

A Work Project, presented as part of the requirements for the Award of a Master's degree in Economics from the Nova School of Business and Economics.

How does personality influence preferences for ecosystem policies? Evidence from Portugal

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Abstract

How does personality influence the support for MCES protection programs? To analyse this I use a representative data-set consisting of stated preferences of participants in a DCE regarding oil spill prevention in Portugal's coastal region. Reducing "personality" to the Five Factor Model I find that some traits indeed show significance in explaining choices for MCES protection in Portugal. Individuals with higher levels of **Openness** and **Consciousness** have a lower preference for the status quo. Higher levels of **Agreeableness** of individuals come with a stronger preference for the Status Quo. **Emotional Stability** is on the verge of being significant.

Keywords: Marine and Coastal Ecosystem Services (MCES), Economic Preferences, Personality, Ten-Item Personality Inventory (TIPI), Environmental Policy, Discrete Choice Experiment, Hazard Goods, Oil Spills, Sustainable Public Policy

For my nephew Theodore Alexander Fritz, born on the 19th of August 2023

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1 Introduction

Environmental protection has become one of the main critical action fields for human policy making in the 21st century. Co-operations of governments worldwide like the United Nations (UN) started to act on the mitigation of environmental risks suspected to be caused by human being. Besides the goal to reduce carbon emissions in order to mitigate climate change and extreme weather conditions, environmental pollution such as oil spills into the sea is seen as one of the main threats to nature and is with that also connected to our existence.¹

In order to design policies to protect environmental services it is firstly important to understand what actions can help prevent pollution. Secondly it is crucial that the implementation of such actions are then supported by the voting population, as they come with a cost. Bernays and Miller (2005) describe this as following: *"In our present social organization approval of the public is essential to any large undertaking"*.

Recent developments in societies show that a part of the citizens is very keen on driving environmental protection, with some of them even joining organized groups focused on preserving the environment and showing this publicly by participating in demonstrations. Other parts seem to not believe in the importance of human beings intervening in such changes in our environment or do not see urgency in acting.²

This raises three important questions for policy-makers in the context of marine natural ecosystems: 1. What preservation actions can be undertaken to reduce hazardous events 2. how much does it cost to implement those actions 3. how much are citizens willing to pay to support those actions (e.g. taxes)? To bring light into the darkness, a hypothetical market can be created allowing to observe how much people are willing to pay for different environmental programs possibly being implemented.

1. See UN Sustainable Development Goals, in detail 13 (climate action), 14 (life below water) and 15 (life on land) [<https://sdgs.un.org/goals>]

2. This can be observed in international news outlets e.g. in recent cases of climate protesters of the "Last Generation" repeatedly gluing themselves to streets in Germany or others solving famous artwork in Paris [<https://www.dw.com/en/germany-climate-activists-glue-themselves-to-berlin-streets/a-65416427>; <https://www.euronews.com/green/2022/12/28/extreme-climate-protesters-made-headlines-in-2022-heres-where-they-are-now>]

To understand differences across the population, that is, to capture heterogeneity, personality can be also an important explanatory variable. Here, this dissertation aims at using data collected by Universidade Nova de Lisboa and use a Discrete Choice Experiment(DCE) design to analyze how different personality traits may influence the preferences for investing in prevention to control for damages that may result from hazardous events. To this end, I am estimating the Willingness-to-pay (WTP) for a representative sample of Portuguese citizens for the implementation of protection programs of marine ecosystem services. Therefore, the research question is: **How do personality traits help predict individuals willingness to pay for protection of environmental services in the southwest coastal area of Portugal?**

Following the literature, "personality" is measured by using the Big Five Personality Traits Openness, Conscientiousness, Extraversion, Agreeableness and Neuroticism. These categories were introduced by the Five Factor Model, that was developed to capture main domains of human personality. In my analysis, I set them into relation with preferences for the Status Quo.

In this context, the different levels in the five traits may explain heterogeneity in the WTP. Herewith I build up on preliminary results by (Cunha-e-Sa et al. 2023) that estimated the WTP for Portugals main Marine and Coastal Ecosystem Services (MCES) with focus on the differences of the payment vehicle (tax vs. crowdfunding) as a baseline. The MCES that were part of the DCE design include Biodiversity, Beach usage, Coastal area and Surf.

One of my contributions is in disentangling the heterogenous preferences for those MCES. The results of this thesis are the first of its kind for MCES protection programs. However, this is very preliminary work.

The outcome of this attempt can be combined with what is already available in the literature and what will still to be researched on how to communicate effectively to individuals with certain personality traits. Yet, these analyses are always context-specific, that is, both temporally and spatially. Merging the understanding of what groups have a lower preference for supporting policies to protect the environment and the knowledge in how to communicate effectively with certain personality types can help constructing effective campaigns when seeking policy support.

By understanding how the personality traits of individuals, that are less in favor of implementing further policies, look like, policy analysts can improve their knowledge about population preferences and therefore communication strategies can be improved for policy drafts(Farizo, Oglethorpe, and Soliño 2016).

Therefore, these very preliminary results can be useful as they may better inform sustainable public policy decision-making.

The rest of the research work is organized as follows. After this brief Introduction, section 2 develops the theoretical part, introducing definitions about foundational topics to create a common understanding of the various terms, and summarizing the current state of research related to personality traits in economic decision making models for environmental policy preferences. Then, section 3 illustrates methodological issues, followed by section 4 where the data analysis is carried out using the DCE design observations before results are presented and critically discussed in section 5. Section 6 offers conclusions and explains limitations with recommendations for further research.

2 Literature Review

In this section firstly relevant terms and concepts that are part of this analysis are introduced. The second part consists of a revision of publications which are forming the current state of research in this field: using personality traits to explain heterogeneity in individuals choices in environmental economic models.

2.1 Theoretical Background

2.1.1 Public environmental goods and Marine and Coastal Ecosystem Services

There are four major maritime ecosystem services that are part of the analysis carried out in this work: 1. Biodiversity conservation, 2. Beach use, 3. Coastal protection and 4. Surf. Marine ecosystem services are a special type of public goods. The issue of policy making in the regard of public goods, and therefore also for marine ecosystem services, is that prices cannot just be observed in marketplace like it is the case for private goods. This means no classical market mechanisms can define the equilibrium price and revealing the economic value individuals attach to them. To still be able to elicit economic agents total economic value (TEV) we need to use methodologies to overcome those public goods features, and, therefore, absence of markets where they are traded.

2.1.2 The Five Factor Model and its value for economic models

To reduce personality to a few tangible variables I use the Ten-Item Personality Inventory (TIPI) questionnaire that consist of ten questions that are loading on the broad five personality traits introduced by the Five Factor Model (FFM).

Historically, neoclassical economic models assumed unbiased, selfish and rational economic agents (*homo economicus*). Those models often failed to prove validity in the complexity of reality by seeing the assumptions violated in practice.

Behavioural economics improved the capability of economic models to predict outcomes by adding (constant) psychological factors as independent variables.

Nevertheless, when looking at personality traits research provides evidence that they might even be the better predictor of heterogeneity for example when it comes to gender. The evidence

suggests that gender differences are actually differences in the averages of personality traits of the two genders while gender is just a proxy for those.(Luchs and Mooradian 2011)

The Five-Factor Model (FFM) with its roots in the research field of psychology emerged in the second half of the 20th century. It is a framework to capture main domains of personality traits and is since then well recognized and has been used in many cases(Paul T Costa Jr and Robert R McCrae 2003; Volk, Thöni, and Ruigrok 2011). More recently, psychology and with that also the FFM found their way into the area of economics. The interdisciplinary approach reflected the need to increase the power of economic theories and models, given that economics is a social science. As a sub-field of 21st century modern economics the previously mentioned behavioural economics or experimental economics was born (Boyce, Czajkowski, and Hanley 2019).

Boyce, Czajkowski, and Hanley (2019) predict that using personality traits to disentangle heterogeneity effects will revolutionize behavioural economics.

For the upcoming econometric analysis individuals answers to the Ten-Item Personality Inventory (TIPI) questionnaire will be used to set personality traits in context to economic choices. The TIPI questionnaire was derived from the Five Factor Model. The Five Factor Model has emerged over years of research combining the work of several authors (Dehne and Schupp 2007). The latest version that formed the big five personality traits as they are being used in this analysis was published by Paul T Costa Jr and Robert R McCrae (2003).

The big five personality traits are defined as following³:

No.	Personality trait	Description (for high values ->7)
1	Openness to experience	Person tends to be creative and curious
2	Conscientiousness	Person tends to be hard-working, well-organized and punctual
3	Extraversion	Person tends to be happy, popular, socially successful and high-earning
4	Agreeableness	Person tends to be uncritical, trusting and good-hearted
5	Neuroticism	Person tends to be worrying, self-pitying and prone to depression (independent of situation)

Table 1: Big 5 personality traits and respective characteristics

3. (Paul T Costa Jr and Robert R McCrae 2003; Farizo, Oglethorpe, and Soliño 2016)

To capture those latent personality traits, several questionnaires have been developed, so for example the extensive 240 item NEO PI R©(Paul T. Costa and Robert R. McCrae 2008), 15-item BFI-S (Gerlitz and Schupp 2005) and the 10 item-personality-inventory(TIPI) (Gosling, Rentfrow, and Swann 2003). The TIPI is the shortest of those questionnaires and proved high validity in capturing agents' levels for the big five personality traits (Volk, Thöni, and Ruigrok 2011).⁴ This seems to be the most adequate instrument to incorporate in questionnaires that are not mainly concerned about personality traits. This reduces costs of adding this dimension to research experiments. As Volk, Thöni, and Ruigrok (2011) also argue, using a very short questionnaire even can reduce measurement errors as survey participants do not reply incorrect to finish the questionnaire as fast as possible.

