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# PERSONALITY AND ECONOMIC CHOICES

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**Abstract**

In this paper, we undertake the first examination of the effects of personality on individual economic choices over public environmental goods, using a stated preference approach. Based on three data sets from three separate choice modelling studies, we examine the effects of personality on preferences for the status quo, for changes in environmental quality, and over the costs of investing in environmental improvement. Using a hybrid choice framework, we show that incorporating personality research into economic models can provide valuable behavioural insights, enriching explanations of why the demand for environmental goods varies across people.

**Keywords:**

personality, preference heterogeneity, hybrid choice models, stated preferences, choice models

**JEL:**

C35, D03, D12, D61, Q25, Q51

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## 1. Introduction

In a recent paper, Boyce *et al.* (2016b) 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 (an area of psychology focusing on *individual differences* in reaction) has the potential to instigate a second wave of behavioural economics to predict individual-specific reactions to economic circumstances."

In this paper, we undertake the first examination of the effects of personality on individual economic choices over public environmental goods, using a stated preference approach. We examine the potential for personality traits to explain preference heterogeneity within an environmental choice context. Based on three data sets from three separate choice modelling studies, we examine the effects of personality on preferences for a change in the status quo, for changes in environmental quality, and over the costs of investing in environmental improvement. We show that incorporating personality research into economic models can provide valuable behavioural insights, since it allows a previously-unexplored class of influences on preference heterogeneity to be modelled, thus enriching explanations of why the demand for environmental goods varies across people.

## 2. Why personality?

Personality is typically defined as patterns of thought, feelings and behaviour that persist from one situation to another (Wood and Boyce, 2014). Personality research spans several decades (Winter and Barenbaum, 1999) and in part originated out of a need to understand how individuals might be expected to react and respond in various situations (John *et al.*, 2008). This body of work gave rise to the influential 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.

The importance of personality for a range of life outcomes is now well established (Borghans *et al.*, 2008; Ozer and Benet-Martínez, 2006). Personality has been shown to help explain a number of important behaviours and outcomes, including wage bargaining (Mueller and Plug, 2006; Nyhus and Pons, 2005), occupational success (Judge and Ilies, 2002), unemployment duration (Egan *et al.*, forthcoming; Fletcher, 2013; Uysal and Pohlmeier, 2011), and well-being reactions to socio-economic events such as unemployment (Boyce *et al.*, 2010), retirement (Kesavayuth *et al.*, 2016), marriage (Boyce *et al.*, 2016a), and disability (Boyce and Wood, 2011b). This body of research has led to a number of economists arguing that personality research needs to be integrated both theoretically and empirically into economic research (Borghans *et al.*, 2008; Rustichini *et al.*, 2012). In their recent paper Boyce *et al.* (2016b) make the case that personality could have important implications for the behavioural sciences in particular with regard to their finding that one personality trait – conscientiousness – is important in determining the extent to which people are loss averse, though an examination of the effects of income gains and losses on subjective well-being.

However, despite the increased use of concepts from psychology to understand economic behaviour (Thaler and Sunstein, 2009), most economists remain unfamiliar with personality research and with how personality might be measured. This, and a lack of validated personality measures in large household panel surveys typically used by economists, has acted as a barrier to incorporating personality measures into a wider economic framework. Personality, however, can be measured quite easily by administering individuals with a self-report questionnaire that is designed to elicit what kind of person they are in general, and how they view the world. For example, an individual might be asked to indicate the extent to which they are someone who generally has a "forgiving nature", or "tends to be lazy". Such scales are widely used in psychology and undergo extensive validation exercises to ensure the scales measure what they are claimed to measure and are relatively consistent across behavioural contexts (Wood and Boyce, forthcoming).

In our study we make use of the Ten Item Personality Inventory (TIPI) which was designed, developed, and validated by Gosling *et al.* (2003). The TIPI, which is much less time-consuming to implement than many Five Factor scales, has been developed specifically to enable personality to be measured under severe time-constraints. It has been used and validated in numerous studies (see e.g., Chamorro-Premuzic *et al.*, 2007; Heller *et al.*, 2007; Westmaas *et al.*, 2007). We asked

participants carrying out three separate stated preference discrete choice experiments concerned with prospective changes in coastal and marine water quality conducted in Estonia (two studies) and Latvia to also compete the TIPI, after they had responded to a series of economic choice tasks. We then used this measure of personality to determine whether personality helps understand how preferences for environmental change vary across participants. The next section gives more details of the choice experiments within which the TIPI questions were implemented.

## 3. Design of the choice experiments

Choice modelling is now a very widely-used technique in economics, marketing and transportation research to understand and predict preferences and demand for a very wide range of goods, services and policies (Carson and Czajkowski, 2014; Hanley and Barbier, 2009). The approach derives its theoretical support from random utility theory and the characteristics theory of value. We designed and implemented three separate choice experiments in Latvia, and Estonia (two studies). All three focused on different aspects of the marine and coastal environment. The studies were designed according to the state-of-the-art recommendations to mitigate hypothetical bias, i.e. respondents were assured about a survey consequentiality (results presented to policy makers informing their decisions) and each scenario used coercive payment mechanism (Carson and Groves, 2007; Carson *et al.*, 2014; Johnston *et al.*, forthcoming). Table 1 summarises the nature of these choice experiments, and Figure 1 shows an example choice card. In each choice task, respondents are asked to make choices from three options described using these attributes and the cost of providing public goods at these levels. One choice option was always a zero-additional-cost opt-out which was associated with no environmental improvement over a baseline. Personality questions, along with a standard set of demographic questions, were asked after the choice tasks were completed. In all cases, we used a Bayesian D-efficient experimental design to construct the choice scenarios, based on priors obtained from pilot study data (Scarpa and Rose, 2008). Where internet sampling was undertaken, samples representative of the national population were recruited from on-line consumer panels maintained by a market research company.

*Latvia*

This study focused on changes to marine and coastal ecological quality off the coast of Latvia. The environmental attributes used to form the choice sets were losses in native biodiversity (described as the areas over which this reduction would take place); water quality in summer in swimming areas (which is adversely affected by nutrient pollution and algal blooms); and invasive, harmful species (described in terms of the frequency of their establishment). The price attribute was increasing national taxes. The survey was undertaken in 2013, and a full account can be found in Pakalniete *et al.* (2017). The sample size was 1,247 people, and the data was collected by a mixture of internet panel-based questionnaires and in-house interviews with random samples of the general public. We did not rely entirely on internet sampling in Latvia, as internet access is quite low (less than 60%) for people in the over 55 age group.

*Estonia study 1*

This study was concerned with changes to pollution and biodiversity in the Baltic Sea off the coast of Estonia. The environmental attributes used to construct the choice sets were oil spills (their frequency, and the probability that a spill would reach the shoreline which could be altered by investing in oil spill clean-up ships and equipment); water quality impacting on recreation, where pollution originates from nutrient inputs such as fertiliser run-off and domestic sewage; and the arrival rate of invasive, non-native species. The cost attribute was again a rise in national income tax. Some 550 responses were collected using an on-line survey in 2013. Full details are in Tuhkanen *et al.* (2016).

