirectly measured because they drive responses to questions as to how individuals see themselves via a personality questionnaire
- the latent variables of our model also enter respondents' utility functions – they are interacted with all choice attributes to investigate differences in the economic preferences of people according to their personality traits


Attitudes
(measurement questions)
Extraverted, Enthusiastic
Reserved, Quiet
Sympathetic, Warm
Critical, Quarrelsome
Dependable, Self-disciplined
Disorganized, Careless
Anxious, Easily upset
Calm, Emotionally stable
Open to new experiences, Complex
Conventional, Uncreative
•7-point Likert scale from 'disagree strongly' to 'agree strongly'
•Ordered probit
Personality traits
(latent variables)
Extraversion
Agreeableness
Conscientiousness
Neuroticism
Openness To Experiences
•Normalized for 0 mean and unit standard deviation in the sample
Economic preferences
(discrete choices)
Utility function
•Revealed in hypothetical choice situations
•Random parameters (mixed) logit

advantages

- Only impose ordinal interpretation on individual's responses to the 7-point Likert scales which constitute responses to the personality questions;
- Secondly, each of the personality traits was measured using two attitudinal questions. Our framework accounts for the possibility that one of the questions is more efficient in measuring a particular personality trait than the other – each latent variable enters each of the two corresponding attitudinal questions with a separate coefficient, hence allowing for an independent relationship.
- Estimate the system simultaneously using FIML
- Recover information on how personality traits influence WTP for each attribute and the SQ

results

- First, we show how personality traits are related to preferences for SQ and towards costs

Choice model preference parameters

Observed effect for:	The alternative specific constant for the status quo		
	Latvia	Estonia 1	Estonia 2
Extraversion	-0.23	-0.62*	0.39**
Agreeableness	-0.57***	0.42	2.88***
Conscientiousness	0.12	0.06	-0.36*
Neuroticism	0.58***	0.20	0.96***
Openness To Experiences	-1.72***	-0.67**	0.00

Green – agrees with prediction
Red – disagrees with prediction
Black – no prediction

Findings on preferences for the Status Quo

- So neuroticism is predicted to increase preference for SQ, and does in 3 out of 3 data sets
- Openness to experiences predicted to decrease preferences for SQ, does no in 2 out of 3 data sets
- Conscientiousness has insignificant effect in 2 cases, and negative effect in 1 data set
- We made no prediction for extraversion – but it has a significant positive effect in one data set and a significant negative effect in another
- Similar finding for agreeableness.

Now the effects of personality trait on preferences towards cost

- Cost parameter usually interpreted as Marginal Utility of income
- Key to WTP estimates, as it is used as the numeraire to “convert” the preference parameters

Observed effect for cost coefficient:	Latvia	Estonia 1	Estonia 2
Extraversion	2.45***	0.31**	-2.52***
Agreeableness	1.15***	0.57***	-4.44***
Conscientiousness	0.25***	0.36**	1.40***
Neuroticism	0.01	0.04	-2.23***
Openness To Experiences	-2.05***	-0.22	-3.28***

Green – agrees with prediction
Black – no prediction

- So where we are able to predict whether a personality trait will increase sensitivity of choices to the price ticket (conscientiousness, openness to experiences), we see that the predicted effect occurs in all three data sets

- We also see significant effects for other personality traits: some inconsistent signs for extraversion and agreeableness (positive in one data set, negative in another)