2.2 Literature Review

2.2.1 Existing Research

A few studies already attempted to bring personality in relation to economic choice predictions when it comes to environmental public goods. In the early years of this century Johansson, Heldt, and Johansson (2006) researched into the connection of personality in form of personal attitudes of an individual to their transport mode choices. As they used a self-developed question-set to capture personal attitudes that were not based on the FFM, results are not easily comparable with outcomes of later publications. The authors found evidence for a (weak) correlation between personal attitudes and choice for sustainable transport mode. That is, for the first time it was shown that personality indeed is somehow related to preferences in sustainable economic choices.

Most similar to the nature of this analysis are publications by Boyce, Czajkowski, and Hanley (2019), Farizo, Oglethorpe, and Soliño (2016), and Kim et al. (2013).

The first publication analyzes preferences for public environmental goods, similar to the data used in this dissertation. The main outcome is the validation that personality traits indeed improve the explanatory power of choices for environmental public goods by using three different studies that used stated preferences in discrete choice experiments (DCE) and captured personality traits via

4. A graphic of how the TIPI items load on the Big Five Personality Traits can be found in the annex

TUPI questionnaire. The authors did not provide particular insights for policy recommendations.

Farizo, Oglethorpe, and Soliño (2016) published their paper that is as well researching on preferences for public environmental goods, namely windparks in Spain. The main difference in the approach is that the personality traits have been captured using the very extensive 240 items inventory, NEO PI R©. As in Farizo, Oglethorpe, and Soliño (2016) who have used a richer inventory set, they opted for a detailed analysis and did not provide results on big 5 level but rather on factor analysis in terms of 30 facets they generated out of the 240 items.

Kim et al. (2013) investigated personality traits of students in Japan and their acceptance of sustainable transport policies. The main difference to the other publications is that the fictional policy implementation being investigated is a lump-sum carbon tax of monthly around 130USD (with exchange rates at that point in time, original currency JPY). The survey was conducted only with engineering students of Kyoto University. Therefore, the downside of this research piece is that the collected sample is not representative, especially because personality traits between students of the same age and major might be similar due to self-selection bias and similar fields of interest.

A more theoretical research approach, in a lab environment, has been published by Volk, Thöni, and Ruigrok (2011). These authors used TUPI to capture the Big Five Personality Traits of participants in a public goods game (PGG) simulating a social dilemma, which was executed three times over a course of five months. The social dilemma is a classic one which introduces a monetary incentive for individuals to free-ride and not cooperate. No environmental aspects and -preferences were included.

Boyce, Czajkowski, and Hanley (2019) results point towards that more *Conscientious* individuals react consistently more sensible to higher monetary costs (of such environmental policy implementations). As the authors blended several different studies together, it should be acknowledged that the results of this paper must be interpreted carefully- considering the importance of the status quo on economic agents' marginal welfare. According to their results, individuals with higher *Openness to Experience* are more likely to support environmental policies and are more likely to be less cost sensitive than individuals with low scores on this personality trait. Individuals with higher

levels of Neuroticism prefer the status quo (are not in favor of additional environmental protection policies).

In comparison to this, Kim et al. (2013) found evidence that *Conscientious* and *Agreeableness* correlate with a higher support to implement additional environmental protection policies. Both personality traits also showed relevance in predicting if an individual is aware of current environmental issues. In the above mentioned lab environment, individuals with high levels of *Agreeableness* appeared to be more in favor of cooperation (in favor of the implementation of (additional) policies for public goods).

All mentioned results have shown significance at common confidence levels. Besides that, few more research papers focus on green consumer behaviour when it comes to private goods.

Nonetheless these results are not promising to be relevant for policies on the protection of public environmental goods, because 1) the complexity of social dilemmas and free riding are not added to the decision/choice (see Volk, Thöni, and Ruigrok (2011)) and 2) further factors like government trust which is expected to influence choice for or against support for public environmental good policies (see Kim et al. (2013)) are not part of the decision process.

A key differentiator is that public goods traditionally come with a social dilemma and free-riding issues. In those also called "social dilemmas" the individual outcome (utility) if everyone cooperates is usually higher than when everyone decides not to cooperate. The dilemma comes into place as a single individual has the incentive to maximize utility by not cooperating, conditional on all the other individuals choosing to cooperate.

Therefore, following publications are listed only to complete the overview of the current state of research using personality traits for modeling preferences in environmental economics.

Busic-Sontic, Czap, and Fuerst (2017) and Busic-Sontic and Brick (2018) analyzed the Big Five Personality Traits with respect to their ability to predict private investments in green energy. Findings for Germany included that *Openness to Experience* and *Neuroticism* showed a positive correlation (weakly) with energy efficiency investments.

Luchs and Mooradian (2011) researched into the genders' difference of sustainable consumer

behaviour. Results are that personality traits in form of *Agreeableness*, *Openness to Experience* and *Conscientiousness* increase the probability of an individual to consume sustainably. Those personality traits are, on average, more often and more well-developed in women compared to men.

In Hirsh (2010) publication, Environmental concern was positively correlated to (listed from strong to weak impact) *Agreeableness*, *Openness to Experience*, *Neuroticism* as well as *Conscientiousness*. *Extraversion* did not show any correlation at common significance levels.

Markowitz et al. (2012) found modest correlations between sustainable consumption behaviour in day-to-day activities and *Openness to Experience*. *Conscientiousness* and *Agreeableness* were not consistently correlated to such behaviour.

2.2.2 Challenges in the context of environmental protection policies

Even though there is already a relatively high share of world citizens recognizing climate change being an urgent issue and environmental protection being important and urgent topics⁵, real policy implementation for public goods always come with an incurring cost that enters the utility function of the agent negatively. This means an individual that is in general supporting environmental protection might still prefer no-cost (status quo) decisions when it comes to public policy options.⁶ As mentioned in the introduction of this thesis, estimating the Willingness to pay⁷ in context of environmental protection is a crucial variable of interest to understand the **nominal support** for environmental protection, rather than considering general responses of survey participants that are not quantifiable. With the results of this work I also intend to contribute to a better understanding of what part of the population is currently in favor of implementing additional ecosystem protection policies and what part (with which levels in personality traits) is hesitant or not in favor (does not accept incurring costs to move away from status quo). As Luchs and Mooradian (2011) describe this is a highly valuable information for policy makers.

5. the UNDP released together with University of Oxford the "People Climate Vote" survey that featured responses of an equivalent of 56% of worlds citizens, while 64% mentioned climate changed being an urgent topic [<https://www.undp.org/publications/peoples-climate-vote>]

6. See the role of cost entering the utility function for environmental policy decisions in Mariel et al. (2021, p.2)

7. See chapter 3.1.1

3 Methodology

3.1 Data Collection

3.1.1 Discrete Choice Experiments and Willingness-to-pay

Discrete choice experiments (DCE) were initially introduced by Louviere and Hensher (1982) and have since then gained more and more relevance in economic research especially to elicit willingness to pay (WTP) for public goods as well as in environmental evaluation (Mariel et al. 2021; Hoyos 2010). DCE are based on the random utility model, firstly introduced by McFadden et al. (1973), that says that an individual's utility function can only be observed by its discrete choices as it is a latent endogenous variable. Therefore utility cannot be calculated but only compared ($u_2 > u_1; u_2 < u_1; u_2 = u_1$) (Daziano 2015). Willingness to pay (WTP) describes a certain amount an individual is willing to sacrifice to change from a status quo (endowment) to a hypothetical state that would increase the agent's utility, *ceteris paribus* (Mariel et al. 2021). Discrete choice experiments build up on economic welfare theory and the fact that every individual takes decisions in daily life that are led by one's preferences, in order to maximize utility. Observing choices of an individual therefore also allows to understand preferences of this individual. As for public goods choices cannot just be observed like for market goods (revealed preferences) DCEs can be implemented in order to simulate choice and let agents state their preferences in a hypothetical environment (Farizo, Oglethorpe, and Soliño 2016; Mariel et al. 2021).

3.1.2 Oil spills as a risk to natural environment in Portugal

For the data collection a case study was developed that aimed at highlighting the risk of oil spills on Portuguese natural environment and with that also the MCES. Due to Portugal's geographical location with a long east and south shore located close to relevant international maritime routes (s. figure 2 in the annex) the study site is under real risk with effects on the quality of the environmental goods and services provided that are enjoyed by residents and visitors. In the past, oil spills already polluted this area⁸. The study area is the coastal area of Southwest Alentejo and Costa Vicentina Naturalpark with its area within 2km of the mainland (s. figure 1 in the annex). In this area a high

8. See <https://www.euronews.com/2022/11/14/spains-biggest-environmental-disaster-the-prestige-20-years-after>

biodiversity, several popular natural beaches and also nation-wide known surfing spots are offered. All these environmental services would be severely impacted by oil spills in the near sea area and were therefore, besides geographical aspects, chosen as area of interest for the study.

3.1.3 Survey Implementation

The survey was designed by NOVA SBE Environment Economics Knowledge Center and implemented by independent market research service providers. After focus groups and test surveys to optimize the survey questionnaire the final data collection was executed in two independent collection runs. Only these data is going to be used for following analysis. A total of 918 individuals have conducted an interview (with complete answers) regarding policy options for the protection of environmental services of the study area, constituting a representative sample of the Portuguese population.

In each of the two survey runs, six different pairs of choice cards (s. attachments) were used while each surveyed individual received one of those choice cards with four choices where to state preferences⁹. In each choice the individual could decide between two different protection programs (that come with a cost) and the Status Quo (no cost). Considering welfare theory and the concept of WTP the idea is that the individual chooses the program (or Status Quo) that provides him the highest possible utility given affordability or prefers not to spend any amount and keeps the Status Quo utility level. Environmental services as dimensions to protect considered for the experiment are **biodiversity**, **beach usage**, **the coasts** and **surf**. At the beginning of each questionnaire, and to ensure that the answers were not contaminated by the survey, individuals were inquired about the TIPI questions to reveal their personality traits. The questionnaire included many other questions, most of them not relevant for this analysis. For a full overview of the questionnaire and the collected dataset metadata see the attachment.