*Estonia study 2*

This study was concerned with public preferences over the management of marine areas within Estonian national waters. The three management options were considered in two locations, namely (i) construction of a conventional off-shore windfarm; (ii) creation of an "environmentally-friendly" windfarm on the same site; and (iii) designating the site as a marine protected area. The cost attribute was an increase in national income taxes. The data was collected using a web-based survey in 2013, with 800 members of the general public. Full details can be found in Karlõševa *et al.* (2016).

Table 1: summary of choice experiment design in the three data sets. For full information on how these attributes and choice options were described to respondents, please see original source paper.

| | 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. |

Figure 1. Examples of the choice tasks used.

1A. the Latvian choice experiment

| | **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:** | ○ | ○ | ○ |

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

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)

4. Anticipated effects of personality on preferences.

All three choice experiments described above were primarily designed to address important environmental problems in the marine and coastal waters of Estonia and Latvia. In each choice experiment, there are two common components upon which personality might be expected to have a systematic influence: the availability of a status quo baseline option, which involves no additional payment by an individual, resulting in no improvements in coastal and marine environmental quality; and the cost to the individual of choosing any non-status quo option. Across all three data sets we can thus examine the effects of an individual's personality on their tendency to prefer maintaining the status quo i.e. to generally prefer no change in environmental quality, and second, their tendency to prefer choices with the lowest private cost.

In addition, where there are clear pro-environmental choices within the choice sets, we can investigate the effects of personality on preferences for specific environmental attributes. To explore whether personality is linked to pro-environmental attitudes we use just one data set (Latvia). This makes our examination more concise since one cannot compare non-price attributes across the three choice experiments as the environmental attributes differ. Preference interaction results for the other two studies are available in appendix 2.

We now summarise what effects could be expected to emerge from incorporating personality interactions into the choice experiment analysis, based on the personality literature in psychology

and behavioural science. Predictions on the effects of personality traits on strength of preference towards the status quo, cost and specific environmental attributes are summarised in Table 2.

*4.1 Expectations for preferences toward the status quo*

In many decision tasks there is a well-known tendency for individuals to disproportionately prefer to maintain the status quo (Samuelson and Zeckhauser, 1988) and several personality traits have been associated with this tendency. Status quo bias has often been explained by a general preference to avoid losses, such that individuals tend to prefer what they have to what they could obtain (Kahneman *et al.*, 1991). Some individuals may be more likely to have an adverse reaction to loss than others and this can depend on personality. For example, those that are high in neuroticism (prone to anxiety, depression, and emotional instability), have been found to be more sensitive to a loss than those low in neuroticism (Hartley and Phelps, 2012) and thus may be more susceptible to acute stress responses (Nettle, 2006). Neurotic individuals may therefore have a stronger desire to prefer to maintain the status quo than those that are less neurotic. Conscientious individuals are generally cautious, orderly, and dutiful (Costa *et al.*, 1991), and at the extreme are characterised as somewhat rigid in thought (Nettle, 2006). Thus it seems likely that conscientious individuals will also have a stronger preference for maintaining the status quo. Consistent with this it has been demonstrated that under certain conditions the classic loss aversion effect is stronger among conscientious individuals (Boyce *et al.*, 2016b). Contrastingly, individuals that score high on openness-to-experiences place higher importance on adventure and action (McCrae and Sutin, 2009) and are more likely to be curious (Nettle, 2006) and seek creative solutions to problems (George and Zhou, 2001). Thus individuals who score high on openness-to-experiences are less likely to have a preference for the status quo. In line with this prediction, individuals who score high on openness-to-experiences are less likely to socially conform (Lee *et al.*, 2010).

To summarise we hypothesise that individuals who are high on neuroticism or high on conscientiousness will have a tendency to opt for the status quo. Those high on openness are predicted to be less likely to want to maintain the status quo. There is no strong a priori reason to expect people who score high with regard to the other personality traits (extraversion and agreeableness) to prefer the status quo option. However, such personality traits might still have a significant effect on preferences towards the status quo option owing to people's preferences for

the environmental attributes specific to each of the studies, and thus with the consequences of voting for the status quo.

*4.2 Expectations for sensitivity to cost*

Individuals high in openness tend to value intellectual pursuits over profit seeking (Renner, 2003) and it has been shown that income changes have lower effects on well-being for those that have high levels of openness (Boyce and Wood, 2011a). We therefore expect that those who are high in openness will be less likely to avoid choices that have a high personal cost. Those that are conscientious, on the other hand, tend to place a high value on wealth accumulation (Ameriks *et al.*, 2003; Ameriks *et al.*, 2007) and also tend to value economic over non-economic goals (Roberts and Robins, 2000). Thus they are likely to be less willing to choose options with high personal cost. In line with this it has been demonstrated that an income loss has a larger impact on well-being among the highly conscientious than those less conscientious (Boyce *et al.*, 2016b).

There is no strong a priori reason to expect the other personality traits, extraversion, agreeableness, and neuroticism, to be sensitive to cost. As with the status quo option, such personality traits might still interact significantly with the costs option owing to preferences for the environmental attributes specific to each of the studies. However, it is not possible to predict the sign of this effect from the psychological literature.

*4.3 Expectations for specific environmental attributes*

Researchers have begun to explore the extent to which personality predicts the strength of environmental concern in an individual. Several traits have been implicated, most notably agreeableness (the tendency for an individual to be trusting, altruistic and compliant) (Costa *et al.*, 1991) and openness are related to having a higher concern for the environment (Hirsh, 2010; Hirsh, 2014; Markowitz *et al.*, 2012). Thus we hypothesize that individuals who indicate they have high levels of agreeableness and openness will more likely make choices that benefit the environment, and thus show stronger preferences for the environmental improvements within each choice experiment than other individuals. Pro-environment behaviours, such as whether an individual engages with recycling schemes, have been shown to depend on conscientiousness, agreeableness

and openness (Milfont and Sibley, 2012; Swami *et al.*, 2011). Thus conscientious individuals may also be more likely to make stated choices that relate to environmental improvements.