Effects on willingness to pay for changes in environmental attributes

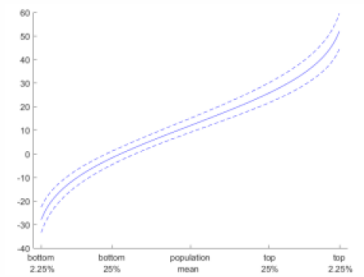
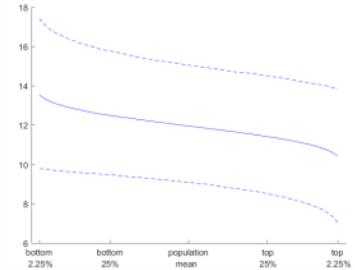
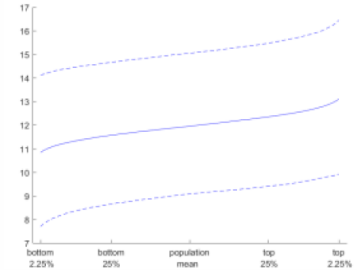
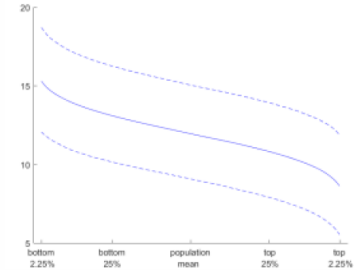
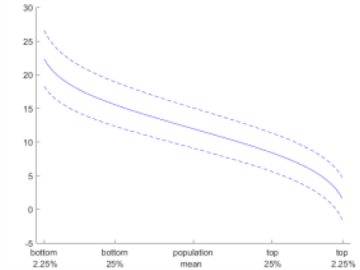
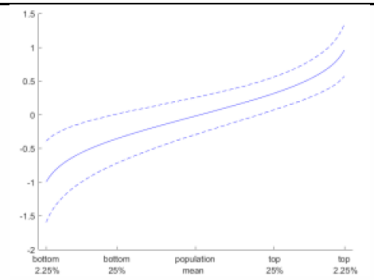
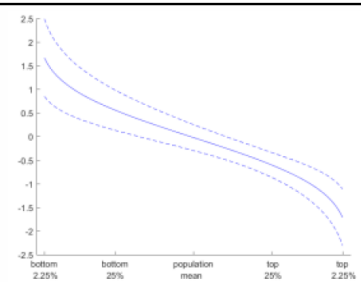
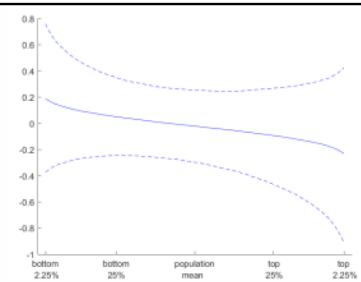
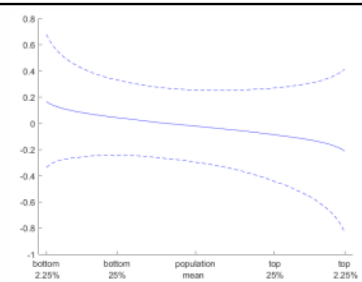
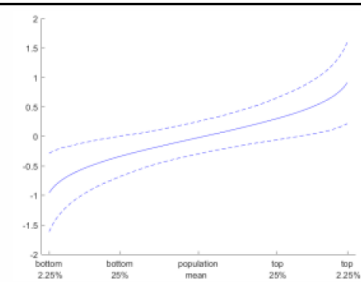
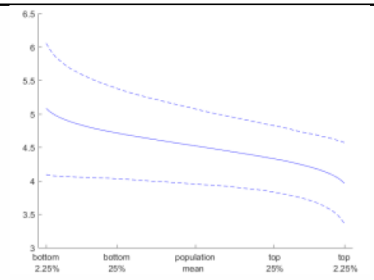
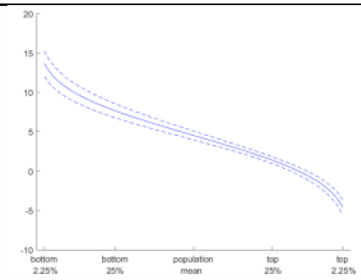
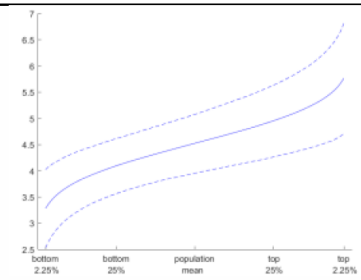
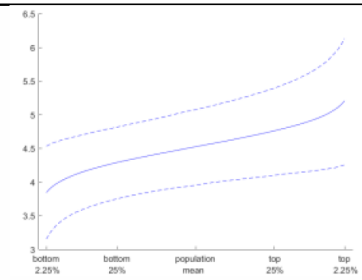
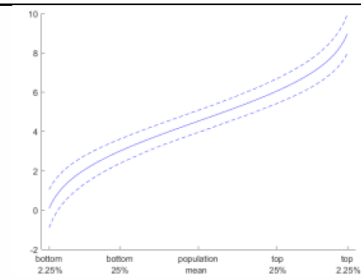
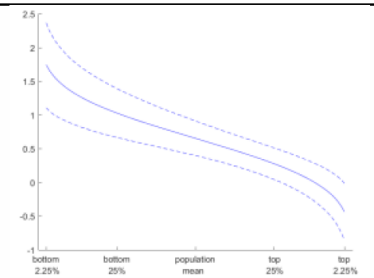
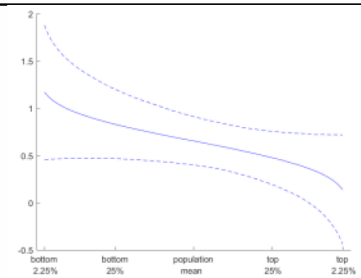
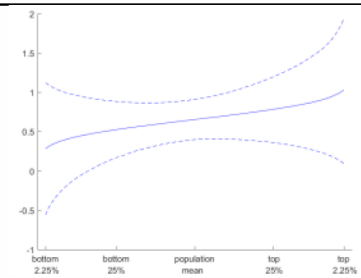
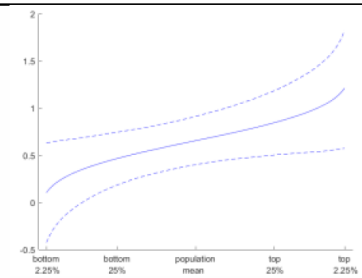
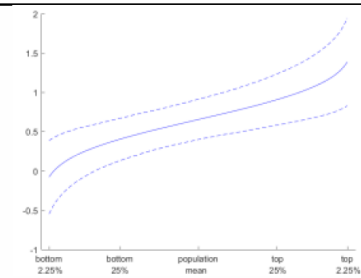
- Focus on one data set, as we cannot compare environmental attributes across studies (they are all different)
- We use the Latvia data set
  - *Areas experiencing losses of native species (over large areas; over small areas; no-where)*
  - *Summer water quality for swimming (bad, moderate, good)*
  - *New invasive species establishing populations (often; rarely; almost never)*