9. prior to this, the participants were shown a video that informed about the study area, the environmental challenges and risks and how protection programs look like. Economic valuation scenario presented in a national survey to portuguese residents - MarES [<https://www.youtube.com/watch?v=hRY9PhGD-5M>]

3.2 Models for analyzing DCE data

Literature mentions a few approaches that are used to analyse data that was collected through DCEs. The decision for one model or the other is dependent on assumptions made on the data and the context of the experiment. Mariel et al. (2021) provide a good summary of relevant estimation models for interpreting choices in DCE environments. Common models are, 1) Multinomial Logit Model (MNL) and 2) Mixed Logit Model (MXL).

1) The MNL is based on the random utility model (McFadden et al. 1973). This model assumes that the utility is formed by preferences and errors while no heterogeneity in preferences of economic agents are accounted for, a single parameter per variable therefore will be estimated. A detailed mathematical review will follow later on in this chapter.

2) The MXL extends the first model by allowing for unobserved heterogeneity that follows a continuous/discrete distribution for the whole population. As it is likely that the preferences for the environmental services that are part of this research differ across the population the first model (MNL) does not meet the assumptions of this analysis. MXL on the other hand allows for unobserved heterogeneity between 1) cross-sections and 2) individuals. The literature therefore suggests the MXL model. In the data analysis section of this paper the different approaches will be considered using the present sample. The MXL model is shortly introduced in its theoretical nature in the following section. With understanding the MXL model, also the MNL model can be grasped.

3.3 Theoretical Model

For modelling and analyzing discrete choices the random utility model is the theoretical framework (McFadden et al. 1973). An individual's indirect utility consists out of a deterministic and a stochastic part:

$$U_{njt} = V_{njt} + \epsilon_{njt} \quad (1)$$

Where U_{njt} the utility for individual n for choice j in occasion t . V is deterministic and ϵ , the error term, is random.

V_{njt} represents the part of the utility that is explicable and represents the taste of the individual n ($n=1, \dots, N$) for choice j ($j=1, \dots, J$) at choice occasion t ($t=1, \dots, T$). ϵ_{njt} represents the idiosyncratic part of the individual's taste in alternative j at time t .

In the random utility model we are assuming that individuals are always maximizing their utility, meaning that observations on individual's choices allow for conclusions on the utility gained from a specific decision for one option compared to available alternatives.

Stochastic tools are needed to model this decision process as the observed choice of individual $n = 1$ for choice j (with choice option $j = 1$) at occasion $t = 1$ comes with a probability $0 < P_{njt} < 1$ due to the several available alternatives that can be chosen.

Keeping the choice occasion constant for a certain individual n , the choice process would be represented by following probabilities:

$$Y_{njt} = \begin{cases} 1, & \text{if } U_{njt} > U_{nkt}, \forall j \neq k \\ 0, & \text{otherwise} \end{cases} \quad (2)$$

$$\begin{aligned} P_{njt} &= P(Y_{njt} = 1) = \text{Prob}(U_{njt} > U_{nkt} \forall j \neq k) \\ &= \text{Prob}(V_{njt} + \epsilon_{njt} > V_{nkt} + \epsilon_{nkt} \forall j \neq k) \\ &= \text{Prob}(\epsilon_{nkt} - \epsilon_{njt} \forall j \neq k) < \text{Prob}(V_{njt} - V_{nkt} \forall j \neq k) \end{aligned} \quad (3)$$

The probability p of individual $n = 1$ for choosing alternative $j = 1$ at occasion $t = 1$ equals:

$$P_{111} = \frac{e^{U_{111}}}{\sum e^{U_{1j1}}} \quad (4)$$

To represent individual specific preferences the basic model out of 1 will be slightly adjusted to represent MXL. Additionally, a cost factor will be added that is necessary for estimating WTP.

$$U_{njt} = -p_{njt}\alpha_n + X'_{njt}\beta_n + Z'_{njt}\gamma + \epsilon_{njt} \quad (5)$$

p_{njt} is the cost factor while X'_{njt} is a vector of variables for individual n for choice j at choice occasion t . α_n and β_n are individual-specific because the MXL model accounts for different preferences across the individuals. An MNL model on the other side does only incorporate universal coefficients, α and β . Z' includes variables that are expected to be constant throughout all individuals therefore γ picks up those effects with no individual-specific marker. Z' is therefore treated like in a normal MNL model.

A necessary assumption for the mixed logit is that ϵ_{njt} is IID extreme value distributed type 1 and allowed to vary for individuals. With k_n being a scale parameter for each individual n , $Var(\epsilon_{njt}) = k_n^2(\pi^2/6)$. The scale parameter is the variance of the variance of choices throughout the choice occasions that is not explained by the preferences.

To modify the model to be represented in the preference-space with similar variance for all individuals in all choice occasions the coefficients can be divided by this scale parameter:

$$U_{njt} = -p_{njt}(\alpha_n/k_n) + X'_{njt}(\beta_n/k_n) + Z'_{njt}(\gamma/k_n) + \epsilon_{njt} \quad (6)$$

With ϵ_{njt} in 6 being independent and identically distributed and $var(\epsilon_{njt}) = \pi^2/6$. This division has also effects on the scale of utility, nevertheless, as utility is ordinal the model still allows for same the degree of interpretation. This also means the coefficients cannot be interpreted directly but only in relation to each other.

As I am interested in the WTP of the individuals, the non-monetary parameters have to be divided by the cost-coefficient α .

$$U_{njt} = -p_{njt}(\alpha_n/k_n) + X'_{njt}(\beta_n/[k_n\alpha]) + Z'_{njt}(\gamma/[k_n\alpha]) + \epsilon_{njt} \quad (7)$$

The MXL in WTP-space therefore estimates two vector coefficients: $\psi_n = \frac{\beta_n}{k_n\alpha}$ and $\zeta = \frac{\gamma}{k_n\alpha}$. So, the vectors ψ_n and ζ can be interpreted as marginal WTPs, forming the reduced-form utility function:

$$U_{njt} = -p_{njt}(\alpha_n/k_n) + X'_{njt}\psi_n + Z'_{njt}\zeta + \epsilon_{njt} \quad (8)$$

In practice, this theoretical model can be estimated via Simulated Maximum Likelihood Estimation (SMLE), which is not an analytical approach but a simulation based estimation method.

For Maximum Likelihood estimation (MLE) the model can be written as follows, while L indicating the logit probability for the choice:

$$L_{nkt}(\alpha_n, \psi_n, \zeta) = \frac{e^{-p_{nkt}(\alpha_n/k_n) + X'_{nkt}\psi_n + Z'_{nkt}\zeta}}{\sum e^{-p_{njt}(\alpha_n/k_n) + X'_{njt}\psi_n + Z'_{njt}\zeta}} \quad (9)$$

Notice how this is related to equation 4. For solving this equation we would need to condition on the parameters α_n, ψ_n and ζ , which are unknown to observers. Therefore, we rather need to estimate the *unconditional probability*, requiring the calculation of the integral over all possible values of α_n, ψ_n and ζ considering the underlying distributions of the parameters θ^* :

$$Q_{nkt}(\theta^*) = \int L_{nkt}(\alpha_n, \psi_n, \zeta) f(L_{nkt}(\alpha_n, \psi_n, \zeta | \theta^*)) d\alpha_n d\psi_n d\zeta \quad (10)$$

As we observe multiple choices of each individual, in several choice occasions, we need to consider the product of the logit probabilities. In its conditional probability form we have:

$$S_n(\alpha_n, \psi_n, \zeta) = \prod_{t=1}^T L_{nk(n,t)t}(\alpha_n, \psi_n, \zeta) \quad (11)$$

while $k(n, t)$ represents the chosen option of individual n at choice occasion t .

To incorporate the sequence of choices in the unconditional probability model in equation 10 it can be rewritten as following:

$$P_n(\theta^*) = \int S_n(\alpha_n, \psi_n, \zeta) f(L_{nkt}(\alpha_n, \psi_n, \zeta | \theta^*)) d\alpha_n d\psi_n d\zeta \quad (12)$$

Estimating the population parameters θ^* as following:

$$LL(\theta) = \sum_{n=1}^N \ln P_n(\theta) \quad (13)$$

We obtain the individual-specific parameters and their standard deviation (difference in tastes) for α_n and ψ_n , so as the mean for ζ for which we are not assuming differences in taste.

As mentioned, the integral is not solvable in an analytical way as the parameters are unobserved. Therefore, we cannot estimate 13 and therefore we cannot apply MLE. To still be able to estimate the parameters, a simulated approach can be followed where we take D draws from the underlying assumed distributions. This numerical simulation is called Maximum Simulation Likelihood Estimation (MSLE) and widely used for simulation-based estimations (Train 2009). SLL is maximized by the estimated parameters (Revelt and Train 1998):

$$SLL(\theta) = \sum_{n=1}^N \ln \frac{1}{D} \sum_{d=1}^D \prod_{t=1}^T L_{nk(n,t)t} \quad (14)$$

4 Data Analysis

4.1 Data Overview

The data-set consists of 918 total (complete) individual questionnaires. With each of them responding in 4 choice occasions with 3 choice options each leads to 11016 observations. All variables of the data-set are described in the attachments.

Individual specific variables are repeated for each of the 12 observations per individual. This is common for DCEs as every choice (and non-choice) have to be brought in relation to the variables of interest, to allow for a correct estimation of the parameters.

4.1.1 Cleaning and pre-processing

As a first step, observations of participants that did not fully complete the questionnaire are excluded. As mentioned in 3.1.3, the data was collected in two different collection occasions. The survey differed in some parts of the questions or their sequence, hence the data-sets are merged on their common variables (s. data description and data domains in the appendix) to form one sample with common variables. Also, several dummy variables have been generated during pre-processing to facilitate the analysis.

In our sample, protesters are considered those individuals that chose the status quo in every choice occasion, despite not being budget constrained. As they do not reveal their true preferences they should be excluded to not introduce a protester bias in the estimations (Louviere 2001). Dropping those individuals from the data-set leads to a new $n = 845$ and a total of 10140 observations

4.1.2 Descriptive statistics

The sample is representative for the Portuguese population, latest published with the census 2021. Gender, Age, Education and Nationality do have similar values as those collected in the Portuguese census.