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 |

## 5. Modelling approach

To analyse the stated choice data in the context of personality trait information we use the hybrid mixed logit model (HMXL), a structural econometric model that allows us to link ordinal responses to the personality questions to respondents' economic choices (Czajkowski *et al.*, forthcoming-a; Czajkowski *et al.*, forthcoming-b; Hess and Beharry-Borg, 2012). At the heart of the empirical modelling lies the assumption 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

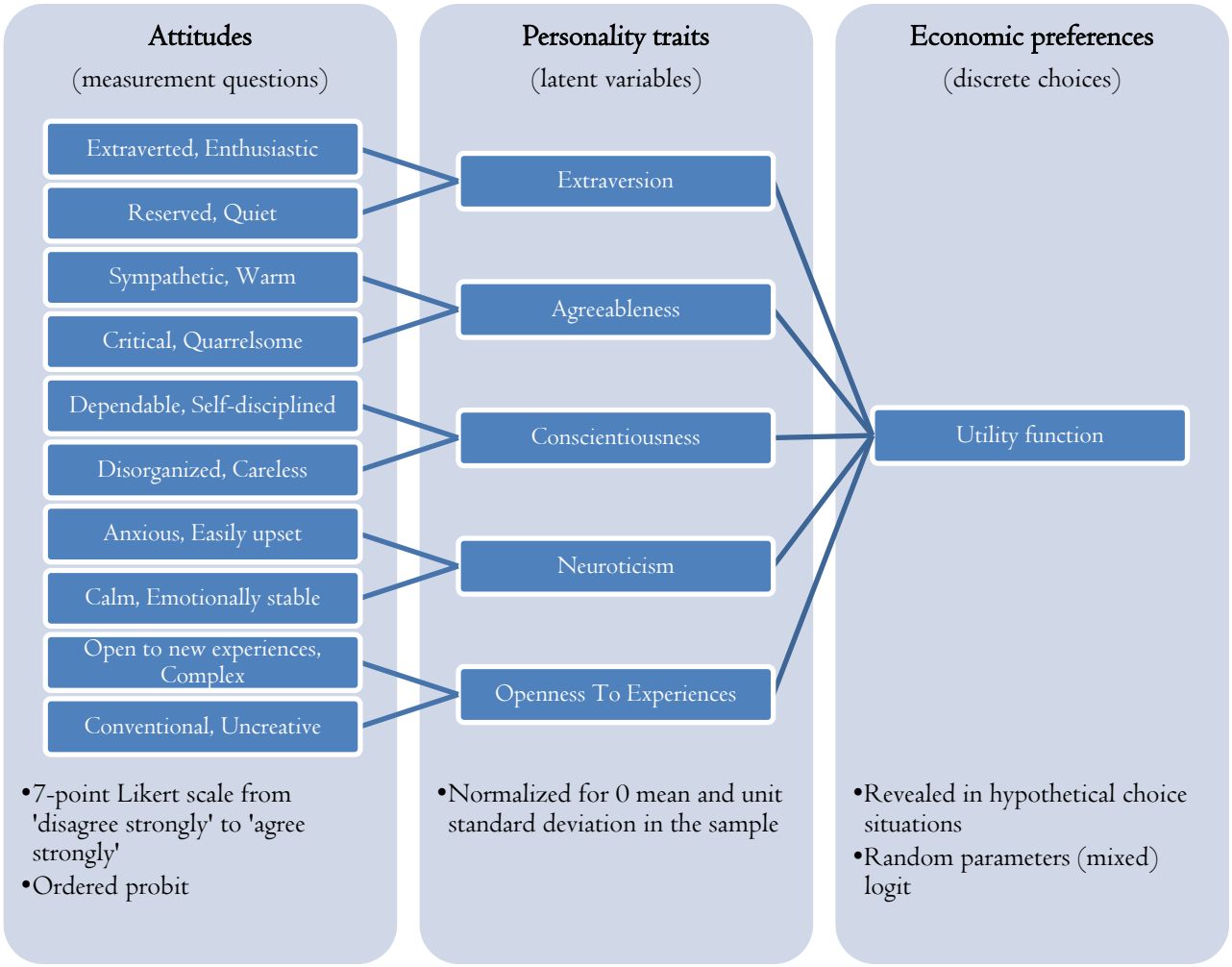
(unobserved) variables. However, they can be indirectly measured because they drive responses to questions as to how individuals see themselves in personality questions. In our survey we included ten such questions, designed specifically to measure personality and extensively used in psychology (Gosling *et al.*, 2003). As detailed in Section 4, people who score high or low on particular personality traits can be expected to differ from the remainder of the population with respect to their economic preferences. To this end, 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. The general structure of the model is presented in Figure 2, while the technical details are provided in Appendix 1.

The econometric framework we use has several advantages. First of all, the personality question responses were collected using 7-point Likert scales (see Annex). It is common in the psychometric literature to impose an absolute interpretation on these Likert-scale responses. Instead, our structural model uses an ordered probit component to model these answers which recovers the ordinal nature of the response scale without imposing other restrictions. This way we do not over interpret the responses and avoid potential bias resulting from modelling responses using e.g., linear regression (Greene, 2011).[1] Secondly, each of the personality traits was measured using two attitudinal questions (so 5 traits imply 10 questions). It is common practice to assume that each of the attitudinal questions has equal weight, for example by simply adding up (following possible reverse coding as necessary) responses to each of the two questions corresponding to the same trait (e.g., Gosling *et al.*, 2003). Our framework, however, accounts for the possibility that one of the questions is more efficient in measuring a particular personality trait than the other – each latent

[1] Instead, many studies assume linear relationship between responses (i.e. assume equal distance between response scales), for example interpreting 'I disagree strongly' as 1, 'I disagree moderately' as 2 and so on. This is a very strong assumption to impose, since the differences between response categories are much subtler and while there could be very little difference between 'I disagree strongly' and 'I disagree moderately', there could be much more difference between 'Neither agree nor disagree' and 'Agree a little'. Using the ordered probit model does not impose this assumption – it uses ordinal scale to interpret responses and flexibly sets the thresholds between neighboring responses.

variable enters each of the two corresponding attitudinal questions with a separate coefficient, hence allowing for an independent relationship. Finally, all components of our structural model are estimated jointly, i.e. the model uses full information log-likelihood function. Many other studies have employed a two-step approach, in which for example individual factor scores are derived first and then interacted with utility function parameters (e.g., Boxall and Adamowicz, 2002; Milon and Scrogin, 2006; Nunes and Schokkaert, 2003; Salomon and Ben-Akiva, 1983). By doing this simultaneously our model is statistically more efficient.

Figure 2. Structure of the HMXL model




## 6. Results

The data collected from the three case studies described in section 3 was analysed using the HMXL model outlined in section 5. The detailed estimation results and their interpretation are provided in Appendix 2.[2] In what follows, we focus on verifying the effect of personality traits on preferences

[2] The datasets, additional results and estimation codes are available from the authors upon request.

towards the status quo and cost sensitivity across all three datasets. We then then use only the Latvian dataset to investigate the effects of personality traits for WTP for all choice attributes.

*6.1 Preferences towards the Status Quo and cost attributes*

The alternative specific constant associated with the status quo represents respondents' preferences towards any change relative to the baseline situation presented in each choice experiment. The cost coefficient shows how peoples' choices respond to variations in the cost to the respondent of each choice alternative and corresponds to their marginal utility of income. Overall, we observe that personality does correlate with individual's preferences for the status quo and for the cost attribute. These findings are summarized in Table 3, and can be compared to the anticipated effects shown in Table 2. Although the coefficients presented in Table 3 do not have direct interpretations in absolute terms (their absolute levels should not be compared between studies), their signs and relative values indicate the correlation with specific personality traits and the strength of their relative influence. Coefficients whose sign (though are not necessarily statistically significant) are in line with our expectations are marked green, whilst coefficients that do not are marked red.