Table 4. Marginal WTP (EUR) of respondents in the Latvian choice experiment with different intensity of personality traits (95% confidence interval provided in parentheses)
In the case of the baseline we test if the values are significantly different than 0. In the other cases, we test for a significant difference with respect to the baseline

Attribute / Personality		**Status quo**	**Reduced number of native species**	**Water quality for recreation**	**New harmful alien species**
Baseline	population mean	11.93*** (9.08;15.02)	-0.02*** (-0.30;0.26)	4.52*** (3.96;5.08)	0.66*** (0.40;0.91)
Extraversion	1 s.d. below mean	-8.41*** (-11.71;-5.18)	-0.52*** (-0.94;-0.09)	4.80*** (4.06;5.55)	1.21*** (0.79;1.63)
	1 s.d. above mean	32.32*** (27.43;37.46)	0.48*** (0.21;0.74)	4.24*** (3.73;4.74)	0.10*** (-0.16;0.36)
Agreeableness	1 s.d. below mean	12.74*** (9.51;16.18)	0.84*** (0.32;1.36)	9.18*** (8.10;10.24)	0.92*** (0.47;1.37)
	1 s.d. above mean	11.14*** (8.23;14.24)	-0.88*** (-1.21;-0.55)	-0.14*** (-0.64;0.38)	0.39*** (0.06;0.73)
Conscientiousness	1 s.d. below mean	11.36*** (8.44;14.51)	0.09*** (-0.26;0.44)	3.88*** (3.33;4.44)	0.47*** (-0.01;0.94)
	1 s.d. above mean	12.51*** (9.53;15.65)	-0.13*** (-0.55;0.30)	5.15*** (4.38;5.91)	0.84*** (0.32;1.37)
Neuroticism	1 s.d. below mean	13.63*** (10.67;16.82)	0.07*** (-0.26;0.41)	4.17*** (3.62;4.73)	0.37*** (0.05;0.70)
	1 s.d. above mean	10.25*** (7.30;13.34)	-0.12*** (-0.54;0.30)	4.87*** (4.14;5.57)	0.94*** (0.53;1.35)
Openness To Experiences	1 s.d. below mean	17.22*** (13.91;20.78)	-0.50*** (-0.92;-0.08)	2.25*** (1.57;2.93)	0.28*** (-0.02;0.60)
	1 s.d. above mean	6.66*** (3.81;9.59)	0.45*** (0.02;0.89)	6.79*** (6.06;7.51)	1.03*** (0.65;1.39)