		Full Sample	n=845	Census 2021
Gender (1=Female)	Mean	0.5479		0.524
Age	Min	18		
	Max	91		
	Mean	47.8		45.4
Foreigners	Mean	0.071		0.052
Education	None/Basic	0.602		0.541
	Secondary			
	or professional	0.219		0.247
	Higher	0.179		0.212

Table 2: Descriptive Statistics of the Data-set

Then, the distribution of the personality traits across the individuals are further described as they are the main explanatory variables of interest for this analysis. Gosling, Rentfrow, and Swann (2003) define how the Big Five can be computed using the TIPI. Graphic 3 in the annex depicts the loadings of the TIPI items on the Big Five.

Variable	Mean	Standard Deviation	Min	Max
Openness to Experience	4.97	1.24	1	7
Conscientiousness	5.45	1.05	2	7
Extraversion	4.53	1.40	1	7
Agreeableness	5.62	0.98	1.5	7
Emotional Stability	4.51	1.19	1	7

Table 3: Summary statistics for the Big Five personality traits captured with the TIPI

Histograms regarding the distributions of the personality traits for this sample can be found in the appendix. I assume a continuous domain for these Likert scale variables (which ranges from 1-7 with steps of 0.5). Due to this assumption any imbalances in the distribution of the variables in the sample can be disregarded as it does not introduce a bias like it was the case for group variables (Johnson and Creech 1983).

5 Results

The results for the baseline model in table 4 show significance for the protection program dummies except Surf, confirming earlier results from Cunha-e-Sa et al. (2023). Additionally, for three of the five personality traits significance can be registered. The MXL model performed better than the MNL, as a lower (negative) LogLikelihood level, listed underneath the table acknowledges.¹⁰ This comes in line with what was expected from econometric theory (see 3.2).

Table 4: Baseline results for Status Quo WTP

	MNL	MXL	
	Mean(SE)	Mean(SE)	Std. Dev.(SE)
Status Quo	150.40*** (22.91)	155.56*** (45.01)	0 (n/a)
Status Quo * Tax version	35.98*** (5.47)	51.13*** (13.01)	0 (n/a)
Biodiversity protection	70.07*** (5.59)	69.99*** (5.06)	61.33*** (5.68)
Beach protection	47.61*** (4.72)	42.03*** (4.18)	54.19*** (5.19)
Coastal protection	20.55*** (4.81)	37.01*** (4.31)	43.40*** (6.29)
Surf activities protection	-6.65 (4.72)	1.92 (3.93)	42.14*** (4.97)
Openness * SQ	-20.54*** (2.66)	-23.85*** (5.13)	0.70 (1.99)
Conscientiousness * SQ	-7.17*** (2.73)	-15.30** (6.15)	5.87*** (1.36)
Extraversion * SQ	-3.23 (2.16)	-5.20 (4.79)	9.66*** (1.92)
Agreeableness * SQ	6.62** (3.00)	13.66** (6.36)	25.14*** (1.90)
Emotional Stability * SQ	6.15*** (2.31)	8.15 (5.67)	3.70** (1.67)
-Cost	0.0141*** (0.0007)	-3.19*** (0.15)	0.64*** (0.16)
MNL LogLikelihood = -3147.04	AIC/n=1.8693	McFadden's	Pseudo-R ² = 0.1525
MXL LogLikelihood = -2412.07	AIC/n=1.4403	McFadden's	Pseudo-R ² = 0.3504
WTP in Euro (€) with significances:	***- $p < .001$,	**- $p < .01$,	*- $p < .1$

10. Also the Pseudo-R² values confirm this, explaining the models' performance compared to an intercept-only model

For the MXL specification, assumptions regarding the distribution of the parameters were introduced. For the cost factor the assumed underlying distribution is log-normal to allow only for positive values. With that, the cost factors enters the estimation negatively as costs influence utility negatively. All the other variables are assumed to be normally distributed or fixed.

Status Quo (SQ) is assumed to be fixed (non-random) for all the individuals, as well as the interaction "Status Quo*Tax version", where the latter captures the marginal increase in the relative preference for the SQ when using tax version as the payment vehicle¹¹. Positive coefficients for those variables indicate what respondents are willing to pay to keep the SQ (CV) for the Status Quo. Therefore the higher the WTP estimate for the Status Quo the higher the relative preference for not implementing any of the programs. The dummies for the four MCES as well as the interactions of the personality traits are specified to be random, estimating individual-specific parameters that account for heterogeneity. The four ecosystem services (ES) attributes have similar WTP as in the paper by Cunha-e-Sa et al. (2023) with Biodiversity, beach and coastal having a significant positive WTP estimate.

As my work focuses on the interconnection of personality traits with choices for ecosystem protection policies the variables of interest are the big five personality traits. In order to relate those to the dependent decision variable of the model they need to be set into relation to one of the characteristics of the choice cards from the DCE, namely Status Quo (no protection program) or one of the four MCES.

I specified the interactions of the personality traits with the Status Quo variable in table 4 as my goal is to understand how personality influence preferences for the implementation of sustainable policies. The means of those interacted terms in both models, MNL and MXL, therefore show marginal effects on the WTP of the Status Quo.

Openness * SQ depicts the personality trait "Openness to Experience" interacted with Status Quo. The result shows a significant negative effect which can be interpreted as a negative marginal effect on the relative preference for the Status Quo. Given what was explained above, a negative

11. We need to control for this as the payment vehicle was designed to be different between both surveys

effect means that individuals with higher levels of "Openness" prefer less the SQ by approximately 24€ (MXL) in the margin. Because the estimation is based on an interaction between a dummy and a continuous variable the effect occurs for marginal increases around the mean of the variable which is in this case at 4.97 (s. table 3). Generalizing this result, we may conclude that an individual with higher levels of "Openness" decides more often for any of the protection programs and against the Status Quo (no protection program) and with that is more in support of environmental policies that come with a cost.

Conscientiousness * SQ is an interaction between the personality trait "Conscientiousness" and the Status Quo. The effect at the mean (5.45) is also negative and therefore reduces the relative preference for the SQ by around 15€.

Extraversion * SQ is an interaction between the personality trait "Extraversion" and the Status Quo. There is no significant effect.

Agreeableness * SQ is an interaction between the personality trait "Agreeableness" and the Status Quo. The effect at the mean (5.62) is positive and significant with ca. 13€ as a marginally increase of the WTP therefore meaning that in the margin the relative preference for the SQ increases.

Emotional Stability * SQ is an interaction between the reversed personality trait "Neuroticism" and the Status Quo. "Neuroticism" is one of the traits from the FFM. Nevertheless the authors of the TIPI Gosling, Rentfrow, and Swann (2003) created the two questions/items loading on this personality trait in an opposite way. Because of that "Neuroticism" is actually captured as "Emotional Stability".¹² Because I am using the TIPI to calculate the Big Five, I am also using "Emotional Stability" and not "Neuroticism" in my estimations as the TIPI has a rich history of validation in the way it was designed. In the MXL model this effect is shown no significance at common levels, with $p = 0.1508$.

Looking at the Mean and Standard Deviation (last column of table 4), we observe that in the case of **Openness * SQ** despite allowing for heterogeneity no significant heterogeneity was obtained.

12. In TIPI, the scale for Neuroticism is coded reverse allowing for being applied here in the same way. The reason is probably that the other four of big five are positive and desirable personality traits compared to Neuroticism which is rather perceived as a negative personality trait, that is not desirable

This means that for "Openness to Experience" the estimated mean parameter is constant across individuals.

For **Conscientiousness * SQ** this is not the case, as there is a highly significant difference in means between the individual-specific parameters (5.87). Combining it with the mean, the underlying normal distribution implies that despite the difference in means over 99% of the Portuguese population have a positive marginal WTP for this.

Agreeableness * SQ as well shows heterogeneity which is rather high in comparison to its mean value of 25.14 (at 1% significance). This means that despite the mean being positive, there is a high variation between individuals, with still 70% of individuals having a positive marginal WTP for higher levels of "Agreeableness".

To check the robustness of these results additional control variables like Gender, Age and Higher Education are included in an additional specification. Results can be found in the annex. Introducing further variables is generally not necessary and uncommon as unobserved heterogeneity is covered by the standard deviations in the MXL specification. Therefore, including traditional controls is not to see very often in the literature of estimating MXL models for DCE data. Besides that, differences in preferences that are usually controlled for have been shown evident in other works to rather act as proxies for differences in personality traits(Luchs and Mooradian 2011).

The control models confirm the baseline model results with respect to the personality traits with the only difference that the positive value for "Emotional Stability" now turns positively significant at common levels with a marginal WTP of around 11€ at the mean.

6 Conclusion

The focus of this work was to analyze how and if personality does influence preferences of economic agents when it comes to choices for investing in natural ecosystems protection programs. I used an unique Portuguese DCE dataset that was collected in the context of MCEs protection, e.g. the prevention of oil spills in order to preserve marine and coastal ecosystem services in the south west and south coast of continental Portugal, namely Biodiversity, Beach usage, Coast and Surf. In order to reduce personality to a few tangible variables I have calculated the values for the Big Five Personality Traits, introduced by the FFM. For this I used the TIPI as the personality traits from the FFM as latent variables.

To connect the personality traits to the stated preferences choices of the individuals from the experiment described I interacted them with the Status Quo dummy. With this specification the model could pick up the marginal effects of higher levels in each personality trait with respect to the relative preference for the Status Quo. Hence, I was able to estimate the marginal changes in the relative preference for the SQ for each personality trait. My results show that indeed three out of the Big Five presented high significance in explanatory power for higher or lower preference for Status Quo, The results indicate that individuals with higher levels of "Openness to Experience" and higher levels of "Conscientiousness" are relatively less in favor to keep the SQ. Higher levels in "Agreeableness" on the other hand comes with higher relative preference for the Status Quo. A fourth personality trait, "Emotional Stability" suggests also a higher preference for the Status Quo while being on the verge of being significant depending on the presence of additional controls in the specification.