Table 3. Personality traits and economic preferences for status quo and cost – summary of findings

| Observed effect for: | The alternative specific constant for the status quo | | | Cost coefficient | | |
|---|---|---|---|---|---|---|
| | Latvia | Estonia 1 | Estonia 2 | Latvia | Estonia 1 | Estonia 2 |
| Extraversion | -0.23 | -0.62* | 0.39** | 2.45*** | 0.31** | -2.52*** |
| Agreeableness | -0.57*** | 0.42 | 2.88*** | 1.15*** | 0.57*** | -4.44*** |
| Conscientiousness | 0.12 | 0.06 | -0.36* | 0.25*** | 0.36** | 1.40*** |
| Neuroticism | 0.58*** | 0.20 | 0.96*** | 0.01 | 0.04 | -2.23*** |
| Openness To Experiences | -1.72*** | -0.67** | 0.00 | -2.05*** | -0.22 | -3.28*** |

*Notes*: ***, ** and * indicate significance at the level of 1%, 5%, and 10%, respectively.

Consistent with our expectations, in at least 2 out of the 3 datasets we find that respondents who are more open to experiences are also significantly less likely to prefer the status quo (i.e., no new policy), and have lower marginal utility of income. Similarly, respondents who are more neurotic are also more likely to prefer the status quo in all of our datasets (2 being statistically significant). Conscientiousness does not seem to positively correlate with stronger preferences for the status

quo, and in fact in the case of one dataset the correlation is significantly negative: this runs counter to a priori expectations.[3] On the other hand, more conscientious respondents are consistently 'more careful with money', i.e. their choices reveal significantly higher sensitivity to cost increases in all three datasets.

In addition, we observe some effects of personality for which we do not have clear expectations. Extraversion is negatively related with the preferences for status quo in Estonia 1 study, and negatively in Estonia 2 study. In the case of 2 datasets, the marginal utility of income for those scoring high on extraversion is greater (and hence their WTP lower), while in the case of Estonia 2 dataset – it is actually lower (implying higher WTPs). The effects of agreeableness for the observed preferences for status quo and the cost parameter are statistically significant, but mixed – the effect is different for different datasets.

Overall, we conclude that our expectations regarding the influence on estimated preferences of openness to experiences and neuroticism are confirmed. In the case of conscientiousness, we find consistent (and expected) effects for cost sensitivity, but not for the preferences towards keeping the status quo. We also observe other effects of personality traits – for these we do not have a priori expectations based on findings in the psychological literature. However, these effects likely depend on individual perceptions of specific environmental attributes used in the three experiments.

### *6.2 Willingness to pay for environmental improvements*

Next we focus on one of our cases studies, Latvia, to explore the role of personality in predicting preferences and Willingness To Pay (WTP) for changes to specific environmental attributes through which the policy options are described to respondents. Note that the effect for WTP is not straightforward – for example, if we expect that more conscientious respondents care more about some environmental attributes, but are also more sensitive to the cost of providing these environmental goods, then their WTP could be either higher or lower than average, depending on

[3] Because the status quo alternative in the case of this study represented no development (neither erecting wind park nor establishing marine protected area) it is possible that it was perceived differently than in the other two studies, where the status quo alternative was a clear 'no improvement' option.

which of the effects prevails (since WTP is defined as the ratio of the cost parameter to the relevant preference parameter).

The results of the model in which personality traits are interacted with all choice attributes are presented in Appendix 3. To facilitate interpretation, the model is estimated in WTP-space (Train and Weeks, 2005), so that the attribute coefficients in the choice model can readily be interpreted as respondents marginal WTP for specific attributes. Table 4 presents the simulated mean WTP for each of the attributes. The 'baseline' WTP represents all respondents in the sample, i.e. WTP for someone with mean scores for each personality trait. Next, we illustrate the effect of personality by simulating WTP of someone who would be 1 standard deviation above or below the population mean for each of the personality traits.

Table 4. Marginal WTP (EUR) of respondents in the Latvian choice experiment with different intensity of personality traits (95% confidence interval provided in parentheses)

| 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) |

*, **, *** represent statistical significance of the difference with respect to the baseline at the 0.1, 0.05, 0.01 level. 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.