- So being one SD higher or lower than the mean for any personality trait has a significant effect on WTP for changes in *all* of the environmental attributes and *all* of the personality traits.
- Taking “agreeableness” as an example, and the “water quality for recreation” attribute, it can be seen that being one SD below the mean in terms of their score implies a marginal WTP of 9.18 euro per person per year
- WTP of a respondent with mean level of agreeableness is 4.52 euro.
- Being one standard deviation above the mean score for agreeableness implies a marginal WTP of -0.14 euro, so it actually becomes negative for these respondents.

- For openness to experience, being one SD below the mean score for this trait implies a WTP of 2.25 euro, relative to a baseline WTP of 4.52,
- whilst being one SD above the mean openness to experience score implies a WTP of 6.79 euro.

		Extraversion	Agreeableness	Conscientiousness	Neuroticism	Openness To Experiences
Marginal WTP (EUR) for	Status quo					
	Reduced number of native species					
	Water quality for recreation					
	New harmful alien species					

discussion

- We speculate that personality data can provide new insights on individual behaviour and values
- we present the first (?) examination of the effects of personality on individual economic choices over public goods, using a stated preference approach.
- We show using three, independent datasets from three separate choice modelling studies that personality helps explain preference heterogeneity and the heterogeneity of Willingness to Pay within an environmental choice context.

- Many of the predicted effects on preferences for the SQ and for price seemed to hold up
- Example: **openness** predicted the extent to which maintaining the status quo was preferred (negative interaction effect in 2 of the three datasets, the other insignificant) as well as the extent to which costs should be avoided (negative interaction effect in 2 of the three datasets, the other insignificant)
- Example: **Conscientiousness** was found to predict the extent to which choices with lower costs were preferred (positive interaction effect in all three datasets) as predicted.
- However, we found limited evidence that conscientious individuals were more likely to prefer the status quo as predicted (a negative interaction effect, as opposed to an expected positive interaction in 1 of the three datasets, the others being positive but insignificant).

- we also found that other personality traits interacted consistently across datasets with the status –quo and cost attributes.
- In particular, **extraversion** was linked to preferences for maintaining the status quo (negative interaction effect in two of the datasets, and positive in the other); as well as the extent to which costs should be avoided (positive interaction effect in 2 of the three datasets).

So what?

So what?

- (environmental) economists have been searching for satisfactory explanations of the heterogeneity in preferences and values
- Economists have used knowledge, socio-economic variables such as income and age, spatial location, attitudes as possible drivers….(*in another paper, we looked at emotions as another possibility..)*
- We add personality to this mix – and it seems to have something to tell us.
- Moreover, adds an extra dimension to thinking about the distribution of the costs and benefits of a policy
- Whilst it also casts light on why people do not vote for environmental improvements. For instance our work suggest that it is not simply because some individuals don’t care about the environment; but perhaps because they have higher concerns for costs and feel less secure when things change, depending on their personality type.

Contact:

Nick Hanley (ndh3@st-andrews.ac.uk)