These results can be used to better understand how preferences of individuals for environmental policies are rooted and how the heterogeneity throughout the Portuguese population can be considered for policy making when it comes to designing campaigns for environmental protection policy endeavours.

My results adds up to the literature that estimates the effects of personality in environmental choices and the WTP for preservation on non-marketed goods and services, that is, the case of

marine and coastal ecosystem services. It uses the first-ever representative sample for the Portuguese population in this subject adding personality as an independent variable to the specification. While the model has limitations in practice like the high complexity due to the simulation and not analytic character, it showed robust results for the above mentioned personality traits.

The results can be understood as a very preliminary study in this topic with estimating marginal effects at the mean. To fully understand the impacts on the WTP of individuals in this context further estimations can be carried out for example via normalization of the personality traits in order to get effects in standard deviations. Herewith, more general conclusions can be drawn to understand effects on the full scale of the Likert-scale personality variables and not only at the mean.

Nevertheless, the direction and intensity of the significant variables is a promising first result, indicating that more research should be undertaken in this field, namely in estimating the total economic value of ecosystem services while understanding the roots of heterogeneity. This is an important contribution in supporting sustainable evidence-based policy-making.

References

- Bernays, E.L., and M.C. Miller. 2005. *Propaganda*. 51. Ig Publishing. ISBN: 9780970312594.
- Boyce, Christopher, Mikołaj Czajkowski, and Nick Hanley. 2019. “Personality and economic choices.” *Journal of Environmental Economics and Management* 94 (March): 82–100. <https://doi.org/10.1016/j.jeem.2018.12.004>. <https://doi.org/10.1016/j.jeem.2018.12.004>.
- Busic-Sontic, Ante, and Cameron Brick. 2018. “Personality Trait Effects on Green Household Installations.” Edited by M. Brent Donnellan. *Collabra: Psychology* 4, no. 1 (January). <https://doi.org/10.1525/collabra.120>. <https://doi.org/10.1525/collabra.120>.
- Busic-Sontic, Ante, Natalia V. Czap, and Franz Fuerst. 2017. “The role of personality traits in green decision-making.” *Journal of Economic Psychology* 62 (October): 313–328. <https://doi.org/10.1016/j.joep.2017.06.012>. <https://doi.org/10.1016/j.joep.2017.06.012>.
- Costa, Paul T, Jr, and Robert R McCrae. 2003. *Personality in adulthood, second edition* [in en]. 2nd ed. New York, NY: Guilford Publications, February.
- Costa, Paul T., and Robert R. McCrae. 2008. “The Revised NEO Personality Inventory (NEO-PI-R).” In *The SAGE Handbook of Personality Theory and Assessment: Volume 2 — Personality Measurement and Testing*, 179–198. SAGE Publications Ltd. <https://doi.org/10.4135/9781849200479.n9>. <https://doi.org/10.4135/9781849200479.n9>.
- Cunha-e-Sa, Maria Antonieta, Til Dietrich, Ana Faria, Luis Catela Nunes, Margarida Ortigão, Renato Rosa, and Carina Vieira da Silva. 2023. “Crowdfunding Vs. Taxes: Does the Payment Vehicle Influence WTP for Ecosystem Services Protection?” *SSRN Electronic Journal*, <https://doi.org/10.2139/ssrn.4364971>. <https://doi.org/10.2139/ssrn.4364971>.
- Daziano, Ricardo A. 2015. “Inference on mode preferences, vehicle purchases, and the energy paradox using a Bayesian structural choice model.” *Transportation Research Part B: Methodological* 76:1–26. ISSN: 0191-2615. <https://doi.org/https://doi.org/10.1016/j.trb.2015.02.012>. <https://www.sciencedirect.com/science/article/pii/S0191261515000405>.
- Dehne, Max, and Jürgen Schupp. 2007. “Persönlichkeitsmerkmale im Sozio-oekonomischen Panel (SOEP)-Konzept, Umsetzung und empirische Eigenschaften.” *Research Notes* 26 (1): 70.
- Farizo, Begoña A., David Oglethorpe, and Mario Soliño. 2016. “Personality traits and environmental choices: On the search for understanding.” *Science of The Total Environment* 566-567 (October): 157–167. <https://doi.org/10.1016/j.scitotenv.2016.05.053>. <https://doi.org/10.1016/j.scitotenv.2016.05.053>.
- Gerlitz, Jean-Yves, and Jürgen Schupp. 2005. “Zur Erhebung der Big-Five-basierten persönlichkeitsmerkmale im SOEP.” *DIW Research Notes* 4 (10.1016).
- Gosling, Samuel D, Peter J Rentfrow, and William B Swann. 2003. “A very brief measure of the Big-Five personality domains.” *Journal of Research in Personality* 37, no. 6 (December): 504–528. [https://doi.org/10.1016/s0092-6566\(03\)00046-1](https://doi.org/10.1016/s0092-6566(03)00046-1). [https://doi.org/10.1016/s0092-6566\(03\)00046-1](https://doi.org/10.1016/s0092-6566(03)00046-1).

- Hirsh, Jacob B. 2010. "Personality and environmental concern." *Journal of Environmental Psychology* 30, no. 2 (June): 245–248. <https://doi.org/10.1016/j.jenvp.2010.01.004>. <https://doi.org/10.1016/j.jenvp.2010.01.004>.
- Hoyos, David. 2010. "The state of the art of environmental valuation with discrete choice experiments." *Ecological Economics* 69 (8): 1595–1603. ISSN: 0921-8009. <https://doi.org/https://doi.org/10.1016/j.ecolecon.2010.04.011>. <https://www.sciencedirect.com/science/article/pii/S0921800910001540>.
- Johansson, Maria Vredin, Tobias Heldt, and Per Johansson. 2006. "The effects of attitudes and personality traits on mode choice." *Transportation Research Part A: Policy and Practice* 40, no. 6 (July): 507–525. <https://doi.org/10.1016/j.tra.2005.09.001>. <https://doi.org/10.1016/j.tra.2005.09.001>.
- Johnson, David Richard, and James C. Creech. 1983. "Ordinal Measures in Multiple Indicator Models: A Simulation Study of Categorization Error." *American Sociological Review* 48, no. 3 (June): 398. <https://doi.org/10.2307/2095231>. <https://doi.org/10.2307/2095231>.
- Kim, Junghwa, Jan-Dirk Schmöcker, Cecilia Jakobsson Bergstad, Satoshi Fujii, and Tommy Gärling. 2013. "The influence of personality on acceptability of sustainable transport policies." *Transportation* 41, no. 4 (October): 855–872. <https://doi.org/10.1007/s11116-013-9502-5>. <https://doi.org/10.1007/s11116-013-9502-5>.
- Louviere, Jordan J. 2001. "Choice experiments: an overview of concepts and issues." *The choice modelling approach to environmental valuation* 13 (3.3).
- Louviere, Jordan J, and David A Hensher. 1982. "On the design and analysis of simulated choice or allocation experiments in travel choice modelling." *Transportation research record* 890 (1): 11–17.
- Luchs, Michael G., and Todd A. Mooradian. 2011. "Sex, Personality, and Sustainable Consumer Behaviour: Elucidating the Gender Effect." *Journal of Consumer Policy* 35, no. 1 (October): 127–144. <https://doi.org/10.1007/s10603-011-9179-0>. <https://doi.org/10.1007/s10603-011-9179-0>.
- Mariel, Petr, David Hoyos, Jürgen Meyerhoff, Mikolaj Czajkowski, Thijs Dekker, Klaus Glenk, Jette Bredahl Jacobsen, et al. 2021. *Environmental Valuation with Discrete Choice Experiments*. Springer International Publishing. <https://doi.org/10.1007/978-3-030-62669-3>. <https://doi.org/10.1007/978-3-030-62669-3>.
- Markowitz, Ezra M., Lewis R. Goldberg, Michael C. Ashton, and Kibeom Lee. 2012. "Profiling the "Pro-Environmental Individual": A Personality Perspective." *Journal of Personality* 80, no. 1 (January): 81–111. <https://doi.org/10.1111/j.1467-6494.2011.00721.x>. <https://doi.org/10.1111/j.1467-6494.2011.00721.x>.
- McFadden, Daniel, et al. 1973. "Conditional logit analysis of qualitative choice behavior."
- Revelt, David, and Kenneth Train. 1998. "Mixed Logit with Repeated Choices: Households' Choices of Appliance Efficiency Level." *Review of Economics and Statistics* 80, no. 4 (November): 647–657. <https://doi.org/10.1162/003465398557735>. <https://doi.org/10.1162/003465398557735>.

- Rodrigue, Jean-Paul. 2020. *The Geography of Transport Systems*. Routledge, May. <https://doi.org/10.4324/9780429346323>. <https://doi.org/10.4324/9780429346323>.
- Train, Kenneth. 2009. *Discrete Choice Methods with Simulation* -. Cambridge: Cambridge University Press. ISBN: 978-0-521-76655-5.
- Volk, Stefan, Christian Thöni, and Winfried Ruigrok. 2011. “Personality, personal values and cooperation preferences in public goods games: A longitudinal study.” *Personality and Individual Differences* 50, no. 6 (April): 810–815. <https://doi.org/10.1016/j.paid.2011.01.001>. <https://doi.org/10.1016/j.paid.2011.01.001>.