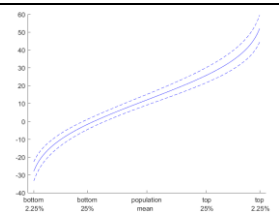
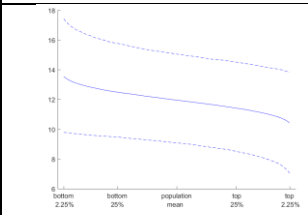
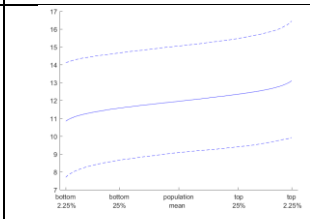
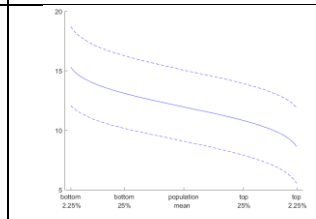
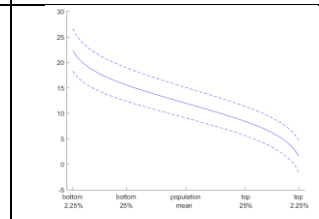
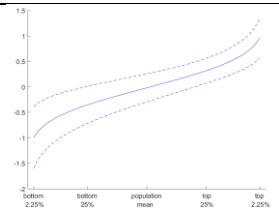
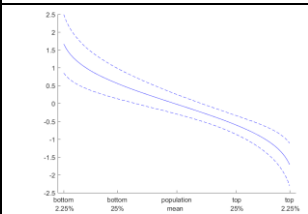
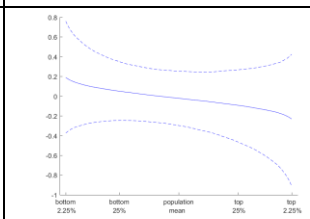
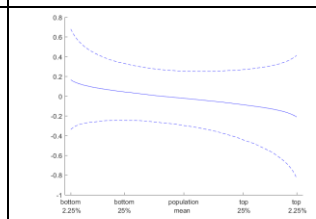
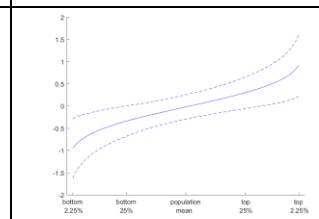
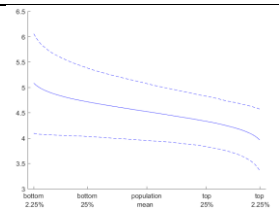
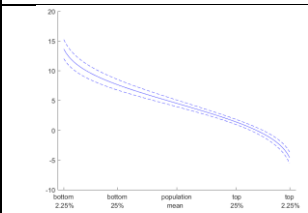
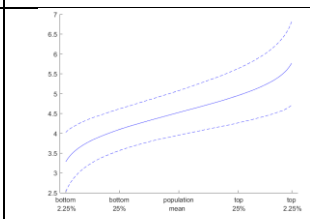
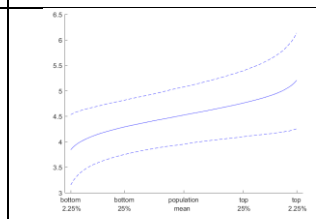
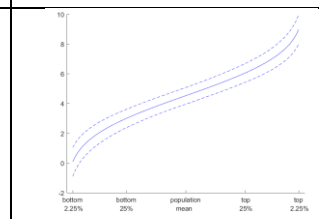
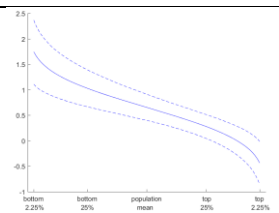
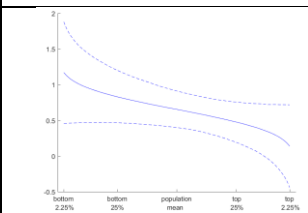
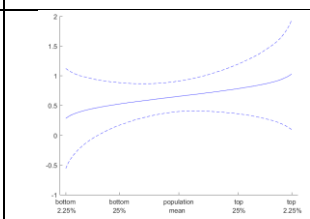
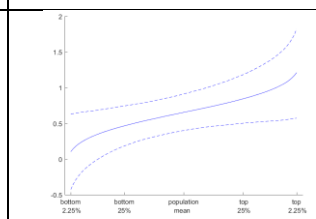
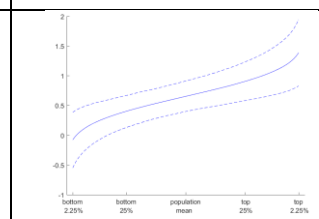
Overall, these results provide an indication of possible WTP changes associated with the differences in respondents' personality traits for the three environmental attributes used in the Latvian study. In the first row of the table, we show that the average of WTP for improvements in each attribute is significantly different from zero: people state that they are willing to pay higher taxes for each of these environmental improvements. In the remainder of the table, the effects of a change in each personality trait (by one standard deviation above and below the mean level this trait) on this baseline WTP value can be seen. Taking "agreeableness" as an example for personality trait and the "water quality for recreation" attribute, it can be seen that being one SD below the mean in terms of their agreeableness score implies a marginal WTP of 9.18 euro per person per year (WTP of a respondent with the mean level of agreeableness is equal to 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 respondents who score low on this personality trait. 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.

The simulation presented here shows that differences in personality traits can lead to significant changes in respondents' preferences and WTP. In this case, being one SD above or below the mean level of each personality trait leads to statistically significant differences in WTP relative to the baseline. Interestingly, high or low enough personality trait scores can even lead to reversing the sign of WTP, i.e. changing the attribute from a 'good' to 'bad'. Although a specific score for an individual on one of the personality traits may produce a low or negative WTP it is possible that this effect may be cancelled out or minimized through the individual also having a score on another personality trait. For example, an individual might have a neuroticism score one standard deviation below the mean that results in them less likely to be willing to maintain the status quo, but have a conscientious score one standard deviation above the mean which may make them simultaneously more willing to maintain the status quo giving them a WTP that doesn't deviate much from the average. Likewise, however, an individual may be equally likely to have a personality profile that results in cumulative negative influence on their WTP.

Overall, personality provides an important means for explaining heterogeneity in preferences and WTP values. In addition to the results presented in Table 4, Figure 4 presents graphical illustration

of how marginal WTP for each of the attributes change with individual respondents' personality traits (relative to the population mean). Large WTP changes and narrow confidence intervals correspond to observing relevant personality effects.

Figure 4. Marginal WTP (EUR) of respondents with different intensity of personality traits

| | | 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 |  |  |  |  |  |

## 7. Discussion and Conclusions

Personality research has a long history in psychology (McCrae and Costa, 2008) yet the potential for personality to inform economic analysis has only just begun to be recognized (Almlund *et al.*, 2011; Borghans *et al.*, 2008; Rustichini *et al.*, 2012). It has been suggested that personality research may even help instigate a second wave of behavioural economics by enabling researchers to better understand individual differences in economic behaviour (Boyce *et al.*, 2016b). Here 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. Even if hypothetical bias results in an inflation of WTP values, the relative changes in stated WTP produced by variations in personality trait are striking and meaningful.

Specifically, we demonstrated that personality plays an important role in predicting whether an individual has preferences to maintain the status quo and to avoid choices that improve environmental quality at a cost to the respondent. Given previous research in psychology, we predicted that individuals with lower levels of openness to experience, higher levels of neuroticism, or higher levels of conscientiousness would have a tendency to opt for the status quo. We also predicted that those with higher levels of conscientiousness or lower levels of openness would be more sensitive to cost. In the three independent data sets used here, we found openness predicted the extent to which maintaining the status quo was preferred (negative interaction effect in 2 of the three datasets, the other positive but insignificant) as well as the extent to which costs should be avoided (negative interaction effect in 2 of the three datasets, the other insignificant). We also found, as predicted, that neuroticism was linked to preferences for the status quo (negative interaction effect in 2 of the three datasets, the other insignificant). 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 (a negative interaction effect, as opposed to an expected positive interaction in 1 of the three datasets, the others being positive but insignificant). However, the tendency to want to maintain the status quo is dependent upon an individual's goal orientation (Chernev, 2004), and since conscientious individuals have a tendency

to be highly motivated (Judge and Ilies, 2002) and goal focused (Barrick *et al.*, 1993), those individuals that are conscientious and particularly value the goal in question (e.g., a cleaner marine environment), may instead be highly averse to the status quo – which in two of our data sets is clearly linked to a relatively poor level of environmental quality.

Unexpectedly, we also found that other personality traits interacted across datasets with the status –quo and cost attributes. In particular, extroversion was linked to maintaining the status quo (negative interaction effect in all 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, the other negative). There were also some effects from those scoring higher on the trait of agreeableness, but these were inconsistent across the dataset. These unexpected and inconsistent significant results are likely to have arisen owing to preferences for the environmental attributes specific to each of the studies. For example, extraverted or agreeable individuals may have preferred attributes that varied across the choice experiments but had differing personality-specific consequences (e.g. better water quality for sea swimming) that resulted in them being more likely to select a study-specific attribute rather than be in favour or against the status quo option per se. We did however predict that agreeable individuals, along with those that were more open or conscientious, would have stronger preferences for environmental improvements. We found that indeed WTP for environmental improvements was generally higher among those with higher levels of openness, agreeableness, and conscientiousness. We additionally found that extraversion played an important role in explaining individual differences in WTP. Indeed, being one SD above or below the mean personality score for each personality trait was associated with a significant difference in marginal WTP for all of the environmental attributes in the Latvian study.