Appendix

Latent Variable	TIPI item	Cronbach's Alpha	N=845
Extraversion	1, 6R	0.5908	
Agreeableness	2R, 7	0.2865	
Conscientiousness	3, 8R	0.3471	
Emotional Stability	4R, 9	0.2228	
Openness to Experience	5, 10R	0.535	

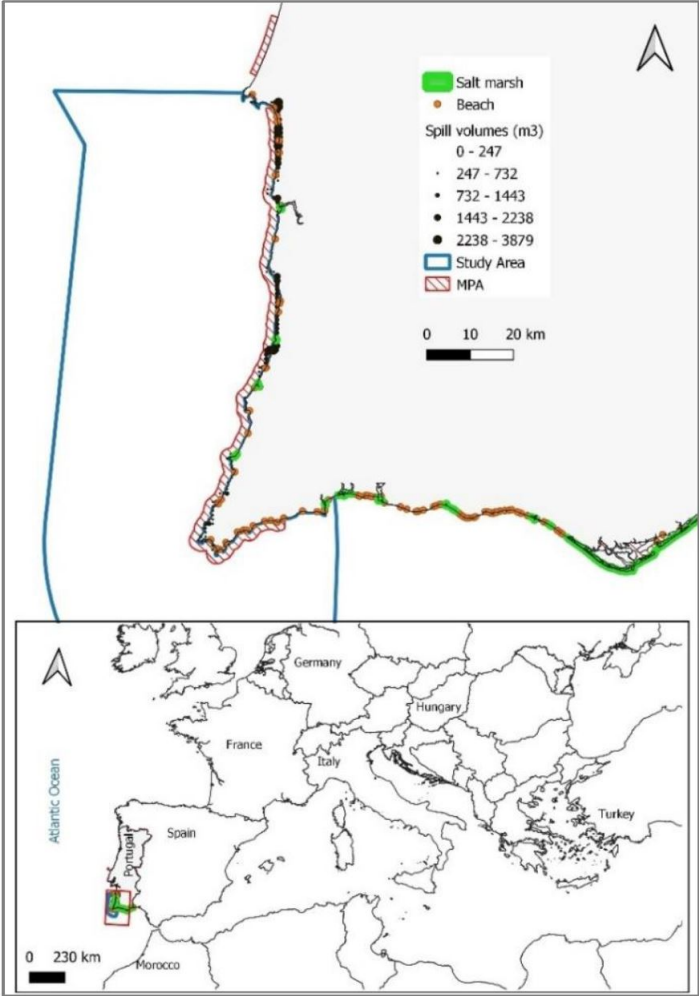
Table 1: Appendix: Cronbach's Alphas for loading of TIPI on latent personality traits

	Model 1 (MXL)	Model 2 (MXL)
	Mean(SE)	Mean(SE)
Status Quo	87.32* (46.96)	37.59 (59.26)
Status Quo * Tax version	50.22*** (10.36)	57.64*** (12.30)
Biodiversity protection	70.07*** (4.95)	69.80*** (4.91)
Beach protection	41.76*** (4.20)	42.89*** (4.37)
Coastal protection	36.82*** (4.81)	37.94*** (4.18)
Surf activities protection	2.31 (3.78)	1.97 (3.88)
Openness * SQ	-19.90*** (5.10)	-17.06*** (6.26)
Conscientiousness * SQ	-17.86*** (5.05)	-17.51*** (6.39)
Extraversion * SQ	-9.49* (5.61)	-1.65 (5.19)
Agreeableness * SQ	11.73** (5.26)	12.13* (6.43)
Emotional Stability * SQ	9.78* (5.04)	11.52** (5.79)
Gender*SQ	-16.38 (10.24)	n/a (0)
Age*SQ	1.93*** (0.35)	1.72*** (0.46)
Higher Edu*SQ	n/a (0)	-54.70*** (17.39)
-Cost	-3.10*** (0.20)	-3.28*** (0.13)
Model 1 LogLikelihood = -2403.45		
Model 2 LogLikelihood = -2399.93		

Table 2: Model with Gender, Age and Higher Education as additional controls

Graphics

Figure 1: Study area



Source: NOVA SBE Environmental Economics Knowledge Center

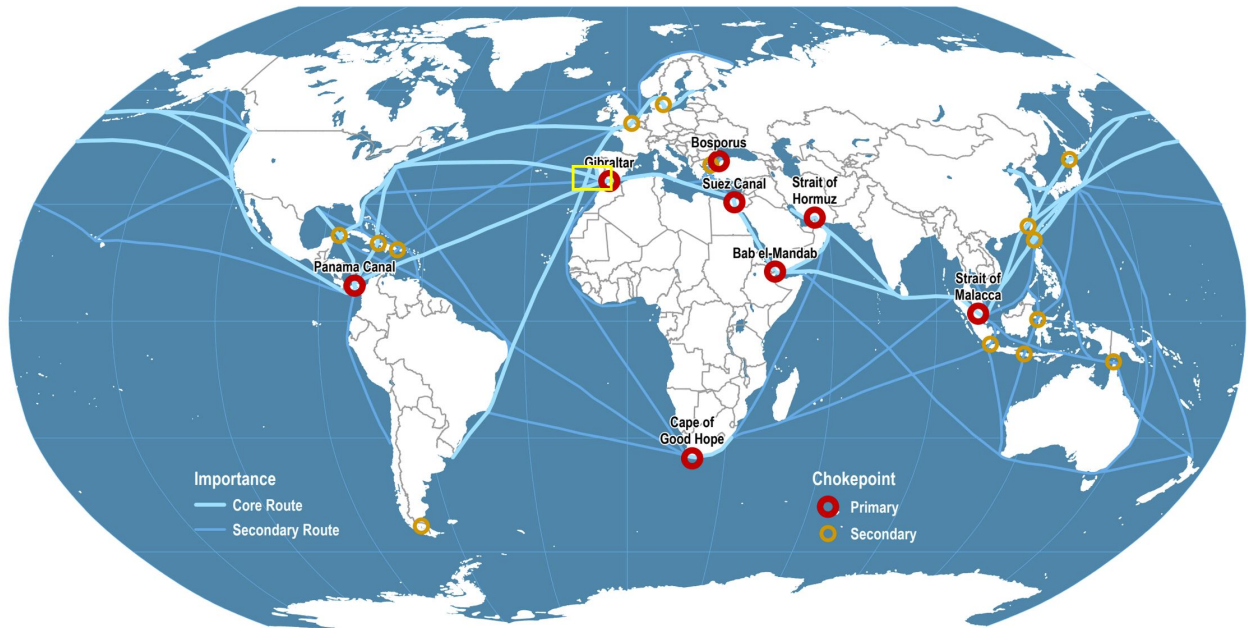


Figure 2: Overview of main maritime logistic routes by Rodrigue (2020)

Additional material TIPI

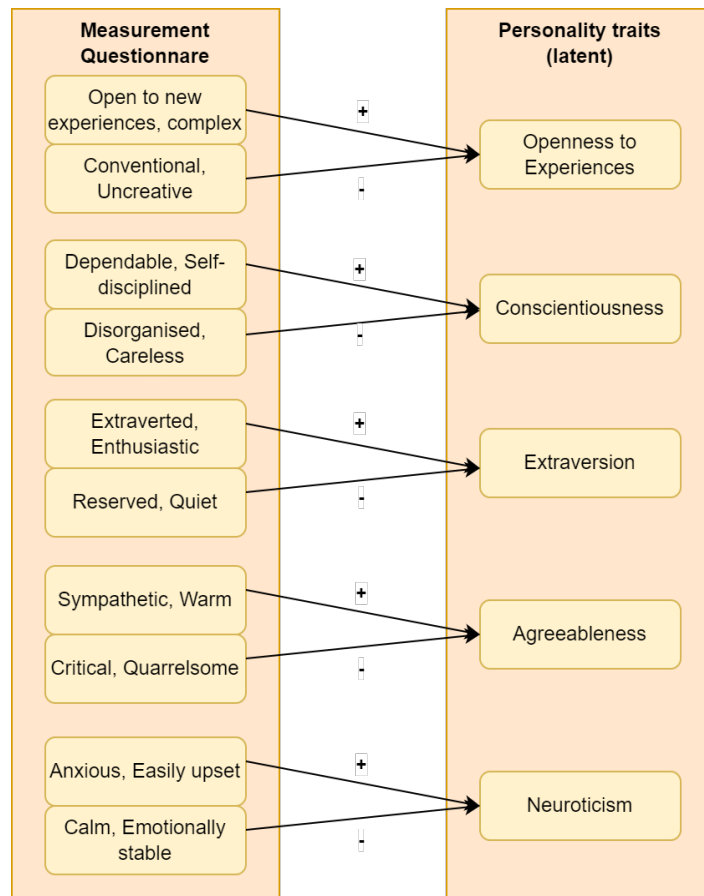


Figure 3: Overview of TIPI items loading on the big five personality traits¹³

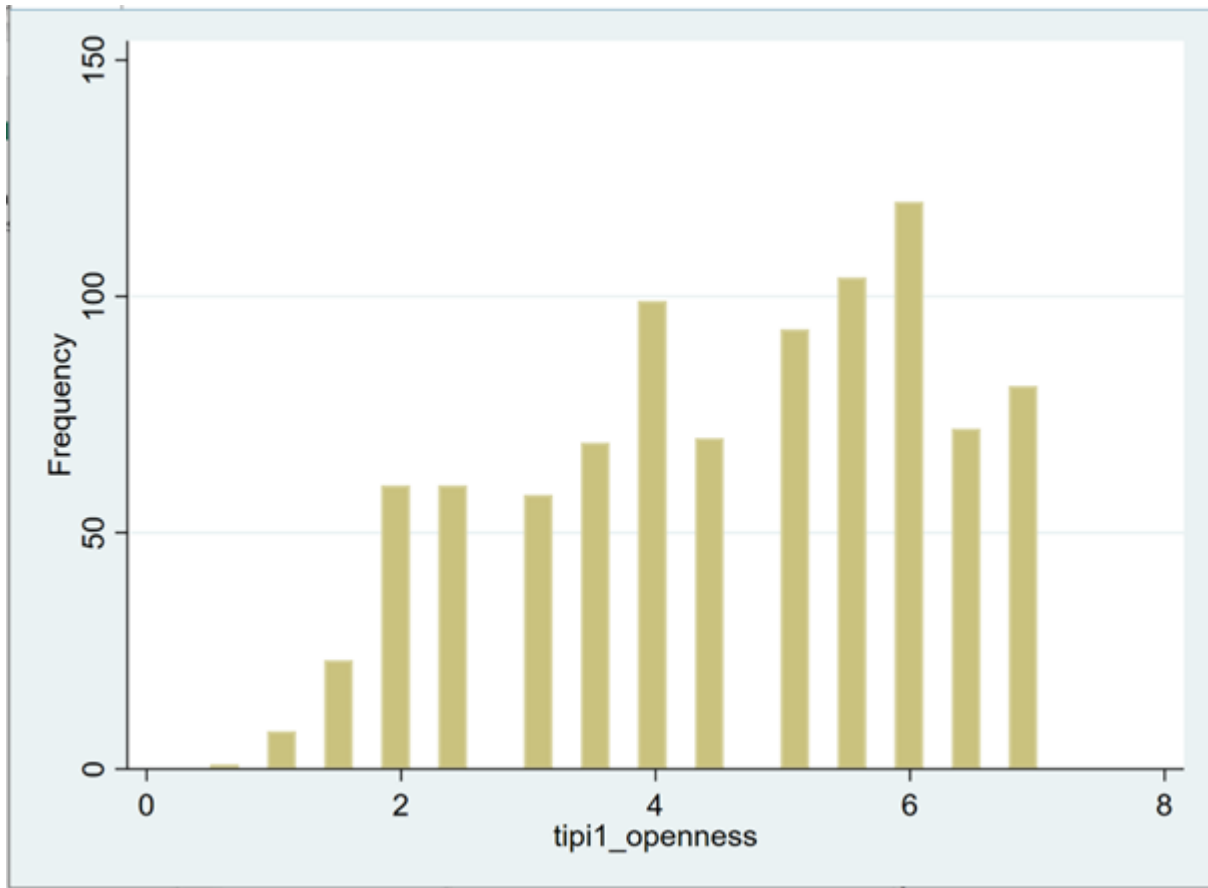


Figure 4: Tipi1 distribution

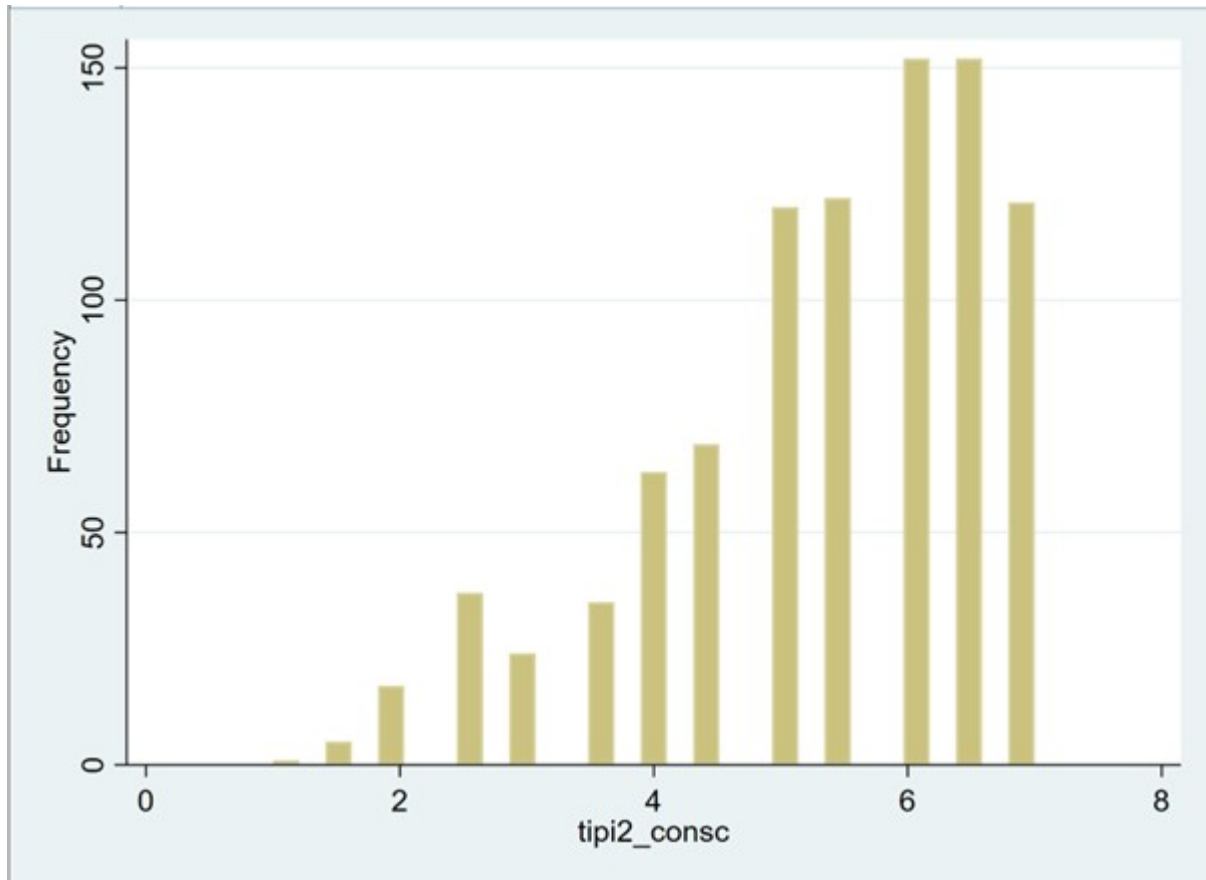


Figure 5: Tipi2 distribution

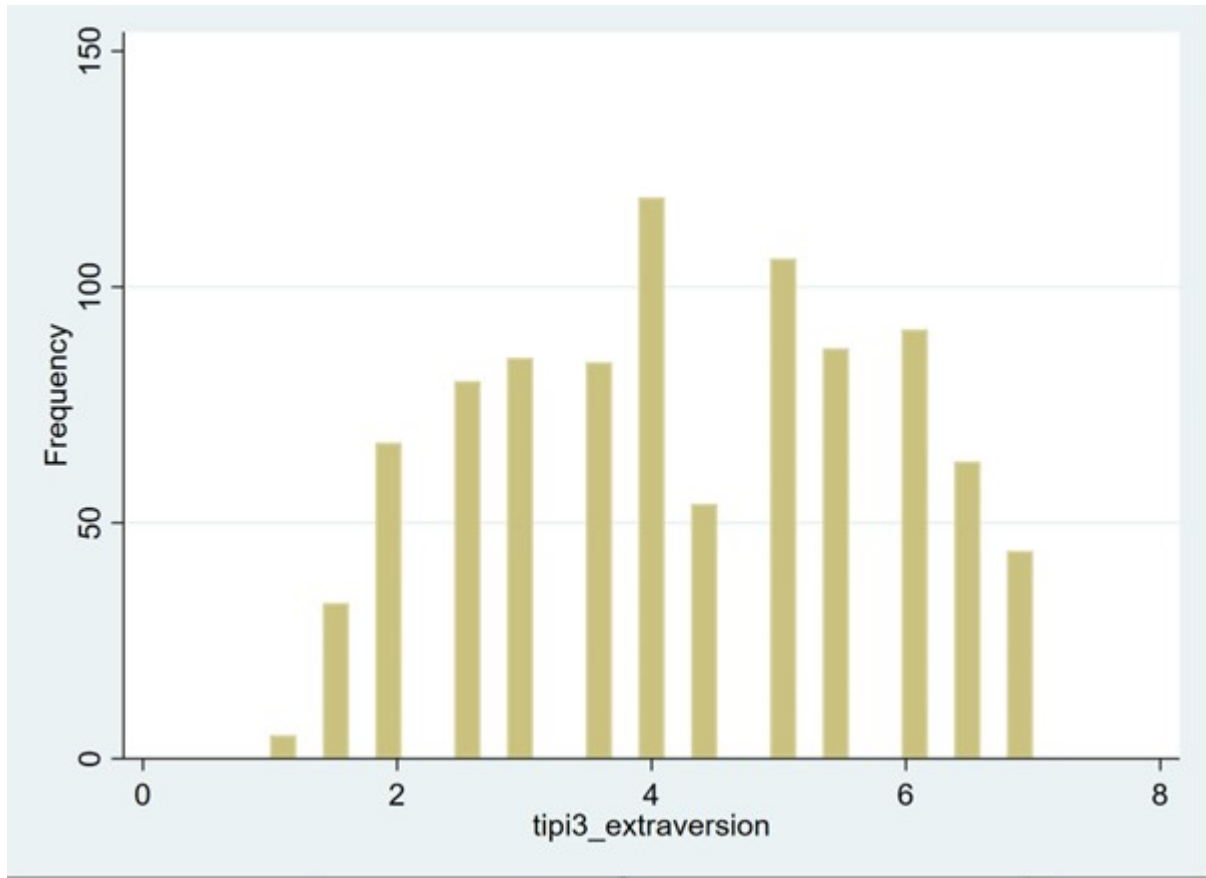


Figure 6: Tipi3 distribution

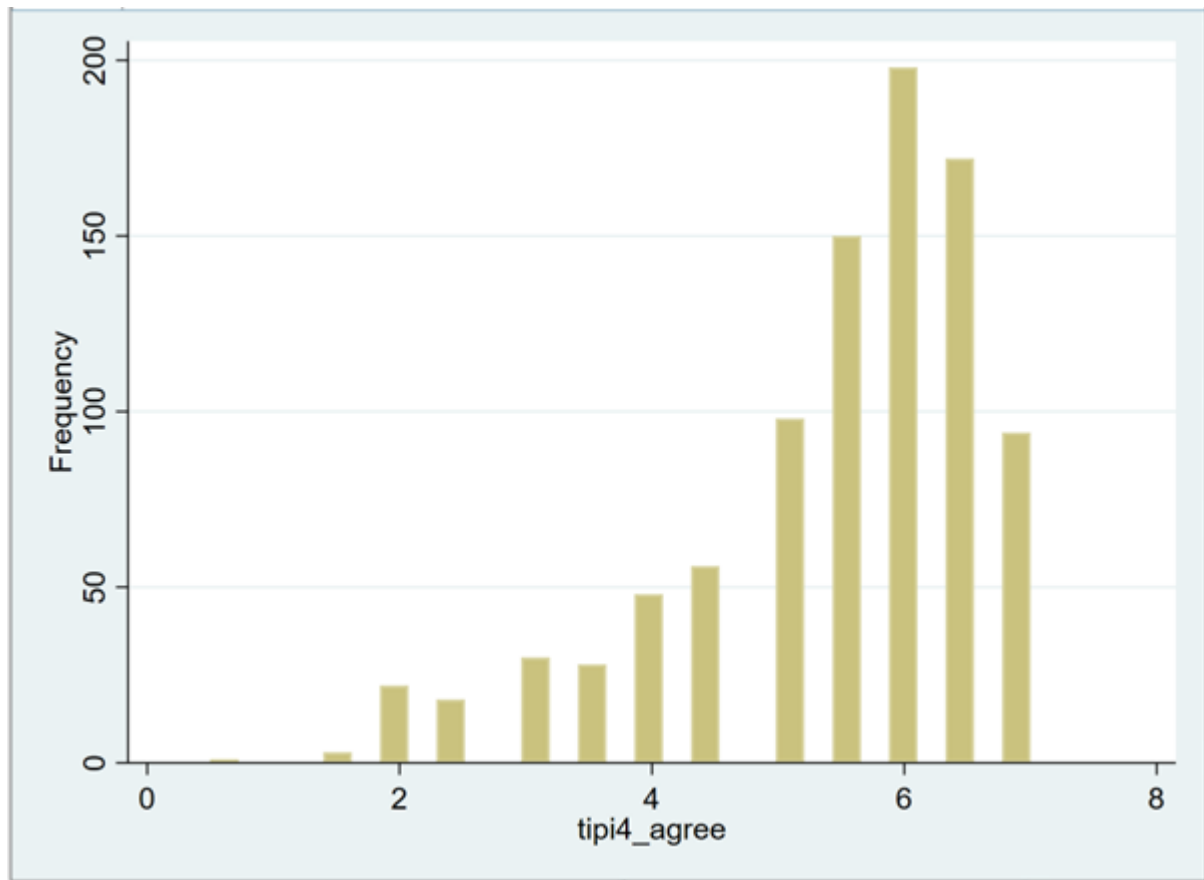


Figure 7: Tipi4 distribution

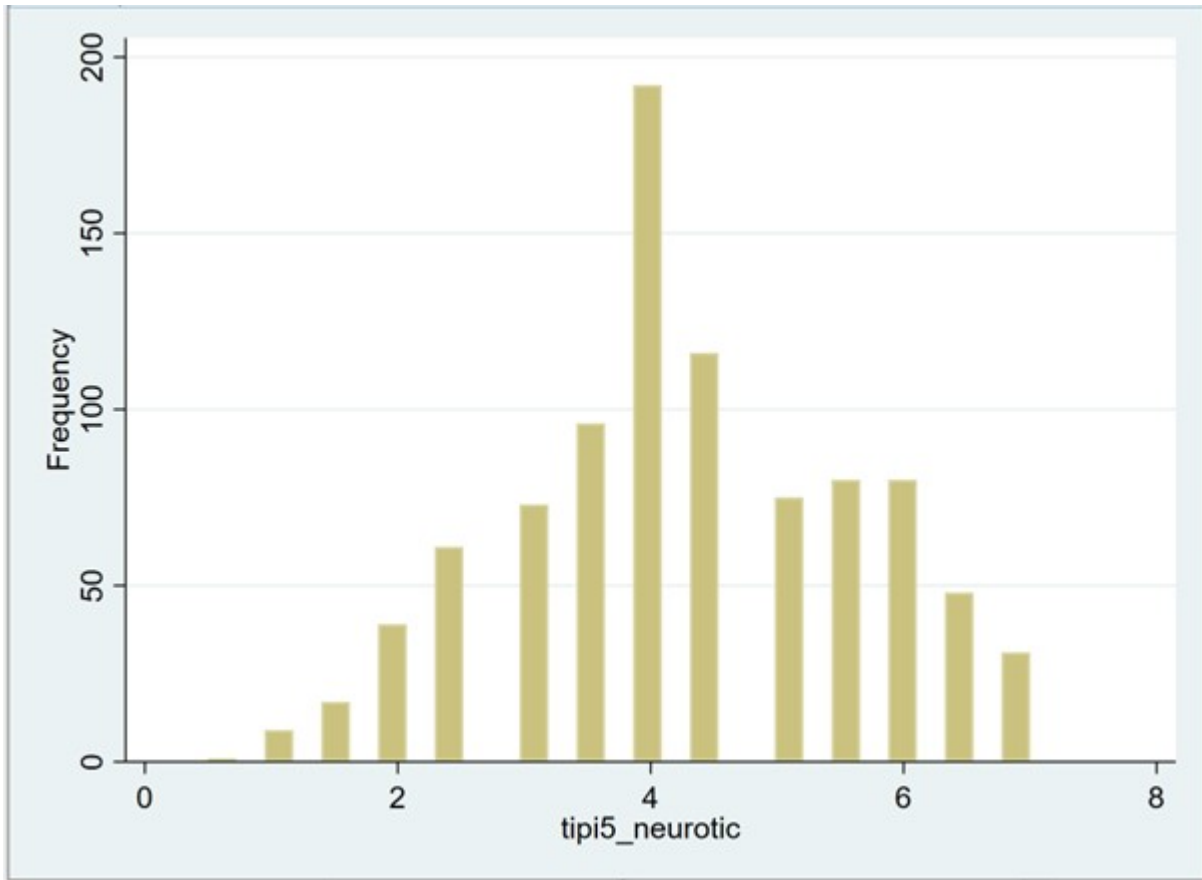


Figure 8: Tipi5 distribution

Choice cards

Data Explanation

The decisions of each agent can be found in following variables of the data-set, while it has to be noted that 6 different choice cards randomly have been assigned to the individuals for variation in the data. One individual therefore was presented with one of the choice cards only. One choice card consisted out of 4 choice occasions between program one, program two, and status quo.

Variable	Description	Possible values (Value description)
Q7_1	First decision of choice card 1	1(Program 1); 2(Program 2); 3(Status Quo)
Q8_1	Second decision of choice card 1	1(Program 1); 2(Program 2); 3(Status Quo)
Q9_1	Third decision of choice card 1	1(Program 1); 2(Program 2); 3(Status Quo)
Q10_1	Fourth decision of choice card 1	1(Program 1); 2(Program 2); 3(Status Quo)
Q7_2	First decision of choice card 2	1(Program 1); 2(Program 2); 3(Status Quo)
...
Q10_6	Fourth decision of choice card 6	1(Program 1); 2(Program 2); 3(Status Quo)





Table 3: Overview of discrete decision variables

The coding which choice card decision (protection program) includes improvements on protection for which of the ecosystem services and for what price can be found in the additional attachment.





Example choice cards

7. Por favor indique o programa que prefere.





Lembre-se que deve ter em conta o seu rendimento disponível e que pode preferir utilizar o montante indicado para realizar outras despesas.

Serviço de Ecossistema	Proteção		
	Programa 1	Programa 2	Programa Atual
 <p>Conservação da Biodiversidade</p>	Protege	Protege	Não Protege
 <p>Uso balnear (praia)</p>	Protege	Não Protege	Não Protege