Overall, our results have important implications for choice modelling. Status-quo and cost variables are nearly always included in choice models, and since preferences for these vary by personality type our research demonstrates that personality has the potential to enrich these types of models. Although choice modelling may give some sense of an overall population-level valuation, such average effects may reflect an amalgamation of individuals with a huge diversity of valuations. Whilst some individuals may have particularly high WTP, others may have low WTP, or even need to be compensated. Thus the implementation of any policy may be more successful were it to take account of variations in the personality traits of the population. A one

size fits all approach may result in discontent from some of the population and indeed some may believe that their views have not been considered at all. However, it is not clear how one would operationalise this concern in future studies, since personality trait is not something one could build a sampling strategy on. More likely is the wider use of personality measures to do a better job of explaining heterogeneity in WTP values across a sample of those likely to be affected by a policy change.

Finally, one might speculate that including personality traits will routinely improve the fit of stated choice models. We tested for this, comparing the improvement in fit in a model which includes personality traits versus one which did not. We found only a small improvement (1-2%) in the McFadden or Lerman pseudo R2 measures across all three data sets from including personality traits in the model. Interestingly, though, this was about the same as the improvement in fit from including standard socio-demographic variables such as income and education in the models.

In conclusion, our research helps highlight which individuals care more about the environment and may have a higher demand for environmental public goods. We show that agreeableness, openness, and conscientiousness all have an important role to play in shaping concerns about the environment but also additionally show that extraversion may also be important. Focusing on the effects of personality on stated preferences and WTP may help an understanding of how environmental improvements can be best achieved, of the distribution of benefits and costs, and highlight possible behavioural difficulties in implementing such environmental improvements. Successful implementation of environmental improvements may come about not simply by demonstrating aggregate benefits but also through minimizing personal costs and helping individuals feel more comfortable with change. Our research also highlights that two individuals, having similar WTP values for a given environmental change, may have arrived at these values for different behavioural motivations. This enriches explanations of why the demand for environmental goods varies across people, and highlights how integrating insights from personality psychology may instigate a second wave of behavioural economics that better explains individual differences in economic behaviour (Boyce *et al.*, 2016b).

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Appendix 1. Technical details of the hybrid mixed logit model

Discrete choice modeling is based on the random utility model (McFadden, 1974). In this framework, the utility function of consumer $i$ from choosing alternative $j$ at choice situation $t$ can be expressed as:

$$U_{ijt} = \mathbf{x}_{ijt}\boldsymbol{\beta} + \varepsilon_{ijt}, \quad (1)$$

where $\boldsymbol{\beta}$ is the vector of utility parameters, $\mathbf{x}$ is the vector of alternative-specific attributes, and $\varepsilon$ is the random component, representing the joint influence of all unobserved factors that influence decision-making (Manski, 1977). By assuming that the random component is standard type-1 extreme value distributed, the multinomial logit (MNL) model is obtained with convenient closed-form expression for the choice probability:

$$P(j|J) = \frac{\exp(\mathbf{x}_{ijt}\boldsymbol{\beta})}{\sum_{k=1}^{J}\exp(\mathbf{x}_{ikt}\boldsymbol{\beta})} \quad (2)$$

In what follows, we apply a mixed logit (MXL) extension of the model which allows to take the respondents' preference heterogeneity into account, as it has been shown to substantially improve model performance. In the MXL model preference parameters are individual-specific, following an a priori specified multivariate distribution $\boldsymbol{\beta}_i \sim f(\mathbf{b}, \boldsymbol{\Sigma})$ where $\mathbf{b}$ is a vector of population means and $\boldsymbol{\Sigma}$ represents a (possibly non-diagonal) variance-covariance matrix. By assuming a structured variation of individual tastes in the sample, in the form of individual-based parameters, the MXL model is more realistic and typically yields a much better fit to the data (Hensher *et al.*, 2015). This comes at the cost of a more complicated estimation procedure, however; the unconditional probability of individual $i$ choosing alternative $j$ in situation $t$ is an integral of standard logit probabilities over a density individual utility parameters (Train, 2009).

In our HMXL model we also assume that the random parameters $\boldsymbol{\beta}_i$ depend on a vector of latent variables $\mathbf{LV}_i$, corresponding to respondents' personality traits. The functional form of this dependence is of the form:

$$\boldsymbol{\beta}_i = \boldsymbol{\Lambda}'\mathbf{LV}_i + \boldsymbol{\beta}_i^*, \quad (2)$$

where $\mathbf{\Lambda}$ is a matrix of estimable coefficients and $\boldsymbol{\beta}_i^*$ has a multivariate normal distribution with a vector of means and a covariance matrix to be estimated.[4]

As a result, the conditional probability of individual $i$'s choices in choice set $t$ is given by:

$$P(y_i \mid \mathbf{X}_i, \boldsymbol{\beta}_i^*, \mathbf{LV}_i, \mathbf{\Lambda}, \mathbf{b}, \mathbf{\Sigma}) = \prod_{t=1}^{T_i} \frac{\exp\left(\boldsymbol{X}_{ijt}\boldsymbol{\beta}_i\right)}{\sum_{k=1}^{C}\exp\left(\boldsymbol{X}_{ikt}\boldsymbol{\beta}_i\right)}. \quad (2)$$

The latent variables are also linked to the measurement component of the model, in which each of the five personality traits is measured using two seven-point Likert scale questions. The measurement equations are modelled using ordered probit. The measurement component of the model can be specified as follows:

$$\mathbf{I}_i^* = \mathbf{\Gamma}'\mathbf{LV}_i + \boldsymbol{\eta}_i, \quad (2)$$

where $\mathbf{I}_i$ represents a vector of (ordered) indicator variables, $\mathbf{\Gamma}$ is a matrix of coefficients and $\boldsymbol{\eta}_i$ denotes a vector of error terms assumed to come from a multivariate normal distribution with zero means and an identity covariance matrix.[5] Under this specification, the relationship between $I_{il}$ and $I_{il}^*$ (for the $l$-th indicator variable which takes $J$ possible, ordered values) becomes:

$$\begin{array}{lll} I_{il} = 1, & \text{if} & I_{il}^* < \alpha_{1l} \\ \vdots & \vdots & \vdots \\ I_{il} = k, & \text{if} & \alpha_{k-1l} \le I_{il}^* < \alpha_{kl} \\ \vdots & \vdots & \vdots \\ I_{il} = J, & \text{if} & \alpha_{J-1l} \le I_{il}^* \end{array}, \quad (2)$$

[4] The number of columns in $\Lambda$ is equal to the number of latent variables and the number of rows equal to the number of non-monetary attributes.