 <p>Proteção costeira</p>	Protege	Protege	Não Protege
 <p>Surf</p>	Não Protege	Protege	Não Protege
Custo	25 €	75 €	0 €
Programa escolhido	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>





8. Por favor indique o programa que prefere.

Serviço de Ecossistema	Proteção		
	Programa 1	Programa 2	Programa Atual
 <p>Conservação da Biodiversidade</p>	Protege	Não Protege	Não Protege
 <p>Uso balnear (praia)</p>	Não Protege	Protege	Não Protege
 <p>Proteção costeira</p>	Protege	Não Protege	Não Protege
 <p>Surf</p>	Não Protege	Protege	Não Protege
Custo	25 €	5 €	0 €
Programa escolhido	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>





9. Por favor indique o programa que prefere.

Serviço de Ecossistema	Proteção		
	Programa 1	Programa 2	Programa Atual
 <p>Conservação da Biodiversidade</p>	Não Protege	Protege	Não Protege
 <p>Uso balnear (praia)</p>	Não Protege	Protege	Não Protege
 <p>Proteção costeira</p>	Protege	Não Protege	Não Protege
 <p>Surf</p>	Não Protege	Não Protege	Não Protege
Custo	25 €	125 €	0 €
Programa escolhido	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

10. Por favor indique o programa que prefere.

Serviço de Ecossistema	Proteção		
	Programa 1	Programa 2	Programa Atual
 <p>Conservação da Biodiversidade</p>	Protege	Protege	Não Protege
 <p>Uso balnear (praia)</p>	Protege	Não Protege	Não Protege
 <p>Proteção costeira</p>	Não Protege	Protege	Não Protege
 <p>Surf</p>	Protege	Não Protege	Não Protege
Custo	125 €	25 €	0 €
Programa escolhido	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

11. Por favor indique o programa que prefere, sabendo também o montante que falta angariar para que o programa seja implementado.

Serviço de Ecossistema	Proteção		
	Programa 1	Programa 2	Programa Atual
 <p>Conservação da Biodiversidade</p>	Protege	Protege	Não Protege
 <p>Uso balnear (praia)</p>	Protege	Não Protege	Não Protege
 <p>Proteção costeira</p>	Protege	Protege	Não Protege
 <p>Surf</p>	Não Protege	Protege	Não Protege
Custo	25 €	75 €	0 €
Valor em falta	2.110 €	1.103.056 €	---
Programa escolhido	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>