[5] It is important to note that the number of measurement equations need not equal the number of latent variables. For instance, cases may arise where more than one indicator for a latent variable may be available. This framework can accommodate such a setting by specifying multiple measurement equations for a single latent variable.

where the $\alpha$'s are the threshold parameters to be estimated for each indicator. This specification leads to the well-known ordered probit likelihood form for $I_i$:

$$P\left(I_i \mid \mathbf{LV}_i, \boldsymbol{\Gamma}, \boldsymbol{\alpha}\right) = \prod_{l=1}^{L}\left(P\left(I_{il} \mid \mathbf{LV}_i, \boldsymbol{\Gamma}_l, \alpha_l\right)\right) = \prod_{l=1}^{L}\left(\Phi\left(\alpha_{kl} - \boldsymbol{\Gamma}_l'\mathbf{LV}_i\right) - \Phi\left(\alpha_{k-1l} - \boldsymbol{\Gamma}_l'\mathbf{LV}_i\right)\right), \quad (2)$$

where denotes the normal cdf, $\Gamma_l$ and $\alpha_l$ are the $l$-th row of the $\boldsymbol{\Gamma}$ matrix and the vector of the threshold parameters for the *l*-th indicator variable, respectively.[6]

Combining equations (2), (2) and (2), we obtain the full-information likelihood function for our HMXL model, where for ease of exposition we stack the parameter vectors $\mathbf{b}, \boldsymbol{\Sigma}, \boldsymbol{\Lambda}, \boldsymbol{\Gamma}, \boldsymbol{\alpha}$ into the single vector $\boldsymbol{\Omega}$:

$$L_i = \int P\left(\mathbf{y}_i \mid \mathbf{X}_i, \boldsymbol{\beta}_i^*, \boldsymbol{\Omega}, \mathbf{LV}_i\right) P\left(\mathbf{I}_i \mid \boldsymbol{\Omega}, \mathbf{LV}_i\right) f\left(\boldsymbol{\beta}_i^*, \mathbf{LV}_i \mid \mathbf{b}, \boldsymbol{\Sigma}\right) d\left(\boldsymbol{\beta}_i^*, \mathbf{LV}_i\right). \quad (2)$$

As random disturbances of $\boldsymbol{\beta}_i^*$, as well as latent variables $\mathbf{LV}_i$ are not directly observed, they must be integrated out of the conditional likelihood. This multidimensional integral can be approximated using a simulated maximum likelihood approach.[7]

[6] Note that this likelihood is a factor of likelihoods of each indicator separately. It is so due to the earlier assumption that $\boldsymbol{\eta}_i$ has an identity covariance matrix. This assumption is equivalent to assuming that whole correlation between indicator variables is explained by the latent variables used. However, this assumption can be relaxed, as in Bhat, C. R., C. Varin and N. Ferdous (2010). 'A comparison of the maximum simulated likelihood and composite marginal likelihood estimation approaches in the context of the multivariate ordered-response model', in (Greene, W. and R. C. Hill Eds.), *Advances in Econometrics*, pp. 65-106: Emerald Group Publishing Limited..

[7] The models were estimated in Matlab. The software used here (estimation package for hybrid choice models) is available from github.com/czaj/DCE under CC BY 4.0 license.

Appendix 2. Detailed estimation results – status quo and cost interacted with latent personality traits (all datasets)

For each of the datasets we first present the results of the measurement component of the model, in which latent variables associated with personality traits are used as explanatory variables. This shows that our latent variables indeed represent the desired personality traits – the links with respective attitudinal questions are significant and of expected sign. As expected, we find that the absolute values of the coefficients often differ, indicating that the two attitudinal questions are not necessarily equally efficient at capturing each personality trait.

Next, the estimates of the utility function parameters follow. The estimated coefficients reflect marginal utilities associated with changes in the levels of the attributes, and as a result, changes in the probability of selecting an alternative. Consumers' preference heterogeneity is incorporated to the model by making the utility function parameters random. We assumed that the distribution of respondents' preferences for each attribute are normal (except log-normally distributed cost parameter, for which the coefficients of the underlying normal are presented) – for this reason each attribute is associated with the estimate of the mean and standard deviation of its distribution in the population. Although the coefficients do not have a direct interpretation[8] their signs reflect whether more of an attribute is perceived as good or bad while their relative values indicate their relative importance.

Finally, the mean of the distribution of preference parameters associated with Status quo and Cost was interacted with all latent variables corresponding to personality traits.[9] This allows us to investigate, if preferences of respondents' who score high or low on one of the personality traits (i.e., have high or low values of the corresponding latent variable) differ from preferences of other respondents. Significance of the interaction terms indicates the existence of the link between a personality trait and preferences for a particular attribute, while the sign of the interaction coefficients reveals the direction of this preference difference.

This appendix does not include the estimated ordered probit threshold parameters and model diagnostics. They are available from the authors upon request.

[8] Utility function is ordinal; the coefficients are confounded with the scale coefficient, because the variance of utility function error term is normalized.

[9] Note that each latent variable is normalized for 0 mean and unit standard deviation in order to facilitate interpretation and comparisons. Respondent with a latent variable value 0 is representing exactly the mean level of the corresponding personality trait, while respondent with a latent variable value 1 would be 1 standard deviation above the population mean, in terms of the strength of the corresponding personality trait. By normalization, we are able to compare which personality traits have relatively stronger influence.

Table A2.1a. The measurement component of the HMXL model – Latvia

| I see myself as: | 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| Extraversion | 0.18** | -0.16** | | | | | | | | |
| | (0.08) | (0.07) | | | | | | | | |
| Agreeableness | | | 0.61*** | -0.21*** | | | | | | |
| | | | (0.18) | (0.07) | | | | | | |
| Conscientiousness | | | | | 0.60*** | -3.10** | | | | |
| | | | | | (0.05) | (1.35) | | | | |
| Neuroticism | | | | | | | 1.38** | -0.54*** | | |
| | | | | | | | (0.59) | (0.11) | | |
| Openness To Experiences | | | | | | | | | 0.49*** | -0.29*** |
| | | | | | | | | | (0.08) | (0.06) |

Table A2.1b. The discrete choice component of the HMXL model – Latvia

| | Status quo | Cost | RS | WQ | IS |
|---|---|---|---|---|---|
| Main effects: | | | | | |
| Mean | -4.31*** | 1.37*** | -0.07** | 0.66*** | 0.18*** |
| | (0.29) | (0.08) | (0.03) | (0.04) | (0.02) |
| Standard deviation | 3.84*** | 3.81*** | 0.34*** | 0.75*** | 0.11 |
| | (0.28) | (0.18) | (0.04) | (0.04) | (0.09) |
| Interactions: | | | | | |
| Extraversion | -0.23 | 2.45*** | | | |
| | (0.45) | (0.14) | | | |
| Agreeableness | -0.57*** | 1.15*** | | | |
| | (0.20) | (0.06) | | | |
| Conscientiousness | 0.12 | 0.25*** | | | |
| | (0.23) | (0.05) | | | |
| Neuroticism | 0.58*** | 0.01 | | | |
| | (0.22) | (0.05) | | | |
| Openness To Experiences | -1.72*** | -2.05*** | | | |
| | (0.23) | (0.10) | | | |

*Notes*: ***, ** and * indicate significance at the level of 1%, 5%, and 10%, respectively. Standard errors (s.e.) are given in brackets.

Table A2.2a. The measurement component of the HMXL model – Estonia 1

| I see myself as: | 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| Extraversion | 0.41** | -0.47** | | | | | | | | |
| | (0.17) | (0.20) | | | | | | | | |
| Agreeableness | | | 0.27 | -0.22 | | | | | | |
| | | | (0.24) | (0.21) | | | | | | |
| Conscientiousness | | | | | 0.83** | -0.85** | | | | |
| | | | | | (0.36) | (0.37) | | | | |
| Neuroticism | | | | | | | 5.48 | -0.37*** | | |
| | | | | | | | (3.97) | (0.06) | | |
| Openness To Experiences | | | | | | | | | 0.62** | -0.40** |
| | | | | | | | | | (0.24) | (0.17) |

Table A2.2b. The discrete choice component of the HMXL model – Estonia 1

| | Status quo | Cost | FLS | PRS | WQ | IS |
|---|---|---|---|---|---|---|
| Main effects: | | | | | | |
| Mean | -4.33*** | -0.13 | 1.58*** | 1.13*** | 0.36*** | 0.69*** |
| | (0.42) | (0.38) | (0.15) | (0.11) | (0.04) | (0.09) |
| Standard deviation | 3.85*** | 5.08*** | 1.38*** | 1.29*** | 0.37*** | 0.72*** |
| | (0.35) | (0.41) | (0.19) | (0.14) | (0.05) | (0.13) |
| Interactions: | | | | | | |
| Extraversion | -0.62* | 0.31** | | | | |
| | (0.37) | (0.15) | | | | |
| Agreeableness | 0.42 | 0.57*** | | | | |
| | (0.55) | (0.21) | | | | |
| Conscientiousness | 0.06 | 0.36** | | | | |
| | (0.29) | (0.15) | | | | |
| Neuroticism | 0.20 | 0.04 | | | | |
| | (0.28) | (0.14) | | | | |
| Openness To Experiences | -0.67** | -0.22 | | | | |
| | (0.32) | (0.23) | | | | |

*Notes*: ***, ** and * indicate significance at the level of 1%, 5%, and 10%, respectively. Standard errors (s.e.) are given in brackets.

Table A2.3a. The measurement component of the HMXL model – Estonia 2

| I see myself as: | 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| Extraversion | 0.26*** (0.10) | -0.35*** (0.11) | | | | | | | | |
| Agreeableness | | | 0.22*** (0.08) | -0.24*** (0.07) | | | | | | |
| Conscientiousness | | | | | 0.79*** (0.13) | -0.97*** (0.18) | | | | |
| Neuroticism | | | | | | | 0.61*** (0.08) | -1.47*** (0.39) | | |
| Openness To Experiences | | | | | | | | | 0.52*** (0.09) | -0.47*** (0.08) |

Table A2.3b. The discrete choice component of the HMXL model – Estonia 2

| | Status quo | Cost | AS_MPA | AS_WP | AS_EWP | WS_MPA | WS_WP | WS_EWP |
|---|---|---|---|---|---|---|---|---|
| Main effects: | | | | | | | | |
| Mean | -1.21*** (0.18) | -2.05*** (0.27) | 0.16 (0.10) | -1.36*** (0.13) | 0.56*** (0.08) | 0.49*** (0.09) | -0.35*** (0.11) | 0.23*** (0.08) |
| Standard deviation | 1.70*** (0.24) | 2.91*** (0.22) | 1.54*** (0.12) | 1.98*** (0.14) | 0.76*** (0.11) | 1.15*** (0.12) | 1.62*** (0.12) | 0.73*** (0.11) |
| Interactions: | | | | | | | | |
| Extraversion | 0.39** (0.18) | -2.52*** (0.21) | | | | | | |
| Agreeableness | 2.88*** (0.23) | -4.44*** (0.28) | | | | | | |
| Conscientiousness | -0.36* (0.19) | 1.40*** (0.12) | | | | | | |
| Neuroticism | 0.96*** (0.16) | -2.23*** (0.17) | | | | | | |
| Openness To Experiences | 0.00 (0.17) | -3.28*** (0.27) | | | | | | |

*Notes*: ***, ** and * indicate significance at the level of 1%, 5%, and 10%, respectively. Standard errors (s.e.) are given in brackets.

Appendix 3. Detailed estimation results – all attributes interacted with latent personality traits (Estonia 1 dataset; WTP-space)

Table A3.1a. The measurement component of the HMXL model – Latvia

| I see myself as: | 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| Extraversion | 0.14*** (0.05) | -0.13*** (0.05) | | | | | | | | |
| Agreeableness | | | 0.28*** (0.07) | -0.05 (0.06) | | | | | | |
| Conscientiousness | | | | | 0.84*** (0.14) | -1.18*** (0.26) | | | | |
| Neuroticism | | | | | | | 0.74*** (0.13) | -0.83*** (0.15) | | |
| Openness To Experiences | | | | | | | | | 0.55*** (0.11) | -0.28*** (0.06) |

Table A3.1b. The discrete choice component of the HMXL model – Latvia

| | Status quo | Cost | RS | WQ | IS |
|---|---|---|---|---|---|
| Main effects: | | | | | |
| Mean | 8.41*** (0.81) | -0.83*** (0.07) | -0.01 (0.10) | 3.18*** (0.20) | 0.46*** (0.09) |
| Standard deviation | 55.20*** (3.62) | 0.19 (0.21) | 0.32*** (0.07) | 1.04*** (0.12) | 0.06 (0.08) |
| Interactions: | | | | | |
| Extraversion | 14.33*** (1.08) | 1.12*** (0.07) | 0.35*** (0.08) | -0.20* (0.11) | -0.39*** (0.09) |
| Agreeableness | -0.56 (0.38) | 0.49*** (0.09) | -0.61*** (0.12) | -3.27*** (0.22) | -0.19* (0.11) |
| Conscientiousness | 0.41* (0.23) | 0.05 (0.11) | -0.08 (0.10) | 0.45*** (0.13) | 0.13 (0.16) |
| Neuroticism | -1.19*** (0.23) | -0.17* (0.09) | -0.07 (0.09) | 0.24** (0.11) | 0.20** (0.10) |
| Openness To Experiences | -3.73*** (0.40) | -0.51*** (0.10) | 0.33*** (0.11) | 1.60*** (0.15) | 0.26*** (0.08) |

*Notes*: ***, ** and * indicate significance at the level of 1%, 5%, and 10%, respectively. Standard errors (s.e.) are given in brackets.

Appendix 3 – TIPI personality questions as used in the three choice experiments

**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 |

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